ABSTRACT

Title of dissertation: THE EFFECT OF A PROGRAM OF PORTABLE ELECTRONIC PIANO KEYBOARD EXPERIENCE ON THE ACQUISITION OF SIGHT-SINGING SKILL IN THE NOVICE HIGH SCHOOL CHORUS

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The problem was to determine whether a method of aural and visual vocal training that included a program of portable electronic piano keyboard experience would be more effective in teaching sight-singing skills to novice high school chorus students than a method that included only aural and visual vocal training. A sub-problem was to determine whether novice chorus students enjoyed playing electronic keyboards in chorus as a reinforcement experience in sight-singing training.

Students were randomly assigned to two treatment groups, tested with the Musical Aptitude Profile, Tonal Imagery, part A, and then trained separately. The experimental group sang repetitions of melodic patterns and utilized techniques associated with the Kodály Method while simultaneously playing keyboard. The

comparison group received a similar treatment without using keyboards. The students were pre- and post-tested in sight-singing using the Vocal Sight-Reading Inventory.

Results of the Analysis of Covariance using MAP scores as the covariate revealed no significant difference ($p<.05$) between post-test scores of the two groups. Improvement was noted in 96% of students from pre-test to post-test regardless of grouping. The repeated measures ANOVA revealed a significant relationship ($p<.006$) between aptitude group and post-test score. High aptitude students in both groups were found to benefit more from the training than low aptitude students. High aptitude keyboard group students achieved an average gain score that was 8.67 points higher than the comparison group. Of the total experimental group, 92% enjoyed playing keyboards in chorus.

It is recommended that future research be undertaken to study the use of keyboards with advanced high school choruses and with uncertain singers in the high school chorus. Research is also needed to develop graded, valid, and reliable sight-singing tests for use in high school chorus. Techniques of the Kodály Method should be further investigated for use in high school sight-singing training.

THE EFFECT OF A PROGRAM OF PORTABLE ELECTRONIC PIANO KEYBOARD EXPERIENCE ON THE ACQUISITION OF SIGHT-SINGING SKILL IN THE NOVICE HIGH SCHOOL CHORUS

by

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Chapter One

Introduction

Effective high school choral music teaching has, in recent history, focused more on outstanding performance of song literature than on musicianship skills such as sight-singing (Demorest, 2001). This situation may be changing because of the increased emphasis given to sight-singing in the national standards. The National Standards for Arts Education (1994), developed as part of the Goals 2000 legislation, have attempted to define national goals for music education. Sight-singing, the ability to interpret notated music vocally upon initial presentation, is identified as an educational goal and its inclusion in the high school curriculum is highly recommended.

Surveys of choral directors carried out in the past two decades suggest that directors value sight-singing as a component of a more comprehensive musicianship that allows students to correct their own errors and learn independently from the score. Additionally they recognize that sight-singing is a skill that facilitates life-long learning in choral music. The paradox exists that in spite of this belief, the skill is being taught inconsistently or not at all in many high school choruses (Daniels, 1988; Dwiggins, 1984; Szabo, 1992). The recent inclusion of a sight-singing requirement in state and county choral adjudications is causing many choral directors to begin to teach sight-singing for the first time (Demorest, 2001). Some directors are unsure what methods and techniques are best for their teaching purposes (Costanza & Russell, 1992; Davidson, Scripp & Fletcher, 1995). "The debate over which system is best suited for teaching sight-singing is frequently intensely emotional and ultimately based on subjective personal preference"(McClung, 2001, p. 5).

There is also a perception among choral music educators that teaching sight-

singing might "hamper the quality of choral performance by taking away instructional time that could be spent preparing literature" (Demorest, 2001, p. 26). Surveys of choral directors conducted by Johnson, (1987), May (1993), and Szabo (1992), each found that time spent on sight-singing per rehearsal on average ranged from about 5 minutes to 11 minutes. Less time was spent on sight-singing in advanced groups because of more demanding performance schedules. Since the efficient use of time is an issue in most choral classrooms, it is important to devise methods that can yield large measures of sight-singing improvement with a minimum of rehearsal time.

Numerous studies have suggested a link between keyboard study and the acquisition of aural skills including sight-singing (Daniels, 1986; Demorest & May, 1995, Henry & Demorest, 1994; May & Elliott, 1980). The present study compared the effectiveness of administering a 14-week program of 15 to 20 minutes of daily aural and visual vocal training with the same amount of training that included portable electronic piano keyboard experience.

Need for the Study

Many studies document the value of keyboard training in the development of aural skills in students of various ages. Some have indicated that music training utilizing the piano or electronic piano keyboard is effective in developing pitch discrimination, tonal memory, pitch accuracy in singing, and other aural skills among students from age seven to college (Bodecker, 1969; Bogard, 1980; Curt, 1990; Finnell, 1974; Hargiss, 1960; Jones, 1971; Lyke, 1967; Martinez, 1976; May & Elliott, 1980; Stecklein & Aliferis, 1957; Wig & Boyle, 1982). Among high school choral students, years of piano training or the presence of a piano in the home were found to be significant factors in the development of sight-singing skill (Daniels, 1986; Demorest & May, 1995; Henry &

Demorest, 1994). In addition, numerous articles in educational journals throughout the 1990's attested to the value of portable keyboards for teaching music concepts and skills (Appell, 1993; Baumgardner, 1995; Bissell, 1995; Chamberlain, Clark & Svengalis, 1993; Walczyk, 1991; Wiggins, 1987). Demorest (2001) suggested that since piano training is the background variable most consistently related to successful sight-singing and aural skills development, "perhaps choral directors should seek to incorporate some basic keyboard training into their choral programs through the use of electronic keyboards" (Demorest, 2001, p. 32).

Looking at the evidence from multiple studies, it seems clear that there is a link between excellence in aural skills ability, particularly sight-singing achievement, and some type of training or experimentation at the piano keyboard. The present study attempted to follow these links in the chain of evidence connecting piano keyboard experience and sight-singing training in the high school chorus.

Problem

The problem of the study is to determine whether an aural and visual vocal method of sight-singing training that includes portable electronic piano keyboard experience is more effective and time-efficient in teaching sight-singing skill to novice high school chorus students than a method that combines only aural and visual vocal training.

Question

Based on the many studies suggesting a connection between aural skills training and keyboard or piano experience, I have formulated the following research question: Is a method of aural and visual vocal training that includes portable electronic piano keyboard experience more effective in teaching sight-singing skills to novice high

school chorus students than a method that combines only aural and visual vocal training?

Null Hypothesis

There will be no significant difference at the .05 level on the Analysis of Covariance using the Music Aptitude Profile, Tonal Imagery, part A as the covariate between the post-test sight-singing scores on the Vocal Sight Reading Inventory of novice high school chorus students receiving aural and visual vocal training for sight-singing that includes portable electronic piano keyboard experience and novice chorus students receiving only aural and visual vocal training for sight-singing.

Sub-problem

A sub-problem of the study is to determine, by means of a researcher-designed survey, whether students enjoyed playing keyboards in chorus as a reinforcement experience in sight-singing training.

Rationale for Keyboard Experience

The use of the portable electronic piano keyboard in the present study is called keyboard experience. It is not keyboard training because the effort does not lead to a solo performance outcome on the keyboard. The keyboard is instead being utilized as a vehicle to reinforce the sound of intervals being sung in solfège through instruction that utilizes techniques associated with the Kodály Method. The purpose of playing and singing is to place those sounds into long-term memory for use in future sight-singing tasks. The use of finger stickers marked with solfège syllables simplifies the keyboard performance task so that students can concentrate on the dual presentation of the sounds in singing and playing. The keyboard experience is, therefore, a reinforcement

experience that aids the formation of the aural imagery needed for sight-singing, not a training experience leading to an instrumental performance outcome.

The experimental condition in the present study was designed to include keyboard experience for several reasons. First, the portable electronic piano keyboard serves as a visual representation of sound because every interval between pitches is displayed there. For example, the spatial distance between the intervals of seconds or thirds can be understood visually as well as aurally. The keyboard allows the performer to feel and measure the intervals through touch of the fingers at the same instant that the sound is heard. The spatial distance between pitches can be instantly compared as the eye sees the notation and then sees the keyboard. When students sing the pitches as they perform, the physical sensations of the vocal-motor muscles are combined with the other sensations (Hargiss, 1960). Increasingly wider intervals to be sung will simultaneously require a wider range of finger movement at the keyboard. The keyboard, therefore, aids in the tonal imagery necessary for sight-singing by providing tactile, aural, and visual clues simultaneously (Bogard, 1983).

Second, of all the types of musical instruments, keyboard instruments are among the most effective in engaging three of the five senses simultaneously. Information processing theory assumes "that information from the external world is initially represented, percept intact, in sensory registers. There is a separate sensory register or sensory store for each sense modality (auditory, visual, etc.) and presumably they can hold large quantities of information but only for a matter of milliseconds" (Bjorklund, 2000, p. 119). The information in the short-term store disappears unless a cognitive operation is performed upon it. The keyboard allows a performer to see, touch, and hear tones and tonal relationships simultaneously. In addition, it is possible to utilize

memory strategies such as rehearsal in conjunction with all three sensory modalities simultaneously. This experience provides more information for the brain to process and provides the cognitive operation that allows the information to move to the long-term store where it can be retrieved in sight-singing performance. The relationships of tones sounding together in chords can also be seen, heard, and touched simultaneously. Additionally, it is possible to play and sing simultaneously with a keyboard, an experience that is not physically possible with many of the other instrument families. Woodwind and brass instruments allow for aural and tactile sensory input, but the relationships among tones cannot be seen and it is impossible to sing aloud while playing. Stringed instruments of the viol family and guitar or banjo family allow for the performance of half and whole steps but the intervallic distance is not marked on the instrument and so involves trial and error until the novice performer understands where to place the finger. Even then, one finger is often engaged in moving from string to string, therefore the performer does not have the advantage of measuring between fingers and easily seeing the distance between the intervals that occurs on the keyboard. Mallet instruments such as xylophone, marimba, or glockenspiel present a keyboard arrangement of pitches allowing one to see and hear simultaneously, but the additional sense of touch is prevented since the mallet intervenes between the fingers and the instrument. While much can be learned through the kinesthetic measurement that occurs in mallet instruments, kinesthetic movement is not one of the five primary senses, so it may not provide the same cognitive experience that is involved in the direct tactile connection of finger to keyboard. Kinesthetic movement may not directly provide information to the brain in the same way that the senses do.

Third, keyboard laboratories are available in many high schools and it would be feasible to conduct the sight-singing portion of each choir rehearsal at the keyboards. If no laboratory were available, small portable keyboards could be purchased for use in the choir room during aural training. Portable electronic keyboards retain their pitch thereby eliminating the need for tuning. Through use of headphones, the keyboard allows the student to become more personally involved with the sound even when sitting in a group.

Fourth, playing keyboards could provide an enjoyable alternative way to learn basic skills that are valuable in choral music education. If the keyboard is considered an enjoyable experience it could lead to more positive attitudes toward and preferences for chorus. If students develop a positive attitude about keyboard study and consider keyboard as an enjoyable activity, they may prefer chorus and choose chorus in part because it includes a keyboard component. Since enjoyment in playing keyboards could lead to enhanced enjoyment of chorus, a survey assessing student enjoyment of keyboard playing and of the sight-singing training of the present study was given to students as an exit strategy. A separate survey elicited information on the attitudes and opinions of the three cooperating teachers concerning sight-singing training. Information from these surveys is presented in chapters 4 and 5.

Definition of Terms

1. Audiation—Assimilating and comprehending in our minds the music we have just heard performed or have heard performed sometime in the past (Gordon, 2003, p. 4).

2. Notational audiation—The ability to hear the musical sound of and give syntactical meaning to what is seen in music notation before you perform it, before someone else performs it, or as you write it (Gordon, 2003, p. 8).
3. Half step—A semi-tone. On the keyboard, a move from one key to the next adjacent key, white or black. The interval of a minor second (Kostka & Payne, 1995, p. 6).
4. Interval—The distance in pitch between two tones. The intervals taught in this study included major and minor seconds, major and minor thirds, perfect fourths, augmented fourths, perfect fifths, and octaves (Westrup & Harrison, 1985, p. 283).
5. Keyboards—Small portable electronic musical instruments containing a row of keys as on a piano and headphones to allow silent performance (Muro, 1990).
6. Kodály Method—The work of Zoltán Kodály, it is a method for teaching aural skills through a thorough grounding in tonic solfa, movable *do* with *la* based minor solfège syllables, hand signs, chromatic syllables, spatially arranged cards, and other teaching aids that leads to sight-singing mastery and music literacy (Choksy, 1999).
7. Major Scale—A specific pattern of half and whole steps encompassing an octave. The ascending major scale order of steps is whole, whole, half, whole, whole, whole, half (Kostka & Payne, 1995, p. 6).
8. Relative solmization—Also known as moveable *do*, it is a system designating the degrees of the musical scales not by letter names, but by syllables in which the position of *do* changes and it is possible for the same syllable names to refer to the

same scale degrees in every key. First espoused by Swiss musician John Weber in 1859, it is a system in which it is possible for *do* to become the first scale degree in every major scale (Zemke, 1974, p. 25).

9. Scale degrees—Names and numbers given to various tones of the scale. For instance, tonic (1), supertonic (2), mediant (3) etc. (Westrup & Harrison, 1985, p. 480).
10. Sight-singing—The ability to convert musical notation into sound upon initial presentation. Such sounds conceived internally may be referred to as audiation (Gordon, 2003) or aural imagery (Radocy & Boyle, 1988) and then produced externally with the voice (Hodges, 1992, p. 467).
11. Solfège syllables—The names given to the tones of the scale by Guido of Arezzo in the 11th century. The syllables used in this study are *do, re, mi, fa, sol, la, ti, do* (Zemke, 1974, p. 25).
12. Tonality—Giving preference to one tone (the tonic) and making this the tonal center to which all other tones are related (Apel, 1968, p. 752).
13. Tonic—The first note of a scale, which is its keynote and the center of its tonality (Westrup & Harrison, 1985, p. 552).
14. Tonic solfa—The system of teaching sight-singing in which the tones are sung to syllables and the ear is trained to recognize and reproduce, through the syllables, the intervals between the tones of the scale and between each tone and the tonic (Westrup & Harrison, 1985, p. 553).
15. Whole step—On the keyboard, it is movement from key to key in which one key is skipped in between. The interval of a major second (Kostka & Payne, 1995, p. 7).

Limitations of the Study

The study was carried out with intact chorus classes in the public schools. This population served as the convenience sample for the present study. Ideally, all students would have been of the same socio-economic status but this could not be controlled. An equal number of males and females would have been desired but this could not be controlled.

Overview of Method

The pre-test post-test control group design was chosen for this study. This experiment utilized three intact public school chorus groups as the convenience sample. Two suburban schools and one rural school were chosen, each having a school population of approximately 1200 students. The groups chosen for the study were the less experienced, novice, or training choirs of each school. Seventy-five students were randomly assigned to experimental and control groups using a table of random numbers. The researcher provided portable electronic piano keyboards to accommodate half the chorus in each school.

Procedures

A music aptitude test and a sight-singing pre-test were administered to all students. Students filled out a questionnaire designed to elicit information about prior private vocal, private piano, instrumental, and choir experience. All students except pianists with 5 or more years of training were randomly assigned to treatment groups. The pianists were placed equally between the two groups. Control group students received fifteen to twenty minutes of aural and visual vocal training during each chorus period. The training consisted of the repetition of melodic patterns taught using solfège syllables in the Tonic Solfa manner that included the principles of relative solmization.

Hand signs, spatial cards, notation cards, melodic dictation, individual testing, and short melodic examples were part of the repetitive training. The experimental group was trained separately in the keyboard lab where they sang and played all vocal material in fifteen- to twenty-minute segments. Gummed stickers marked with the first letters of the solfège syllables were affixed to the fingers of the hand one-by-one as they were introduced in the training. Students rehearsed the intervals in the key of C Major and then were trained to move the hand to the positions for F Major and G Major. In this way the principle of relative solmization was extended to the keyboard and students sang and played and read in the three keys under study. The experimental training included the same hand signs, spatial cards, notation cards, melodic dictation, and other materials as the control group. The major difference between the groups consisted of the fact that the experimental group sang and played keyboards simultaneously, often while observing notation. Sight-singing training proceeded for fourteen weeks on an alternate day schedule until the December holiday break. One class period of review was conducted in January after which all students were individually post-tested.

Summary

Sight-singing is a cognitive skill that empowers a choral student with the musicianship needed for independent practice and lifelong learning. Students who can sight-sing demonstrate an understanding of tonality and can correct their mistakes quickly in the choral rehearsal. Sight-singing is a required skill that is adjudicated at choral festivals and is recommended as a core skill in the National Standards for Arts Education. High school students may be able to acquire the skill more quickly with the addition of keyboard experience. The experimental treatment of the present study was designed to turn the fingers of the hands into extensions of the major scale by labeling

each as a solfège syllable and then moving the hands to each major key in turn with the consistent use of the same syllable-marked fingers. In this way the technique of relative solmization was clearly extended to the keyboard and served as a reinforcing agent in solfège instruction. This reinforcement was the keyboard experience in the present study. Playing and singing solfège syllables through a systematic and consistent treatment such as this may speed the formation of aural imagery or audiation because of the overlapping aural, visual, tactile, and kinesthetic input.

Numerous studies have established a link between keyboard playing and aural skills development (Daniels, 1986; Demorest, 2001; Demorest & May, 1995; Henry & Demorest, 1994; May & Elliott, 1980). There are currently no studies that have examined the use of portable electronic piano keyboards as a training vehicle for teaching sight-singing in chorus. It is possible that the simplified keyboard experience of the present study in conjunction with aurally and visually presented vocal material might result in faster learning of the sight-singing skill among high school chorus students.

Chapter Two

Review of Related Literature

Organization of the Chapter

This chapter begins with an overview of a major method of teaching music literacy, the Kodály Method, and Music Learning Theory, an important theoretical framework that reveals much information about the aural imagery leading to sight-singing achievement. The present study utilized systematic training and techniques associated with the Kodály Method for the purpose of developing aural imagery and sight-singing skill in chorus students. Music Learning Theory is based on broad research on audiation, a term for aural imagery. Component aspects of Music Learning Theory and the Kodály Method will be compared and contrasted. The importance of each to the acquisition of sight-singing skill as well as some related research will be presented. In an effort to clarify issues surrounding sight-singing training, research related to the constructs of sight-singing, context in sight-singing, and the distinction between sight-singing and instrumental sight-reading will also be presented. Theories supportive of the use of portable electronic piano keyboards as a reinforcement in sight-singing training will be presented next. These include information processing theory, multiple modality learning, and perceptual motor learning. Finally, a review of studies that link piano keyboard training with aural skills acquisition will conclude the chapter.

The Kodály Method

The Kodály Method, a comprehensive plan for teaching the aural, reading, and writing skills that lead to music literacy, represents the life work of the Hungarian composer, ethnographer, and educator Zoltán Kodály (1882-1967). In the early 1900s, after attaining international success as a composer, Kodály turned his attention to the

musical education of young people. He was discouraged by the lack of music skill he observed in students entering Hungarian music conservatories (Choksy, 1999). These students were unable to read or write music fluently and were unaware of their folk music heritage. In addition, the poor quality of music and of singing in the general population troubled him greatly. It became his mission to develop music literacy in his countrymen.

Kodály traveled around the Hungarian countryside for many years, collecting folk songs from peasants in small towns and villages. These authentic songs formed part of the literature base for his method along with authentic children's games, nursery songs, chants, and good composed music (Choksy, 1999). Kodály believed that folk music is drawn from speech patterns that are familiar to children. He published six volumes of Hungarian folk music in his lifetime, including over 1000 children's songs. In addition, "he composed four volumes of pentatonic music, numerous volumes of two-and three-part graded exercises, the *Bicinia Hungarica*, which consists of two- and three-part exercises based on folk music, and numerous pieces for children's chorus" (Choksy, 1999, p. 15)

Kodály believed that singing was a natural activity of humans and that through vocal music education a person could develop the ability to read and write music. This knowledge would make people more musically literate and able to participate fully in the musical life of their community (Zemke, 1974). " Kodály believed that singing should be the first vehicle for the music education of children and once aural skills were in place instruction on a musical instrument should follow" (Zemke, 1974, p. 12).

Kodály was influenced by the child development ideas of the Swiss educator Heinrich Pestalozzi (1746-1827) (Choksy, 1999). Pestalozzi was one of the first to

recognize the natural stages of growth and development in children. The Kodály Method was sequenced to allow for a child's abilities at these various stages of growth. Because moving rhythms were believed to be more child related than sustained ones, quarter and eighth note patterns were taught first. The major second, minor third, and perfect fourth were found to be the intervals that children sang most easily (Choksy, 1999). Kodály and the teachers working with him at the Academy of Music in Budapest recognized four characteristics of children's vocal development that were important in establishing the teaching sequence of the method. "Young children have a limited range of five or six tones. Descending tones are easier to reproduce with accuracy than ascending tones. Small skips are easier to sing in tune than small steps. The keys of D Major, E-flat Major and E Major fit the tessitura of young children's voices" (Choksy, 1999, p. 11). Kodály chose the pentatonic scale as the basis for teaching musical tones with knowledge of diatonic major and minor being taught afterward. To reform the Hungarian music education system, Kodály encouraged his composition students to write for small children. In addition, he divided the many Hungarian folk songs he collected for use into various grades and classified them according to age. Along with Jenö Ádám he compiled the curriculum *Sol-Mi*, which was a collection of graded pieces for grades one through four. This was gradually expanded until the curriculum was written for nursery school through grade 12. Relative solmization was incorporated into these books of folk songs and he supplemented these books with his own compositions. Elements of melody and rhythm were learned naturally and logically in the context of the songs.

"Lois Choksy has said that the Kodály Method is child developmental rather than subject discipline oriented" (Zemke, 1974, p. 29). The thrust of the nursery school

music curriculum in Hungary is threefold: to teach Hungarian nursery songs, to develop inner hearing, and to heighten the sense of rhythm. Children of all ages experience the music before they analyze any part of it. They sing, play games, move, play rhythm instruments, and thoroughly enjoy the song before they analyze it. They are encouraged to sing songs inside themselves in order to strengthen the sense of inner hearing. This inner hearing leads to the ability to sight-sing independently during the elementary school years. In high school, Hungarian students are singing and studying the masterworks of choral literature including those of Hungarian composers. This is the musical literacy that the method seeks to develop in every citizen.

In the 1920s, Kodály looked at the educational methods of other European countries and incorporated their most successful techniques into his method (Landis & Carder, 1972). Tonic solfa was observed in England and rhythm syllables in France. Solfa, a system designating the degrees of the musical scale by syllables, was developed by the Italian monk Guido of Arezzo in the eleventh century (Grout, 1960). Kodály adapted the English variant called Tonic Solfa, which was devised by Sarah Glover (1785-1867) of Norwich England (Stevens, 1986). "Tonic Solfa is a name given to the system of teaching ear-training in which the tones are sung to syllables and the ear is trained to recognize and reproduce the intervals between the tones and the tonic" (Westrup & Harrison, 1985, p. 556). Her system utilized movable *do* with minor *la* solfège as an aid to sight-singing. The first letters of the syllables were affixed to the notation as a stepping stone to staff reading. Glover's system was further developed by John Curwen, (1816-1880), an English Congregationalist minister, who added hand signs for each tone and provided chromatic syllables for sharps and flats. The signs are performed in front of the body with low *do* performed at waist level. The signs can also

be used to direct unison and two-part singing. The three steps of the Glover-Curwen approach included reading solfa notation, then reading staff notation with solfa, and finally reading staff notation alone (More, 1985). Glover developed the solfa ladder so that teachers could emphasize the distance between tones both visually and aurally. Kodály adapted all these ideas into the Kodály Method. The present study utilized the tonic solfa system, solfa notation, staff notation, Curwen hand signs, the solfa ladder, and chromatic syllables. Students first heard the vocal sounds, then read solfa notation as they sang, and finally read staff notation as they sang. Keyboard students played as they followed these steps and sang. After enough repetition students were encouraged to independently sight-sing entire eight-measure melodies.

One of the most basic principles of the Kodály plan is relative solmization. The system of relative solmization was codified in 1849 by Swiss musician, John Weber (Zemke, 1974, p. 25). With movable *do* solfège it is possible for the same syllable names to refer to the same scale degrees in every key. *Do* or tonic can be placed anywhere on the staff to represent the home tone in each major key. When a child learns the sound of *sol-mi* in relation to *do*, "he can immediately read them in any placement on the staff" (Choksy, 1999, p. 12). Relative solmization was extended to the keyboard in the present study. Students used finger stickers to turn each finger into a solfège syllable. These fingers were moved to various major scale hand positions on the keyboard to provide reinforcement of the movable *do* solfège they were singing.

Hearing and singing each interval in relation to the tonic provides a strong context for sight-singing. "As students sing in solfa, transference from unconscious imitation to conscious inner hearing takes place as singers repeatedly label the same relationship with the same syllables and internalize those relationships" (Cetto &

Dietrick, 2003, p. 20). The dynamic relationship that exists between tones is strengthened by their connection to the tonic. Melodies are sung not as a collection of individual intervals but as relationships of intervals to each other and to the tonic. Tonality enables students to organize the intervals in the brain. "By naming tonal constructions, solfège equips singers to think about them. Solfège gives speech to tonality and enables singers to express tonal thoughts in words" (Smith, 1987, p. 19). Solfège thus provides the key to unlock the door to sight-singing mastery.

The aural portion of the method is an imitative system. After the teacher sings two- and three-note tonal melodic patterns, students attempt to sing after her with exactness of pitch. The melodic patterns are introduced gradually in a sequential order. "The melodic teaching sequence includes the minor third *sol-mi*, *la* and its intervals with *sol-mi*, *do*, the home tone and its intervals with *sol-mi* and *la,* and *re*, the last tone of the pentaton. Following come low *sol*, low *la*, high *do*, and then half steps *fa* and *ti"* (Choksy, 1999, p.11). Students sing many songs that utilize the tones that are being studied (Choksy, 1999). After the students have heard the intervals repeatedly, cards are used to represent the pitches (Leganyne Hegyi, 1975). Only the first initials of the tone syllables are used. For example S, L, and M, representing the syllables *sol*, *la* and *mi*, are spatially placed higher and lower on the cards to indicate higher and lower pitch. Students are given opportunities to write solfa using only the first letters of the syllables. "Notes above high *do* are shown with a superscript and notes below low *do* are shown with a subscript" (Choksy, 1999, p. 14).

The sight-singing training of the present study was conducted using the same vocal modeling techniques described above. Curwen hand signs were used to reinforce vocal sound and as a teaching technique for directing part-singing. The students were

taught correct placement on the staff as they learned each combination of syllables. They studied placement in the keys of C, F, and G Major. At the correct time, the syllable cards were replaced by notational cards containing attached syllables. When enough time had been spent studying the preliminary cards, cards containing only notation were presented and the class read the cards from sight using their inner aural imagery to guide them. Keyboard students additionally played and sang from notated examples in their workbooks.

Suggestions for using the method with older students are contained in *The Kodaly Method II: Folksong to Masterwork* by Lois Choksy. She lists ten skills for the hypothetical ideal older music student who loves and supports music. Skill four includes "vocal independence and a high level of sight-singing proficiency. He or she can both look at notation and think sound and think or hear sound and notate it correctly" (Choksy, 1999, p. 3). That goal is identical with the purpose of sight-singing training in the present study.

The ideas of Zoltán Kodály were first brought to America by Mary Helen Richards through her *Threshold to Music* books and charts (Choksy, 1999). Other teachers traveled to Hungary to study the method. According to Choksy (1999), it was not the techniques of the Kodály Method but the underlying philosophy that attracted American educators to study his ideas and struggle to adapt them for American music education. Kodály considered music an essential subject that should be included at the core of the curriculum. This was a refreshing idea for music teachers who had long heard that their subject held merely entertainment value in the school day. Kodály also believed that music literacy was possible for every child and that the best instrument for instruction was the child's own voice. This made music education through his method a

very democratic operation and one that could be promoted easily in elementary music education. The idea that music education should begin with children in infancy was a new idea to American educators. Kodály was one of the first educators to suggest that if we want a musically intelligent audience of adults, we must compose music for the youngest children and train them with as much care as older students. His insistence on using only the best musical literature, especially folk songs, from infancy to adulthood appealed to American music educators who were dealing with an onslaught of rock and pop styles in the 1970's. It also caused music educators to look critically at the contents of the series books for elementary music and to make some needed changes. Additionally appealing was Kodály's insistence that it mattered very greatly that only qualified music educators teach in the public schools. At a time when music was still being taught by the classroom teacher in some parts of the United States, it was a welcome validation, coming from a prominent musician and educator, of the importance of specialized training of teachers in music education.

The Kodály Method as it was designed in Hungary is meant to train students from nursery school to adulthood in the aural, reading, and writing skills necessary to produce musically literate adults. The training method of the present study utilized some techniques and a similar training sequence as the Kodály Method, but the training was accelerated for the high school learner and included portable electronic piano keyboard experience in the experimental group. The goal of the training was the development of aural skills through solfège training, which facilitates sight-singing skill.

Research related to the Kodály method. Since the 1970's various researchers have examined aspects of the Kodály Method and its effectiveness as a tool in

American music education. Martin's 1991 study examined the effect of using hand signs, aural syllables, and tonal syllable abbreviations (printed on the staff or on unlined paper) on the development of verbal and symbolic tonal skill in first graders. She defined verbal skill as "aural perception demonstrated by performance" and symbolic skill as "sight reading skill demonstrated by performance." Levels of tonal aptitude and school readiness in the first grade students were also examined to determine their role in tonal syllable skill development. The materials consisted of three-or four-note tonal patterns using the syllables *do, re, mi, sol,* and *la* in F pentatonic. Each tone was used as a starting pitch, no tone occurred twice in succession, and *do* was always first space F in treble clef.

Martin constructed three singing tests to obtain information concerning the effectiveness of the three teaching methods. Two tests involved echoing tonal patterns without visual stimuli such as tonal pattern cards or hand signs and one test involved sight-singing patterns written on cards. Tonal patterns were randomly chosen from a 378-item list of three- or four-note pentatonic tonal patterns. Each of the five tones was used as a starting pitch, no tone was used twice in succession, and the tonal range spanned middle "c" to "a". The students were taught in three, 30-minute classes per week. The first 9 minutes were spent with the full group echoing 20 tonal patterns after the teacher; then each child individually echoed the patterns.

Group 1 echoed patterns, Group 2 echoed and used hand signs, and Group 3 echoed, used hand signs, and saw letter representations of the patterns spatially arranged on cards. After two months of imitation, the teacher sang the patterns on the neutral syllable "bum" and the students sang them back in tonal syllables. The echoing and training sessions alternated again using a different 20 patterns. At mid-year the students

were tested with 10 familiar patterns and 10 unfamiliar patterns that were pre-recorded on tape. Students listened to the neutral syllable and sang the correct solfège syllable onto another tape. Next, the students were trained to echo from notation cards instead of syllable cards, after which another 20 patterns were taught by rote, then by syllable cards, and then by notation. At the end of the year, students were again tested individually. The results of the training showed that all three training groups scored essentially the same with high aptitude students making the greatest gain. Martin concluded that most first-grade students did not have an aural understanding of the tonal syllable relationships at the end of one year of training.

Martin claimed to be testing hand signs, tonal syllables, and cards as they are used in the Kodály Method. However many of the procedures used were those of Gordon's Music Learning Theory. The use of the neutral syllable "bum" and the description of the various stages such as verbal association and symbolic association are not part of the Kodály Method. The Kodály Method is characterized by the careful manner in which children are first prepared for new material by singing many songs containing the pattern before the concept is named. After naming the tonal concept, new songs are learned through which the concept can be discovered again. This sequential presentation of material requires much prior planning. The instructor never presents tonal patterns in a random order as occurred in the Martin study. The emphasis on the term tonal pattern is a concept used in Gordon's Music Learning Theory. The use of the entire pentatonic scale at once was probably too overwhelming for the first-grade children to aurally understand. Since the careful sequence that characterizes the Kodály Method was not followed, this is not really a study of the signs, syllables, and cards as they are used in the Kodály Method.

Cassidy (1993) used some strategies associated with the Kodály Method to aid non-music students at the college level in accurately performing sight-singing tasks. This was done to see if improved sight-singing accuracy would transfer to improved pitch accuracy while students sang familiar children's songs. Ninety-one music education majors were placed in five groups and pre-tested on accuracy of sung notes and intervals in four composed sight-singing exercises and a subject-selected children's song. One group received solfège training coupled with Curwen hand signs, one received solfège alone, one used staff letter names, and one used the neutral syllable *la*. The groups received Kodály training in 16 classes for 6 weeks during which they echoed phrases sung by the teacher in the keys of C pentatonic, C Major, F Major, and G Major. A one-way Analysis of Variance (ANOVA), used to compare pre-test singing scores for all groups, revealed that all of the subjects were more accurate on the post-test but no group mastered the task after six weeks. The solfège-with-signs and the solfège-alone group performed significantly better than the other two groups. Cassidy concluded that any set of labels that helps to differentiate the tones is more helpful for sight-singing than the neutral *la*.

Part of the definition of sight-singing is the need for aural imagery to develop over time and 6 weeks was probably not a sufficiently long training period. There is no evidence in the description of the training as to whether the syllables were presented in a sequential manner or in a random manner or whether the tones were presented in the context of tonic. In addition, there is insufficient evidence regarding the validity or reliability of the researcher-composed songs used for the pre-test.

MacKnight (1975) sought to develop teaching techniques and materials for beginning wind instrumentalists that would treat music reading as a process and

emphasize the structure of the melodic line. Her subjects were 90 fourth-grade students who had studied wind instrument performance for 1 year. The students were given the Music Aptitude Profile and a questionnaire designed to elicit information about their attitudes toward music. The experimental and control groups were equated on the basis of the Music Aptitude Profile and Thorndike Intelligence Test scores. Six students at a time received a 30-minute lesson each week for 32 weeks. The experimental group was introduced to pitch through tonal patterns similar to the Kodály sequence. *Sol-mi, sol-mi-do, sol-la-sol, mi-re-do, sol-mi-sol, mi-do-re, sol-fa-mi, sol-fa-mi-re-do, do-la-sol, do-ti-do* and *sol-la-ti-do* was the sequence of presentation of tonal patterns in the study. Each pattern was taught first by aural presentation, then by aural and visual presentation, and finally aural-visual presentation within a musical phrase. The students echoed the patterns both vocally using syllables or letters and on their instruments. An instruction book was specially prepared by the researcher that contained melodies with the tonal patterns presented in the same sequential order of aural presentation. This sequential arrangement of the music is similar to the careful sequencing of interval presentation in the Kodály method. Rhythm was taught through the Galin-Paris-Chevé syllables also utilized in the Kodály Method.

The control group, by contrast, used a standard method book, *Breeze Easy*. A new pitch and its fingering was introduced on each page and rhythm was taught as it relates to beat. The students were tested using the tonal and rhythm portions of Colwell's Music Achievement Test and the Watkins Farnum Performance Scale. Criterion scores were analyzed for main effects of treatment and interaction between treatment and levels. For analysis, students were classified by treatment group, instrument (brass or woodwind), and musical aptitude (high or low). The tonal-pattern-

trained students in the experimental group scored more than 12 points higher than the note identification group. The researcher concluded that melodic training based on audio-visual recognition of a series of tonal patterns is an effective strategy for teaching the meaning of notation to beginning music readers. She further noted that this understanding can be taught without sacrificing proficiency on the instrument. The instruction emphasized "the identification of music patterns, active involvement in listening, singing with tonal syllables, chanting with rhythm syllables, thought and conceptualization, and pre-organized reading materials that introduce tones and rhythms in their most frequent patterns" (MacKnight, 1975, p. 33).

This study was well controlled. The groups were equated on the basis of intelligence scores and musical aptitude, and there was a complete description of the treatments given to the experimental and control groups. Both groups were taught for the same amount of time and valid and reliable tests were used. The significant results for the experimental group can reliably be attributed to the experimental treatment. No mention of Kodály or Gordon was made in the study but it is interesting to note that Gordon's Musical Aptitude Profile was used for grouping purposes while most of the procedures used were those of Kodály. The significant results were attributed to the use of tonal patterns in singing and the chanting of rhythm syllables as well as the sequential nature of the materials used. All of this strongly suggests the Kodály approach. The combination of aural, visual, and vocal elements led to improved sight-reading ability in the beginning instrumentalists. No mention was made of the possible tactile connection when the students sang the patterns and then played them on the instruments. Perhaps the playing provided tactile reinforcement to what was learned aurally and visually.

Summary. Zoltán Kodály developed the Kodály Method in response to the lack of music literacy he observed in the Hungarian population around 1900. He based the method on ideas borrowed from outside sources including tonic solfa, movable *do* with minor *la* solfège, Curwen hand signs, and Curwen's chromatic syllables. Kodály constructed graded reading exercises and composed two- and three-part melodies for rehearsal. He recorded and transcribed authentic Hungarian folk songs for use with the method. With the help of other Hungarian music teachers he carefully sequenced the presentation of intervals and rhythms to coincide with stages of children's development from preschool to adult and wrote a curriculum for use in the schools. One of the central aims of the Kodály Method is sight-singing or the ability to "see with the ears and hear with the eyes." American folk songs have been adapted to the method for use in American public schools. Training in the Kodály Method is available at selected colleges and universities in America and around the world. Techniques and the sequential presentation of solfège syllables associated with the Kodály Method were utilized in this study for the purpose of developing aural imagery in high school students as an aid in the sight-singing of vocal literature.

Music Learning Theory

Music Learning Theory is a widely used method for teaching music literacy through the development of aural skills, which are called audiation skills. The development of audiation skill is identical to the development of the aural imagery needed for sight-singing. Edwin Gordon is a musician, music educator, researcher, and writer who has devised Music Learning Theory to describe how students learn music. It is based on years of research on music aptitude, preschool music, and elementary music education. Many of the ideas are relevant to the aural skills development needed for

sight-singing at any age. The goal of instruction based on Music Learning Theory is music literacy that leads to music appreciation and joy in making music.

Audiation, the central tenet of the theory, is defined as "an assimilation and comprehension in our minds of music we have just heard performed or have heard performed sometime in the past" (Gordon, 2003, p. 4). Gordon lists eight types of audiation as part of Music Learning Theory. Type 1 occurs when students listen to familiar or unfamiliar music. Type 2 takes place when students read familiar or unfamiliar music. During Type 3 audiation, students audiate when writing familiar or unfamiliar music. In Type 4, students audiate when recalling and performing familiar music from memory. Type 5 involves recalling and writing familiar music from memory. Audiating while creating and improvising unfamiliar music either in silence or in performance is Type 6. Type 7 audiation occurs when students create and improvise while reading new music. Creating and improvising while writing new music is Type 8 (Gordon, 2003).

Of the eight types, Types 2 and 3 are most closely associated with sight- singing. The assimilation and comprehension in the mind, which Gordon calls audiation, is a synonym for the aural imagery that is often described in the sight-singing process (Radocy & Boyle, 1988). "If you are able to hear the musical sound of and give syntactical meaning to what you see in music notation before you perform it, before someone else performs it, or as you write it, you are engaged in notational audiation" (Gordon, 2003, p. 8). "Syntactical meaning" refers to the ordering of sounds. Notational audiation represents a deep level of cerebral activity because students must assimilate and comprehend sound and then perform or write it accurately without the aid of a musical instrument. "In cognitive terms the structure of audiation is deep and serves as

background conception. The structure of imitation is superficial and serves as foreground perception" (Gordon, 2003, p. 10). When a student sight-sings they "transcend the print" and give musical meaning to the symbols they see. Gordon used the metaphor of a window to describe the relationship between notation and audiation that occurs during sight-singing. "Notation is a window that one sees through and audiation is on the other side" (Gordon, 2003, p. 8). When students sight-sing successfully, they give sound meaning to the notes both tonally and rhythmically. "To truly read in all cases is to be able to audiate from notation what is to be performed before the sound is physically present" (Gordon, 2003, p. 15).

Type 3 audiation, writing music from dictation, is also useful when teaching sight-singing. In dictation, students first hear the music performed, then audiate or give musical meaning to it within their minds, and then notate it correctly on paper. Since it is the reverse operation of sight-singing, the writing tends to reinforce the development of the audiation needed for sight-singing. While hearing the sounds being performed, students audiate the tonality, meter, rhythm patterns, and tonal patterns, and then write using their theoretical knowledge about key signatures, time signatures, note values, and other score elements to guide them.

When audiating, students both hear and think music; one always accompanies the other. It differs from aural perception, which Gordon defines as "hearing sound the moment it is being produced" (Gordon, 2003, p. 4). The sound must be acted on in the brain before audiation occurs. "When students audiate as they read and write notation, they are continually reflecting on and explaining the notation to themselves in terms of sound" (Gordon, 2003, p. 112).

Gordon compares tonal reading of melody to language acquisition. Just as one word does not have meaning until being combined with others to form a phrase or sentence, so one note is not meaningful until combined with other notes to form a pattern. "To be able to audiate patterns in given tonalities is the only real readiness to read and write music notation" (Gordon, 2003, p. 39).

In Music Learning Theory, tonal and rhythm patterns are learned first and then students progress to complete melodies. During audiation, students recognize familiar patterns that Gordon calls "essential tonal and rhythm patterns" as well as "essential pitches and durations." The term essential refers to their function within the tonality or harmony of the music. For instance, a melodic progression *do-mi-sol* performs a tonic function in major tonality that the eye can recognize, the ear hear, and the mind audiate. A melodic line moving *ti-do* can be recognized as a leading tone progressing to the tonic or a cadential function. These contextual clues help to organize the information during audiation. Gordon defines inessential pitches as repeated tones and rhythms that do not have a strong harmonic or tonal function. They are organized in the brain after the essential patterns to complete the entire melody.

Gordon has identified and classified tonal pattern functions for major, minor, and all the modes. The eight functions of major tonality include tonic, dominant, sub-dominant, multiple, chromatic, modulatory, expanded, and cadential. The combinations of tonal syllables included in each function are described in detail. Students are taught the tonal patterns through correct imitation of the teacher. When students first imitate they are "learning through someone else's ears" and when they begin to audiate they "learn through their own ears" (Gordon, 2003, p. 9).

The tonal pattern must be learned within a context in order to be encoded in the brain. The tonal center or resting tone and the harmonic function of tonal combinations provide the context for patterns of tones. Meter, involving macrobeats and microbeats, provides the context for patterns of rhythm. In Music Learning Theory, students retain or memorize the sounds of tonal or rhythm patterns they have learned by rote. When looking at unfamiliar music, they extract from memory the familiar patterns they see and connect them with their resting tone. Students also recognize familiar rhythm patterns and associate them with beat and meter. When this audiation activity has taken place, students are prepared to sight-sing.

Gordon makes a strong case for the use of movable *do* with *la*-based minor solfège system for aural training. Because Music Learning Theory is based on the audiation of tonic as it relates to a series of tonal patterns, movable *do* with *la*-based minor is considered by Gordon as the best tonal system for the development of audiation skill. The name of the resting tone changes to correspond to tonality and *do* is movable to correspond with key. There are separate syllables for chromatic tones so that chromatic melodies and modulations to other keys can be performed. The syllables end with vowels and can be sung with beauty of sound. Groups of syllables can be taught relative to harmonic function regardless of key or tonality. For example, *do-mi-sol* is always tonic function in major. "If teaching students of all ages to audiate is an important goal, an appropriate syllable system must be one in which the syllable name of the resting tone changes with a change in tonality, but the syllable name of the tonic does not change with a change of key. That is true only of a movable *do* with *la*-based minor system" (Gordon, 2003, p. 68).

Gordon describes discrimination and inference as the two general ways that music is learned. Imitation and memorization are of great importance in discrimination learning. When students learn tonal patterns by rote in imitation of the teacher they are discriminating among the pitches and patterns (Gordon, 2003). This forms the basis of later inference learning in which students learn unfamiliar music by inferring from familiar music. The skill learning sequence of Music Learning Theory is divided into sequential steps under both discrimination and inference learning (Gordon, 2003, p. 90).

Table 1 describes the progressively more complex levels under discrimination and inference learning. The simplest stages of aural/oral and generalization move progressively to the complex composite synthesis and verbal symbolic stages at which point students read, write, and create musically.

Table 1

Gordon's Skill Learning Sequence

Discrimination	Inference
1. Generalization	1. Aural/Oral
2. Verbal Association	2. Aural/Oral—Verbal Symbolic
3. Partial Synthesis	3. Creativity—Aural/Oral Symbolic
4. Symbolic Association—read, write	4. Theoretical Understanding-Aural/Oral
5. Composite Synthesis—read, write	5. Verbal-Symbolic

In Music Learning Theory, students imitate at the aural-oral stage using a neutral syllable but at the verbal association level students are introduced to solfège syllables as a way to name sounds that have already been internalized. Later, at the partial synthesis level students hear individual patterns as part of a series and can identify their harmonic

function. At the symbolic association level, students begin to read and write what they can audiate. Notation is then a picture of sounds that students can already hear.

Gordon includes sight-singing or sight-reading at the generalization-symbolic level of inference learning. Reading means audiating and then singing what one sees in notation. Writing means hearing and then audiating and then writing (Gordon, 2003). "Being able to recall in audiation familiar patterns seen in the notation of unfamiliar music is what allows us to engage successfully in sight-reading" (Gordon, 2003, p. 113).

At the elementary school level, Gordon advocates that students be placed in high, medium, and low groups on the basis of music aptitude test scores. Tonal patterns, which have been labeled as easy, moderately difficult, and difficult are presented. Easy patterns are given to all and then more difficult patterns are presented to the middle and upper groups. The aim is to challenge students according to their ability and provide for individual differences. The teacher is responsible for keeping track of each child's achievement by checking off patterns successfully performed in solo. Specific instructions for teaching are provided in *Jump Right In: The Music Curriculum,* also written by Gordon (1986).

Gordon does comment on the role of tactile association. "Some instrumentalists rely on tactile association rather than verbal association by associating finger movements on instruments with tonal patterns they hear. Persons with high music aptitude can accomplish a great deal through tactile association, but regardless of the value that tactile association may have to a performer, it has limited educational value, not only because all students do not have high music aptitude, but because it is unrealistic to assume that all students will have the opportunity to play a musical

instrument" (Gordon, 2003, p. 98). The statement may be an attempt to credit the ability of many musicians, particularly jazz instrumentalists, to perform much more complex music on their instruments than they can read or understand from a theoretical position.

It is perhaps imprudent to state that tactile association has limited educational value or to assume that it requires high music aptitude. Keyboards can be utilized in public schools and many middle school programs provide an exploratory program in keyboard to all students. While this is not one-on-one training, it is still experience with a musical instrument. If this preliminary training was enhanced at the high school level in association with aural skills training, then tactile reinforcement might play a significant role in music education. There are currently no studies indicating that tactile reinforcement requires high musical aptitude or has limited educational value. If the keyboard is used as an educational resource to turn the ten fingers of the hand into an extension of the diatonic scale where each finger can be associated with a tonal syllable, then the keyboard could be used in conjunction with the solfège training of tonic solfa as an aid in the formation of the audiation skill needed to sight-sing.

Research related to music learning theory. Edwin Gordon conducted his own research on rhythm patterns and tonal patterns in the following published studies: "Toward the Development of a Taxonomy of Tonal Patterns and Rhythm Patterns: Evidence of Difficulty Level and Growth Rate," (1974), "Tonal and Rhythm Patterns: An Objective Analysis," (1976), "A Factor Analytic Description of Tonal and Rhythm Patterns and Objective Evidence of Pattern Difficulty Level and Growth Rate," (1978), "The Manifestation of Developmental Music Aptitude in the Audiation of 'Same' and 'Different' as Sound in Music," (1981), and "The Effects of Instruction Based Upon Music Learning Theory on Developmental Music Aptitudes" (1988). In addition, he

wrote and researched the following music tests: Musical Aptitude Profile (1965), Iowa Tests of Music Literacy (1971), Primary Measures of Music Audiation (1972), Intermediate Measures of Music Audiation (1982), and Advanced Measures of Music Audiation (1989).

In his 1985 article, "Research Studies in Audiation I", Gordon sought to substantiate the stages of audiation, to determine whether the stages are common to both tonal and rhythm audiation, and determine the extent of the relationships among audiation skills and music aptitude. He worked with kindergarten children from a Catholic school for a few minutes of each 20-minute music class. The children echoed tonal and rhythm patterns and then were tested using the Primary Measures of Music Audiation, composed of a tonal test and a rhythm test.

The stages of audiation were investigated in conjunction with the first and fourth types of audiation. These types are audiating when listening to familiar or unfamiliar music and recalling familiar music silently or performing familiar music vocally. For the testing, students listened to a pattern performed on a synthesizer and then were asked to echo it. After listening to a second pattern and echoing it, the students were asked to remember and perform both patterns in succession. Next, the students were asked to sing a song with patterns like the two just echoed. Then the two patterns were played on a synthesizer and the students were asked to perform more patterns in order to make a song.

The children's overall scores were low on the tonal and rhythm tests regardless of musical aptitude. Gordon theorized that the students were still in the music babble stage and too immature to match pitch accurately. Since the children had not yet firmly established their singing voices, the techniques may have been inappropriate. He

concluded that stage four audiation may not occur in five-year-olds. He further concluded that chronological age, culture, and music achievement apparently affects how children audiate.

Although the training did not appear to have the predicted effect, the study reminds us that all kindergarten classes are not equal and that children develop at different rates. Apparently students with extensive early music experiences, including singing, may develop their singing voices and be ready for audiation tasks earlier than others. Gordon found that for young children, stages one, two, and three of audiation are the most useful.

Jones (1985) hypothesized that sight-singing skill in the high school choir could be improved through a program of echoing tonal patterns. She investigated the difficulty level of patterns for use with high school choral students. She devised 30 patterns from those occurring most often in the most frequently performed songs identified in a survey of ten MENC north central states. She modeled her study after Gordon's 1976 research and replicated his procedures for deciding which patterns were easy, moderately difficult, or difficult. One hundred-two high school students were given aural and oral tests. For the aural test they decided if two patterns they heard played on an organ were the same or different. Patterns that participants considered different but were the same were labeled as more difficult than those that were actually different. For the oral exam students listened to a pattern and sang it back. Jones concluded that high school students found it easier to hear similarity of pattern than to sing back those patterns with accuracy. The age of the student, vocal or instrumental music experience, and voice part were identified as significant factors influencing

singing test scores. She also concluded that descending patterns were easier to sing than ascending patterns.

It would be easier to comment on this research if more information had been given about the subjects. It is surprising that high school students would have difficulty hearing similarity of pattern, particularly if they had previous sight-singing training. One might assume that older students performed more accurately and that more musically experienced students performed better, but this is unclear from the report. It is also unclear why a student's voice part should have a bearing on his or her ability to echo patterns accurately or discriminate accurately.

Feierabend (1986) studied the effects of teaching tonal patterns that are either easy to sing, easy to aurally discriminate, or both easy to sing and easy to discriminate on the singing and aural discrimination abilities of first grade children. Researcher-constructed singing and aural discrimination tests were administered to four groups of first graders. The students echoed major, tonic, and dominant patterns on neutral syllables for five minutes a day for seven weeks. Group 1 echoed easy-to-sing patterns that varied in aural difficulty, group 2 echoed patterns that were easy to discriminate but varied in singing difficulty, and group 3 echoed patterns that were easy to sing and easy to discriminate. Group 4 served as the control group and received no training.

An analysis of covariance on the post-test scores was performed to determine which treatment had a significant effect. Correlations between the scores on the singing test and on the aural discrimination test were performed for pre-test and for post-test. The pre-test and post-test correlations were compared to determine if any of the treatments affected the relationship of singing ability to aural discrimination ability. No significant treatment effect was found for any group. In his discussion section

Feierabend stated, "both Gordon and Kodály advocate the development of tonal pattern comprehension through aural and oral experience." While that statement is broadly true, the Kodály Method advocates presentation of intervals tied to the tonic in a carefully arranged sequence. It is unclear whether the patterns were carefully connected to the context of the tonic pitch, or only to a harmonic context through imitation of patterns of the tonic, dominant, and sub-dominant harmonies. The presentation of the variously labeled tonal patterns in this study is more akin to Gordon's Music Learning Theory. Seven weeks was probably not a long enough training period in which to develop aural discrimination abilities in first graders.

Summary. Edwin Gordon has developed Music Learning Theory to describe how students learn music. The basic tenet of the theory is audiation, or the assimilation and comprehension in the mind that takes place when music is heard or read or as it is being written. Of the eight types of audiation, notational audiation is central to sight-singing. When students can see unfamiliar notation, organize the sounds and hear them in the mind, and then accurately sing them, they are engaged in notational audiation at the symbolic level of inference learning. This is sight-singing. The stages of training that are required to reach this level are described in the skill learning sequence. Writing music in dictation is recognized as another type of notational audiation but it is the reverse of sight-singing because the music is heard, audiated, and accurately notated instead of seen, audiated, and accurately performed.

The development of audiation in Music Learning Theory is based upon the imitation and discrimination of same and different in tonal patterns and rhythm patterns. Tonal patterns are categorized according to their tonal and harmonic function within tonality. Patterns are labeled as easy, moderately difficult, and difficult. Classes of

students are ranked by music aptitude tests into high, medium, and low aptitude groups. The patterns are presented to groups according to their ability to audiate in order to accommodate individual differences in learning. Pattern training in the elementary general music class is meant to occupy the first 10 minutes of class after which general music activities resume. Teachers keep track of individual student achievements by checking off patterns they can sing accurately in solo performance. Specific instructions for teaching are provided in *Jump Right In: The Music Curriculum,* also by Gordon (1986).

Comparisons and Contrasts

The following section presents an analysis of the striking similarities and distinct differences between the methods of Kodály and Gordon. Just as Kodály borrowed educational techniques from the world around him, so Gordon borrowed ideas from Kodály and others in the construction of Music Learning Theory. Gordon has expressed admiration for the "exceptional music literature of Hungarian folk songs" and later American folk songs used with the Kodály Method (Gordon, 2003, p. 30). Both methods teach listening and moving before singing and rhythm or tonal reading. Both believe in training the ear and voice of young children before proceeding to lessons on a musical instrument. Both methods utilize movable *do* with *la*-based minor solfège as their training system and both methods use a rhythm language to teach rhythm reading. Both are "sound before sign" methods advocating that children have many experiences singing, listening, and moving to music before tonal and rhythm pattern training is introduced. Both methods are child-centered based on what is known about child development and they stress rote learning, in which children excel. Both methods teach performing, reading and writing, and theory in that order.

Kodály's was the first pedagogical system to use tonal and rhythm patterns in the context of tonality and meter rather than teaching isolated intervals or rhythm counting. He taught tonal patterns without rhythm and rhythm patterns without melody in order to strictly separate the two musical elements. Kodály devised the simple stick notation method for children to use in reading and writing. Kodály stressed the concept of inner hearing, which is comparable to Gordon's term audiation. Kodály was one of the first music educators to stress the importance of sequential teaching and repetition in the development of inner hearing. He was among the first to realize that music literacy rests on the ability to hear what is seen in notation and that this inner hearing is best developed through performance (Gordon, 1981).

Gordon's instructional method differs from the Kodály Method in some fundamental respects. Gordon teaches tonal patterns tied to harmonic function and tonality. The tonal patterns are carefully classified according to their harmonic function and labeled as easy, moderately difficult, and difficult. The tonal patterns are identified for major, minor, and all the modes. Kodály instruction stresses the sound of *sol-mi*, for example, in relation to the tonic. The emphasis is less on labeling and more on hearing and understanding the sound in context of the tonic pitch. Gordon uses three-note patterns of notes while Kodály begins with two-note patterns. Kodály first teaches only pentatonic melodies because of a belief that half steps are difficult for children to sing and because much Hungarian folk music is written in the pentatonic scale. After a thorough introduction to pentatonic, the children are then led to discover the half steps of the diatonic major and minor scales. Gordon's research led him to believe that diatonic patterns can be sung accurately by children from the start and that some half steps are easier to sing than the falling minor third, which is the first interval learned in

the Kodály Method (Gordon, 1981, p. 10). The leading tone is necessary in Gordon's view to develop the identification and recognition of a resting tone. Gordon, therefore, advocates teaching diatonic major and minor scale patterns from the start.

Gordon also criticizes the use of primarily duple meter in the Kodály Method. He advocates the simultaneous teaching of duple and triple meter patterns from the beginning of training. Gordon carefully differentiates the use of rhythm syllables in duple and triple meter and also differentiates by function within meter. Kodály was less careful about this. Gordon has gone much further in assigning syllable names for all meters and beat functions in simple, compound, usual, and unusual meters. Gordon objects to the use of the first letters of syllables as a step in reading as it is used in the Kodály Method. He differentiates sign from symbol in Music Learning Theory and so finds the technique of using a symbol (letter name) with a sign (note) confusing (Gordon, 1981). Provision for creativity and improvisation is not as clearly delineated within Kodály as within Gordon's method. Gordon uses music aptitude testing as a way to differentiate ability levels within the general music classroom: His method attempts to teach to individual difference in ability, thereby meeting everyone's educational need.

Great care is taken in the Kodály Method to use literature, games, chants, and exercises that are enjoyable and child-centered. The method is carefully sequenced within the preparation, presentation, and practice framework. The Kodály Method is primarily a vocal method, which recognizes the child's natural instrument, the voice, as the most natural vehicle for learning music. By contrast, Gordon's method uses the voice as a vehicle to develop audiation, which is of use in developing sight-reading skill in instrumentalists. Gordon has an instrumental background, not a vocal background,

and the method reflects his background of instrumental drill and practice. It requires teachers to spend ten minutes of every music period drilling on tonal patterns that are labeled as easy, moderately difficult, and difficult. Students are likewise labeled as less talented, moderately talented, and talented on the basis of the Musical Aptitude Profile. It seems unwise to label small children in this way before they have had a chance to develop their musicianship more fully. It is questionable whether the slow learner would want to progress much under this system.

Gordon's rhythm language is excellent and comprehensive and he went much further than Kodály in providing logical syllables for every usual and unusual meter. He also advocates teaching the differentiation of duple and triple meter through movement and then echoing rhythm syllables right from the start. Songs and music in both duple and triple meter would proceed together in this way. While the care that was taken to provide syllables for all meters is admirable, most children's literature does not utilize those meters and unusual meters could well be left to middle school or high school. The great emphasis that is placed on learning the solfège syllables for Dorian, Phrygian, and all the modes as well as major and minor tonalities seems unnecessarily complex for elementary school children whose literature base does not include these modes.

Sight-Singing Constructs

Because the present study involves the teaching of sight-singing, it is important to identify the many constructs that underlie the skill. The following section presents ideas about the musical elements contained in the definition of sight-singing. Various definitions have been given for the skill of sight-singing but none seem to be completely accurate in identifying all the underlying constructs or concepts involved in the skill. Some definitions mention knowledge of music notation, understanding of the principles

of tonal and rhythm relationships, practice in applying the principles, and evaluation of the application as a guide to future progress (Kanable, 1969). Others would add to the definition habit, memory, and imagery, which must be learned over a period of time (Apel, 1968). The importance of a tonal-harmonic context for sight-singing has been suggested as an aid in the memorization of intervals embedded in short melodies (Cuddy, 1982; Marquis, 1964; Ottman, 1965) and as an integral part of sight-singing (Boyle & Lucas, 1990; Killian, 1991).

One of the key concepts involved in sight-singing is aural imagery (Radocy & Boyle, 1988) or audiation as it is referred to by Gordon (2003). "In aural imagery...the singer perceives what a specific pitch should sound like in relation to the written and or aural context of that specific pitch. Because aural imagery is context dependent, some contextual conditions may more easily facilitate accurate aural imagery leading to more accurate vocal performance" (Lucas, 1994, p. 204). Ottman, in his 1965 study, described the formation of imagery as a musical power. "One of the most important attributes of musical talent and the central aim of all ear-training is the power of musical imagery. It presupposes the ability to think music and through rudimentary knowledge of music theory to associate appropriate notational symbols with the sounds they represent. The act of sight-singing is a vocal expression of this power" (Ottman, 1965, p. 46). Ottman's statement might be interpreted as an early recognition of sight-singing as a cognitive skill.

Perception of pitch may be a construct of sight-singing. Gordon defines aural perception as "hearing sound the moment it is being produced" (Gordon, 2003, p. 4). He also defines audiation when he states that "audiation involves assimilation and comprehension of the musical sound which occurs a short time after the sound is heard"

(Gordon, 2003, p. 5). Perception, therefore, precedes audiation and it is apparent that the sound must be correctly perceived before comprehension can take place. Accurate pitch perception is also necessary for correcting errors when sight-singing unfamiliar music. Tonal memory, or the ability to remember short phrases that were heard and repeat them with accuracy, was an important skill needed for the sight-singing training of the present study. Tonal memory was also required for success on the MAP, Tonal Imagery, part A, which required students to remember a short melody and decide if they heard that melody in the subsequent phrase.

Melodic discrimination, or the ability to differentiate the sound of individual pitches and the ability to match pitch with the voice are important skills for sight-singing (Madsen & Geringer, 1983). Larson (1977) wrote that melodic discrimination should be regarded as an important means of aiding in the development of the auditory discrimination ability that is needed for sight-singing. In recent research with children, some researchers have concluded that pitch discrimination is less important than earlier thought. They found no association, for instance, between children's pitch discrimination skill and the ability to match pitch vocally (Apfelstadt, 1984; Geringer, 1983; Goetze, Cooper & Brown, 1990). Pitch discrimination is thought to be a developmental skill that occurs with age and experience (Goetze et al., 1990). For older high school students who have already had many experiences with vocal music, pitch discrimination and pitch matching skills should already be in place.

The understanding of music notation is generally considered a prerequisite for sight-singing. Gordon (2003) defines notational audiation as the ability to "give syntactical meaning to what you see in music notation before you perform it, before someone else performs it, or as you write it" (Gordon, 2003, p. 8). A recent definition

by Hodges states that sight-singing is "the ability to convert musical notation into sound upon initial presentation. Such sounds conceived internally may be referred to as audiation (Gordon, 2003) or aural imagery (Radocy & Boyle, 1982) and then produced externally with the voice" (Hodges, 1992, p. 467). The ability to read rhythms accurately has also been identified as a sight-singing construct (Colley, 1987). It seems clear that the sound of melodic intervals must be connected with the visual imprint of musical notation and combined with some theoretical knowledge before the cognitive process that is sight-singing can occur. From the previously mentioned research the following skills and abilities have been extracted which will serve as constructs of sight-singing in the present study.

Accuracy of pitch perception

Accuracy of pitch matching in performance

Ability to detect and correct pitch error in performance

Audiation or tonal imagery of melodic intervals in a tonal-harmonic context

Audiation or aural imagery of rhythm patterns and meter

An understanding of melodic and rhythmic notation, which leads to accurate reading

A useful definition of sight-singing is: the ability to associate music notation with audiated musical sounds, both melodic and rhythmic, in order to sing with good relative pitch within a tonal-harmonic context.

Context in Melodic Perception

Historically sight-singing has been taught through the use of isolated intervals. Recent research has indicated that intervals are easier to hear within a melodic or

harmonic context. The following section deals with the value of teaching sight-singing within a context. American colleges and universities employed the method of teaching sight-singing through the singing of isolated intervals and the naming of those intervals throughout the 1950s and 1960s. In the 1970s some significant research on melodic perception was completed which increased our knowledge about the cognitive processes involved in sight-singing.

It was determined that memory for the pitch of an individual tone deteriorates over time, particularly in the presence of other tones (Deutsch, 1970). In addition, the ability to identify individual tones is limited to three or four tones in the average person. This information comes from I. Pollack's study (as cited in Deutsch, 1999, p. 218). Researchers began to investigate the structure of the diatonic major and minor scales as an organizing factor in the tonal memory needed for sight singing. Cuddy, Cohen, and Miller, (1979) composed thirty-two short tonal sequences based on the structures of diatonic scales and harmonic progressions. The first tone sequences they wrote were highly structured but then succeeding melodies were altered and the structural rules were relaxed. Listeners rated the structure of the thirty-two melodies on a six-point scale. The melodic sequence that received the highest structural rating was the diatonic sequence based on I-V-I harmonies that began and ended on the tonic and contained a leading tone to tonic ending (Cuddy et al., 1979; Cuddy, Cohen & Mewhort, 1981). It was determined that even people without musical training could discern harmonic structure within a diatonic melodic line but that non-diatonic sequences could not be so easily discerned. Movement away from the underlying I-V-I structure was perceived as disordering the structure. The researchers suggested that there may be multiple structures existing in a hierarchy that support melodic perception. They concluded that

individual pitches are coded with respect to the tonic, dominant, or other harmonies. There is a hierarchy existing in which notes of the tonic take precedence over other diatonic tones, which take precedence over non-diatonic tones (Cuddy, 1982). Krumhansl and Shepard (1979) determined that single tones of a melody can be interpreted and remembered because of their tonal function and organization within the diatonic scale. They also found that the melodic information connected to underlying harmonies helps to establish tonality for the listener.

The information from these studies was available to Edwin Gordon and may have influenced his ideas concerning audiation of tonal patterns. Gordon has gone further than any of his predecessors in describing and labeling harmonic functions of tonal patterns. Students are taught to recognize and label harmonic functions of the major, minor, and modal scales after they are learned through imitation.

The Kodály Method provides the context necessary for accurate sight-singing. Intervals of the major and minor scales are taught in the context of their relation to the tonic pitch. Provision is made for teaching Phrygian, Lydian, and Mixolydian modes through their individual relationships to either major or minor scales. Students are taught to vocally harmonize the primary and secondary chords in both major and minor tonality using solfège syllables (Choksy, 1999, pp. 168, 170).

Boyle and Lucas (1990) studied how context affects college students' ability to sight-sing tonal melodies either with or without a tonal harmonic accompaniment. The research was based upon the research of Cuddy (1982) and Krumhansl and Keil (1982), which suggested that melodic expectations are a reflection of previous experiences with a tonal harmonic framework. Boyle and Lucas believed that sight-singing in a tonal harmonic context is similar to what students do in chorus when they sing familiar and

unfamiliar music with piano accompaniment in a vocal-harmonic context. Thirty undergraduate music majors were asked to individually sight-sing eight unfamiliar melodies twice, once with a tonal-harmonic accompaniment and once with no accompaniment. There was a 1-week interval between recorded sessions. The students could use any sight-singing technique they preferred. The eight melodies came from standard sight-singing literature and were notated in the keys of C, F, and G Major and e, d, and g minor. The researchers found that the students who sang with a tonal harmonic accompaniment sang with significantly more accuracy than the students who sight-sang without accompaniment. It is unclear from this study whether the students had had prior training in solfège or aural techniques.

Lucas (1994) further investigated the influence of harmonic context on the sight-singing skills of middle school students. She formed four harmonic contexts within which the students were tested; melody alone, piano harmony, vocal harmony with the melody in the top voice, and vocal harmony with the melody in the bottom voice. The melodies used for testing were taken from a standard sight-singing text. The subjects who obtained the highest scores were the ones tested in the melody-only context. In addition, there was little difference between the melody-only and piano-harmony groups. Apparently sight-singing in the presence of vocal harmony was confusing for middle school students. "For middle school students it is apparent that testing using melodies isolated from direct harmonic context yields higher sight-singing performance than using melodies in either a piano or vocal harmonic context, and that instruction within a melody-only context is superior to instruction within a vocal harmonic context" (Lucas, 1994, p. 215).

Even though students were sight-singing in melody-only context there is still the context of each tone in relation to the tonic and the harmonies that are outlined by the tones. This tonal context was apparently all that was needed for accurate sight-singing at the middle school level. It may not be necessary to hear an accompaniment in order to sight-sing. It seems that using an accompaniment might deviate from the strict definition of sight-singing, which is to sing an unfamiliar melody at sight without having previously sung it or heard it played on an instrument. This study's findings contradicted the finding of Boyle and Lucas (1990), and Lucas attributed the different finding to the age of the students.

Killian (1991) investigated the possible relationship between sight-singing accuracy and error detection ability in junior high school choir students. Seventy-five students studied sight-singing using *Keys for Sight-Reading Success*, Book 1, by Leach, Hemmingway, and Wehrung (1983). One-half the class read the exercises by seeing and singing from the first letters of solfège syllables only, and the other half read from standard notation using solfège. The students were tape-recorded singing eight two-measure examples from the text. Rhythm errors were not counted and they were given credit for individual intervals sung correctly even if tonality changed. The students also were given a perception task in which they identified errors in a taped performance while viewing a printed score of the same examples they had sight-sung.

Killian discovered no significant difference between sight-singing from notation and sight-singing from syllables for the eight examples. She discovered that the students who sang accurately at sight were also excellent error-detectors. She noted that the context in which an interval occurred made a difference in performance accuracy. Overall, descending intervals were performed more accurately than ascending intervals.

The finding that students sight-read just as accurately using the first letters of solfège as they did from notation may support the use of solfège letters as part of the sequential progression of difficulty in sight-singing training.

This study is valuable because it points out the connection between pitch perception and error detection. There are numerous studies that have indicated a relationship between pitch perception and error detection ability (Grutzmacher, 1987; Hansen, 1961; Killian, 1991; Larson, 1977; MacKnight, 1975; Sheldon, 1998). Killian concluded that the two skills may be increasingly related as the music to be performed increases in complexity. "If this is true then good sight-singers should do better on perception tasks than unskilled sight-singers and older more musically experienced students should perform better on perceptual tasks" (Killian, 1991, p. 224). While numerous studies have indicated that descending intervals are easier to perform with accuracy, it is not clear why. If enough study of the intervals in relation to tonic has taken place then all intervals should be equally secure.

Summary. Numerous studies from the 1970's onward increased our knowledge about the cognitive processes involved in sight-singing. Deutsch (1970), Cuddy, Cohen and Miller (1979), and Cuddy, Cohen, and Mewhort (1981) investigated the structure of diatonic major and minor scales as an organizing factor in tonal thinking. They discovered multiple structures existing within the scales to support melodic perception. In addition, individual tones were identified within tonic, dominant, and secondary harmonies.

Boyle and Lucas (1990) investigated the sight-singing abilities of college students within the contexts of accompanied or unaccompanied melodies and found that students performed more accurately with a piano accompaniment. Lucas (1994) utilized

four different contexts with middle school students and discovered that these students sang more accurately in a melody-only context. Killian (1991) investigated the relationship between sight-singing and error detection ability in junior high choir students. She discovered that excellent sight-singers were also excellent error detectors and that the context in which an interval occurred affected performance accuracy.

Instrumental Sight-Reading

The following paragraphs are intended to draw distinctions between vocal sight-singing and instrumental sight-reading. Some studies involving instrumental sight-reading or error detection are also presented. Instrumental sight-reading and vocal sight-singing apparently involve quite different cognitive operations. In fact, the only common bond between the two is the fact that the reader is looking at unfamiliar notation. "Sight-reading means performing from a score without any preceding practice on the instrument of that score" (Deutsch, 1999, p. 509). It involves reading distinct patterns of notes all at once in order to maintain a set tempo. The object is to "read note patterns coming up in the score while simultaneously performing notes just read" (Deutsch, 1999, p. 509). Sight-reading involves decoding a symbol in order to push a key on an instrument or blow air with a certain degree of intensity (Gordon, 2003). Sight-reading is immediate and must be implemented anew with each new piece of music but the skill can be improved with practice over time.

Sight-reading on an instrument has as much to do with eye as with ear. Sloboda (1974) discovered that the good sight-reader places chunks of material in short-term memory. The eye movement is quick as the eye stops and examines visual information and then moves on to the next visual point of interest (Hodges, 1992). Information comes to the visual store while the eye is focusing on an area about one inch in diameter

(Hodges, 1992). Previewing music before sight-reading can allow the sight-reader to focus on larger features and skip over smaller details. Experienced readers can scan up to seven notes in performance (Sloboda, 1974).

By contrast, the process of sight-singing is one that is learned slowly as students recognize and rehearse each interval or melodic pattern until the sound and sight of each has been placed in long-term storage in the brain. Accurate sight-singing is the goal of this process. The ability to sight-sing unfamiliar melodies is acquired over time and once in place should be a permanent skill that can be utilized when needed. Sight-singing may be allied more correctly with memorization. Memorization on an instrument is a skill in which the instrumentalist works slowly with awareness and control of each note until the motor process and memory for tones and rhythm is secured in long-term memory and can be drawn forth in memorized performance. Sight-reading is a process of instantaneous decoding, which may or may not involve audiation of musical sounds, while sight-singing is a process of performance of memorized sounds. By contrast, "instrumental sight-reading and memorization are different processes. The goals as well as the means are different." This information comes from T. Wolf's study (as cited in Deutsch, 1999 p. 511).

Gordon (2003) describes instrumental sight-reading as a decoding of symbols in order to finger or blow correctly on an instrument. He calls this "meaningless decoding." "The reason for poor sight-reading skill is a lack of audiation skill, not necessarily a lack of instrumental skill" (Gordon, 2003, p. 280). Gordon advocates teaching an extensive audiation vocabulary of tonal and rhythm patterns to students before they are exposed to note reading on an instrument. Instrumentalists would benefit from learning to sing patterns because "tonal and rhythm patterns originate in

the throat and muscles before they are extended to the instrument" (Gordon, 2003, p. 280). When this is done, instrumentalists can bring musical meaning to the reading process by seeing, audiating, and then performing instead of just seeing and performing. "To read vocally students associate syllable names with a tonal pattern in notation and then associate the syllable names with sound in audiation, whereas to read instrumentally, students associate syllable names with a tonal pattern in notation, and then through audiation they associate the syllables with the sound that they produce with their fingers on the instrument. Musicians who bring meaning to notation are singing and chanting tonal and rhythm patterns in audiation as they produce the sound of these patterns with the voice or on instruments" (Gordon, 2003, p. 280).

Grutzmacher (1987) investigated the relationship of tonal pattern instruction using harmonization and vocalization techniques to the tonal concept development and performance achievement of beginning wind students. Two instructional curricula were compared: one course of study used tonal patterns as the content in conjunction with techniques of harmonization on the instrument and vocalization. The other course of study used the single note identification approach in which a range of pitches was taught from notation with an emphasis on instrumental technique.

Fifth- and sixth-grade students studying brass or wind instruments formed the experimental group. This group learned ten major-key and ten minor-key tonal patterns both aurally and vocally through reading notation. They sang long tones, scales, and arpeggios with solfège syllables and then performed them on their instruments. They also played the patterns on their instruments with harmonization. Time was spent recognizing the familiar patterns in new exercises and with new fingerings. Students learned the difference between major and minor tonality aurally and then through

notation. Instruction proceeded from aural playing to music reading. The control group used the same textbook music but tonal patterns, vocalization, and harmonization were omitted. They performed long tones, scales, and arpeggios from notation without harmonization and vocalization. The teacher verbally described major and minor modes while new notes and music symbols were presented through looking at the notation and then fingering on the instrument.

The students were pre- and post-tested using the tonal, aural perception portion of the Iowa Test of Music Literacy, level 2. They were also pre- and post-tested using the Iowa Test of Music Literacy, level 2, tonal reading recognition portion. A researcher-constructed test of sight-reading achievement was also administered. The students who studied tonal patterns through vocal solfège and instrumental harmonization improved their melodic sight-reading skills significantly more than the traditionally trained group. Grutzmacher attributed the results to a shift from dependence on the visual aspect of notation to a combination of both aural and visual perception in reading notation. "A program in which students sing, play, listen, and compare major and minor leads to a higher level of conceptual understanding than definitions alone can provide" (Grutzmacher, 1987, p. 177). Students improved their music reading skills due to a combination of aural skills training through singing and playing on the instrument. It seems likely from this study that there may be a connection between singing and playing an instrument in aural skills acquisition. Perhaps the hearing of the pitch vocally and then instrumentally reinforces the sound of the individual tones and their relationship to each other and to the tonic pitch. In addition, the same process of vocal training using solfège that leads to sight-singing and aural skills development may also lead to sight-reading improvement in instrumentalists. The

results support Gordon's suggestion that students who are trained aurally before starting an instrument become better sight-readers because of their audiation ability.

Sheldon (1998) used sight-singing training with solfège to improve the error detection abilities of future band directors. The instrumental music majors received 11 weeks of instruction in solfège syllables using children's songs and progressing to phrases extracted from beginning school band repertoire. The pre-test and post-test consisted of excerpts from band literature. The control group was given traditional band methods training. At the end of 11 weeks, the subjects receiving sight-singing and aural training using materials from band repertoire were significantly more accurate in identifying pitch and rhythm errors in the band literature and were less likely to assume errors when compared to the control group. Sheldon concluded that a "systematic approach to sight-singing and ear training and the use of context specific materials may assist in the development of error-detection skills in the novice conductor" (Sheldon, 1998, p. 394).

The conducting students were tested on the same materials they had studied through solfège training for 11 weeks. After that much study, the materials should have been very aurally familiar and this would result in error detection success. A more revealing approach may have been to train the conductors in solfège for 11 weeks and then present them with the performance of unfamiliar music in which they must detect errors from the score as they listen. This situation would be more similar to the error detection tasks of most instrumental and choral conductors. It would be interesting to determine if 11 weeks would be a long enough period to allow for the development of sufficient skill that would result in efficient error detection ability.

Elliott (1974) investigated the effect of using vocal techniques to improve sense of pitch in beginning band class students. His subjects were 196 wind students in beginning band classes at six public schools. All of the students were similar in academic achievement and participation in extracurricular music activities. They were pre-tested using the pitch discrimination and tonal memory portions of the Seashore Measures of Musical Talent. In addition, they were tested on a researcher-constructed test to measure their ability to match music heard aurally with musical notation. The Kwalwasser Ruch Test of Musical Achievement, third portion, which measures mental ability to convert notated music to musical sound, was also administered. Students heard familiar melodies and were instructed to pick out the measures in the score that contained pitch errors.

All students were taught from the *First Division Band Method*, parts 1 and 2. The experimental group was taught to vocalize pitches and exercises from the text using a neutral *la* syllable. The exercises were played, sung, and played again. The control group received standard instrumental band training consisting of identifying pitches and playing them. The classes were taught for one period a day for one school year.

For the pitch discrimination and tonal memory subtest the experimental and control groups posted similar scores. However, the experimental group scored significantly higher on three of the four subtests of the Seashore Measures. They excelled in matching music perceived aurally with musical notation (part C) and converting musical notation to musical sounds (part D). The researcher extracted the students with piano experience (34 out of 97 in the control group and 28 out of 99 in the experimental group) and compared their scores. The results indicated that for subtest C (ability to relate musical sounds to music notation) and for total score, pianists in the

control group scored higher than non-pianists. Pianists in the experimental group scored higher than non-pianists on subtest C. Pianists in the experimental group, however, scored higher on the post-tests overall than pianists in the control group. Students who performed in outside vocal groups scored no higher on average than those not participating in vocal ensembles.

Elliott concluded that private piano study affected the sense of pitch in both the groups. His findings agreed with those of Stecklein and Aliferis (1957). "Pianists on average possess a greater ability than do non-pianists to visualize music notation heard aurally" (Stecklein & Aliferis, 1957, p. 128). Elliot also concluded, "regular practice in vocalization during instrumental music class may compensate somewhat for the absence of private piano study" (Elliott, 1974, p. 128).

This study used standardized tests with good validity and reliability. There was a clear distinction between the content of instruction in both experimental and control groups. The same amount of time was given to instruction for both groups. This study supports both aural training and piano study as strong contexts in which to develop aural imagery or the ability to visualize music notation heard aurally. Since this is the skill necessary for accurate sight singing, the study seems to support the use of piano keyboard training with aural skills training.

The researcher did not consider the possible connection between the tactile reinforcement of singing and then playing the pitches on the instrument. This study discovered significant improvement in aural skills development by instrumentalists who both sang and played on musical instruments as they read music notation. Hearing the pitches sung by their voices and then hearing the sound on the instrument may have served to reinforce the learning.

Summary. Instrumental sight-reading and vocal sight-singing may involve different cognitive operations. Sight-reading is a process of decoding symbols while maintaining a steady tempo with an immediate goal in mind. By contrast, sight-singing is a process of slowly learning intervallic sounds and connecting them to notation, which may be more closely related to memorization. Grutzmacher (1987) measured improvement in the melodic sight-reading ability of elementary band students who were taught using vocal techniques. Elliott (1974) taught band students using vocal techniques and discovered that the band students with prior piano training possessed a greater ability to visualize music heard aurally. Sheldon (1998) utilized vocal training with solfège to increase the error detection abilities of novice instrumental conductors.

Keyboard Experience

The following section serves to explain the reason for the use of the term "keyboard experience" to describe the program of portable electronic keyboard reinforcement utilized in the present study. In the 1950s, the emphasis among music educators was on conceptual learning. Many educators argued that while the piano was the ideal instrument for teaching concepts, all students didn't learn to play the piano through class instruction. "The term keyboard experience was officially created, as far as music education is concerned, in March, 1950, at the Biennial convention of the Music Educator's National Conference at St. Louis, Missouri" (Bodecker, 1969, p. 50). Keyboard experience can be defined as "using the piano informally as a teaching aid in class during the general music period to illustrate pitch relations, rhythmic patterns, basic harmonies, expressiveness, and encourage creative impulse toward music" (Music Instruction Committee, 1952, p. 12). It was originally envisioned that this instruction be carried out either by the regular classroom teacher or by the music specialist.

Raymond Burrows, National Piano Committee Chairman and President of MENC, devoted much of his life to the establishment and extension of class piano as part of the music education program. In his view, the good piano class included song singing and extended this to the keyboard so that the piano became a physical outlet for what was heard in the music. Burrows and others in this decade stressed the importance of creativity at the keyboard, not only in creating new compositions, but in the development of improvisational skills. It was believed that through the piano, music reading and harmonization could be more easily taught (Music Instruction Committee, 1952).

Robert Pace was another music educator of this period who kept alive the principles of sound musical education through class piano or keyboard experience. Pace was head of the Class Piano Department at the Teacher's College, Columbia University, was also piano editor of the *Music Educator's Journal* and chairman of the piano committee of the Music Educator's National Conference. In his book *Piano for Classroom Music*, published in 1956, he emphasized the use of familiar songs to enable students to make music right from their first class piano lesson. He stressed the importance of teaching the harmonization of melodies, transposition, sight-reading technique, and creative activities. Pace was also a proponent of the informal use of piano in the classroom as a teaching aid during general music class. The piano provided individual keyboard experience for students and was used as a resource instrument by the teacher to highlight music understanding (Richards, 1962).

The increased technology of the 1980s and 90s up to the present has produced small portable keyboards, which can be connected to a computer by means of a MIDI interface. A number of new software programs have been written in recent years that

allow students with minimal keyboard skills to compose simple melodies and have them printed out via the computer. Other software programs allow students to layer sounds under their melodies, thereby composing a finished instrumental composition. This mode of operation allows students to be creative with music while requiring very little playing skill (Muro, 1990). This technology provides another type of individual keyboard experience.

It is clear that there are precedents for using the piano keyboard to teach music skills in public school music education, whether by the teacher in demonstration of musical concepts or by the student in direct hands-on experience with those skills. The portable electronic piano keyboard will be used in the present study in the way that Burrows and Pace envisioned in the 1950's; to provide students with hands-on piano keyboard experience that serves to reinforce a musical skill, sight-singing.

Information Processing

The four sections that follow present theories and research supportive of the pairing of sight-singing with electronic piano keyboard experience. This section presents the cognitive theory known as Information Processing, and includes various memory strategies that are utilized within this theory. The relationship of this theory to keyboard reinforced sight-singing training will also be presented.

The Information Processing paradigm of cognition emerged in the 1950s and 60s when developmental psychologists began to compare the human mind to a computer. The capacity of human memory and its speed of processing can be compared to computer hardware. Likewise the ability to use strategies and other learning devices can be compared to computer software. While the mind probably does not function

exactly like a computer, information processing is one of a number of cognitive theories currently being researched (Bjorklund, 2000).

In 1968, Atkinson and Shiffrin suggested a multi-store model of memory, in which information from the world is coded briefly in sensory registers, one for each sense modality (auditory, visual etc.). This information is only held there for milliseconds before it is passed to the short-term store, called working memory. "Working memory describes a workspace in which to maintain information while it is being processed" (Bjorklund, 2000, p. 122). Since information in this store lasts for seconds, there is time to evaluate it. The capacity of working memory is limited, however, and if something is not done with the information it is lost. If a cognitive operation is applied to the information in the short-term store, it can be transferred to the long-term store where it will be retained for months or years.

Two types of information can be encoded in long-term memory. Declarative knowledge generally refers to the kind of knowledge that is explicit and can be brought to mind as an image, such as facts, lists, and events. This information is called domain-general knowledge. Procedural knowledge includes procedures and familiar routines (Bjorklund, 2000). Skills are expressed through procedural knowledge and must be carried out in performance (Squire, 1987). Within the Information Processing paradigm procedural knowledge is called domain-specific knowledge.

Memory strategies. Information is encoded into long-term memory through the use of memory strategies. Some commonly used strategies are rehearsing, categorizing, and elaboration (Kail, 1990). In rehearsal, target information is repeated over and over. With enough rehearsal the information will move into the long-term store and be available for retrieval at any time. The sight-singing training in the present study

involves much repetition of melodic tonal patterns, first through imitation of what is heard aurally, and then through repetition of what is heard and seen simultaneously. The addition of the keyboard as a reinforcing experience adds another layer of tactile and kinesthetic rehearsal to the aural and visual. Singing and playing the keyboard simultaneously should be powerful rehearsal, providing much information about the distance between intervals and the relationship of each interval to the tonic. "Children beyond age seven rehearse spontaneously and do so with increasing proficiency as they get older" (Kail, 1990, p. 11). Rehearsal should be an effective technique for use with the high school students of the present study.

In categorization, groups of items are lumped together for ease of memory. In elaboration, images may be connected to information to form a more elaborate scheme for remembering. For instance, one could picture a car hood to remember to have the car serviced on the way home from work. Picturing the piano keyboard can be a useful elaboration strategy for remembering the pitches that need to be written in melodic dictation exercises. Imagining the keyboard can also be helpful when singing the intervals and imagining oneself fingering the instrument can help in pitch placement. Another encoding strategy is the use of external devices as memory aids. The spatially arranged solfège letter cards and the notation cards with solfege and without solfège letters are designed to tie the memory of interval sounds learned in the training with the symbolic representation of those sounds. After enough rehearsal with cards and keyboard, students can begin to recognize and hear the sounds though aural imagery in longer unfamiliar melodies.

There are age differences in the speed with which sensory information is transmitted to the short-term store. Young children can register and hold visual

information but are less able to get this information to the short-term store where they can process it. Case (1985) devised the total processing modes to explain why students process more efficiently with age. An individual's total processing capacity equals the operating space for current and cognitive processes plus short-term storage space. Processes are executed more efficiently with age so they take up less operating space. A larger part of total processing can therefore be devoted to the short-term store (Bjorklund, 2000). High school students, with their larger processing capacity, should be ideal candidates for the multiple aural, visual, and tactile rehearsals that will create aural imagery by moving the sounds from short term to long-term memory.

Information processing and keyboard reinforced sight-singing training. Information processing and memory theories help to explain what happens in keyboard reinforced sight-singing training. Sight-singing and performance on keyboards is defined in information processing theory as procedural knowledge. In the present study there will be a great deal of sensory information entering the visual, auditory, and tactile registers. In addition, there will be kinesthetic motor activities of hand and arm movements both in the air (hand signs) and on the keyboard (fingering). As these sensations are placed in short-term memory storage, the student will begin to give meaning to them. In order to keep the sound of the aural patterns in short-term memory there will be much rehearsal through singing and playing. First, there will be just the aural vocal sensations, then the visual store will receive messages from the syllable and notation cards, then the hands will feel and measure the intervals on the keyboard, then the voice and fingers will work in unison as the ear hears both the sound of the voice and the sound of the instrument simultaneously. All of these overlapping sensations are aimed at moving the sounds of intervals connected to tonic or tonal center into long-

term memory storage where they are available for retrieval when sight-singing unfamiliar melodies. The portable electronic piano keyboard is being used as a tactile memory strategy. The goal of its use is to aid in the memorization of intervallic patterns of melody by tactile rehearsal. Its use in this study can be justified as an aid to information processing.

Multiple Modality Learning

Recent work by memory theorists indicates that there are multiple working memory stores rather than just one. These multiple stores are mostly associated with auditory and visual processing. If auditory and visual systems are independent, then the size of working memory might be increased by presenting information in a mixed (auditory and visual) mode rather than in a single mode. This has been termed dual-mode processing. Alport, Antonis, and Reynolds (1972) found that people could listen to and repeat auditory speech while sight-reading piano music. This suggested that more capacity was available when two modalities were used.

Mayer and Anderson (1995) applied the theory of multiple modalities to instructional techniques in education and found that simultaneous presentation of visual and aural material was superior to successive presentation. In their 1999 study concerning multimedia learning with animation, Moreno and Mayer further tested the modality principle. In one experiment three groups of college students were presented animated versions of an explanation for lightning. One group listened to narration while viewing a picture, one group viewed a picture with an explanatory text spatially arranged close by, and the remaining group viewed a picture with the explanatory text spatially arranged at a distance. After viewing the animations, the three groups were tested on knowledge of lightning. The group who heard narration as they viewed the

picture scored higher than either of the text plus picture groups. Moreno and Mayer concluded that more information is likely to be held in both auditory and visual memory rather than in just one working memory. They also concluded, "the combination of auditory verbal materials with visual non-verbal materials may create deeper understanding than the combination of visual verbal materials with visual non-verbal materials" (Moreno & Mayer, 1999, p. 366).

Sight-singing training consists of auditory verbal material in the form of the singing of solfège syllables, first through aural imitation. Notation cards, notated melodies, and keyboards are non-verbal materials. These auditory verbal and non-verbal materials will be used simultaneously. If the dual mode principle of working memory is correct, sight-singing from notation while playing keyboards may allow students to increase their effective working memory capacity, which may result in faster, stronger learning.

Shehan (1987) investigated rhythm learning in second and sixth graders by comparing the effect of using rote training or note presentation training. Patterns of rhythm were presented in four different modes to the children. The rhythms were presented aurally as played on a woodblock, through the voice using syllables, and in notation as they were heard on the woodblock. Finally, rhythms were heard in vocalization as they were seen in notation and repeated in rhythm syllables. Students who saw notation as they repeated rhythm syllables showed significantly more improvement than students who received aural training only. Sheehan concluded that for beginning music-readers, the blending of aural and visual strategies may best facilitate the learning of rhythm patterns. Seeing the patterns while hearing the syllables

and then saying them proved to speed the learning of the rhythm patterns at both grade levels. This research supports the dual-processing theory of learning.

Keyboard Research

The following section presents the results of research linking piano keyboard training with the development of aural skills and specifically sight-singing skill in students of all ages. Studies by Bogard (1983), Bodecker (1969), Colwell (1963), Curt (1990), Daniels (1986), Demorest and May (1995), Finnell (1974), Hansen (1961), Hargiss (1960), Henry and Demorest (1994), Jones (1971), Lyke (1967), May and Elliott (1980), Martinez (1976) Stecklein and Aliferis (1957) and Wig and Boyle, (1982) will be presented.

The first two studies presented were conducted with college students. Hargiss (1960) examined the acquisition of sight-singing ability in college level piano classes. Her subjects were elementary education majors at the University of Kansas. One integrated music class was required for all elementary education majors; functional piano skills were taught separately. She wanted to determine the results of teaching sight singing, ear training, and theory in the piano lab in connection with keyboard instruction. She thought this would provide the students with needed piano skills while improving their ability to perceive meaning in music notation as they sang. She based her idea on the earlier work of her teacher, E. Thayer Gaston. In his 1938 study, he described the piano keyboard as a space frame in which tonal relationships could be seen and touched as well as heard. Gaston viewed melody as a sequence of tones that arose, historically, directly from the space frame. Music did not progress as an art form until there was a space frame for the organization of musical sound. On the piano keyboard, melodic pitches are laid out in an organized arrangement of half and whole

steps that can be seen and felt and measured spatially with the fingers. This arrangement is a space frame for musical sound. Gaston conducted research studies on pitch discrimination in adults and found that those who were able to judge pitch relatively with precision had had experience with some sort of space frame (Gaston, 1938). Hargiss reasoned that the piano can provide the space frame for the perception of tonal relationships, but actual singing requires vocal practice. The student can provide himself with vocal motor imagery if he sings as he plays.

Hargiss quoted S. Cobb's book *Borderlands of Psychiatry* (1943), and his discussion of motor learning and eupraxia. This term refers to the function of higher thought processes in motor activity. "All complex motor acts must be thought of and rehearsed mentally before they can be performed expeditiously. This is eupraxia, the learning of motor skills by symbolic thinking" (Cobb, 1943, p. 34 as cited in Hargiss, 1960). This principle can be applied to the vocal apparatus and its related motor processes, which are involved in sight-singing as well as the motor processes related to keyboard performance.

Hargiss divided the 64 students into three groups based on intelligence and musicality. An existing college intelligence test score was used as an intelligence indicator. Next, the Knuth Music Achievement Test was administered to measure the ability to perceive meaning in music notation. The Gaston Test of Musicality, parts two and three, which assessed overall musicality, attitude, and musical background were also administered. The researcher, in consultation with professional piano teachers, devised a piano test. Four pieces representing four increasing levels of piano difficulty were chosen for sight-reading. The test also included playing by ear and improvisation sections. For the play-by-ear portion, the student was asked to pick out a familiar tune

with one hand and then play whatever they could with both hands. Student performances were graded subjectively on a 20-point scale. Students were also asked to improvise on a familiar melody with one or both hands. This was also rated subjectively on a 20-point scale. The sight-singing test consisted of five songs judged by three members of the music faculty to represent five degrees of difficulty in sight-singing. Students were rated on a scale of 1 to 100 and judged on-the-spot from live performance.

Individual scores from all these measures were combined into one numerical rating for each student. These were converted to *z* scores and used to determine the groupings at the beginning of the semester. The 15 highest were placed into level three, the next 34 were placed in level two, and the 15 lowest were placed in level one. At each level, experimental and control lab groups were formed for a total of six groups in all.

The control group laboratories were taught music theory, playing by note, chording, improvisational skills, playing song accompaniments, and rhythmic skills. When the students saw notation it was immediately felt and heard at the keyboard. Sharps, flats, octaves, semitones, and major and minor key relationships were studied through the playing of major and minor scales. Students studied intervals, phrases, and shape of melodic lines. Harmonic training involved triads and seventh chords as well as their inversions. Block and note-chord accompaniment styles were used and students were taught to modulate and transpose to different keys. Performing and sight-reading were always connected with music theory.

In the experimental lab the same material was introduced but there was an insistence that students sing everything as they played. There was a consistent tying in

of the motor-visual with the aural-vocal. As the examples lengthened, the students played first and sang afterward. They gradually developed the ability to sing what they saw symbolized without playing it.

Hargiss described the process as a "total Gestalt, which once established, could function as a whole even when only part of it was present" (Hargiss, 1960, p. 69). By "total Gestalt" she meant that the image of the keyboard and the sound and feel of the intervals could still be present in the mind and contribute to the sight-singing performance of unfamiliar melodies even when the keyboard was not being played.

After fifteen weeks of study with only one hour per week in the piano laboratory, the groups were all given the same Knuth, Gaston, and performance measures that they had received on the pretest. For the performance measures, the jury of three musicians was given a rating score tape to listen to which served as a standard of excellence. They then listened to each student perform and rated them on the spot. The mean of the three judges' scores was computed for each performance.

The data were analyzed in various ways. The *t*-test for correlated measures was used to determine the significance of the difference between the means of the pre-test and post-test for each student. *T*-ratios were computed for the scores on each of the four tests at each level of each group. The Analysis of Covariance was computed to compare the achievement of all groups holding intelligence and pre-test score constant. For the sight-singing measure the *t*-test for independent groups was used to assess the difference between the means of the sight-singing pretest scores and the means of the sight-singing posttest scores. The significance of the variance from pre-test to post-test was determined.

In terms of the Knuth Achievement Test, significant gains were made equally by the experimental and control groups. On the Gaston Test of Musicality the experimental group made only a slightly greater gain than the control group. In terms of piano performance all students gained, but the experimental group did not make a greater gain than the control group. In sight-singing, the experimental group made a much greater mean gain from pre- to post-test than the control. The results of this test were significant at the .001 level. An interesting fact was that the pre-test of the experimental group was actually lower than the control group: a mean of 17.47 versus 23.87. The post-test score of the experimental group was much higher than the control group: 42.47 versus 29.37. Students who did not sing and play showed improvement but not as much as those who sang and played simultaneously.

Hargiss concluded that "understanding of music fundamentals and the development of several kinds of imagery, which are provided by instrumental experience, are important and may of themselves enable many persons to sing at sight to some extent, but the addition of vocal practice and its motor imagery enables them to develop the ability much more rapidly and effectively" (Hargiss, 1960, p. 72).

The major weaknesses in the Hargiss study were the validity and reliability issues associated with the performance tests. She did not perform pilot studies for these measures and no validity and reliability information was given. The rating scales for the measures were not explained so it is impossible to know how the judges allotted the 20 points used to judge the sight-singers. It is unclear whether the grading was totally subjective or whether guidelines were given. The judging may have been more fair and accurate if the student performances had been taped and then listened to more than once by the judging panel.

The fact that Hargiss was able to post such sight-singing gains with non-musicians in 15 weeks of training with only one hour of instruction per week indicates that simultaneous keyboard and singing performance can be a powerful tool in sight-singing training. It is interesting that all three of her sight-singing groups scored higher in spite of their differences in intelligence and musicality.

Bogard (1983) conducted an experimental study for 30 weeks with college students. She was interested in finding out if an interrelated approach to teaching sight-singing, ear-training, music theory, and class piano would be more effective than teaching each subject separately. Her subjects were 16 freshman music education majors whom she divided into experimental and control groups. All students received three periods of lecture in music theory, two periods of ear-training and sight-singing training, and two periods of piano class. Both groups got the same lectures in music theory. The difference was that the experimental group met in the electronic keyboard laboratory for both sight-singing and ear-training and for piano instruction. These two classes were taught in an interrelated approach using the keyboard for understanding as well as skill. The control group received conventional sight-singing and ear-training in a regular classroom setting and conventional class piano training. Pre-tests using the Aliferis Music Achievement Test and the Seashore Measures of Music Talent indicated that the groups were evenly matched in musical ability. There was a piano skills pre-test given that indicated that the groups were almost identical in beginning piano skill. Post-tests given included identical Aliferis Achievement Tests, a theory final exam, an ear-training final exam, a sight-singing final exam, and a piano posttest. The experimental group scored significantly higher on the Aliferis Test. There was, however, no significant difference between the groups on the other four measures.

It was unfortunate that Bogard used such a small number of subjects because it is difficult to generalize findings with a total *N* of 16. There was a lack of a detailed accounting of exactly what instruction the control group received, which allows for no clear distinction in how their instruction was different from the experimental group. The two piano groups used different method books and different pieces to sight-read and play by ear but there is no discussion of why this was done or how this may have affected the outcome. There were more pieces in the popular genre given to the experimental group, while the control group was given folk and patriotic music. The experimental group sang as they played but it is unclear what procedure was followed with the control group.

The following two studies involved adult musicians. Hansen (1961) sought to determine the background factors that the best sight-readers have in common. The research was conducted on musicians either preparing for a career in music or actively engaged in one. The subjects were tested on their ability to detect melodic and harmonic errors in the performance of choral music while inspecting the score. After this, they were given a background questionnaire to elicit information about their amount of training in music theory, principal performing instrument, length of study on the instrument, keyboard facility, directing experience, vocal part sung in an ensemble, age, and sex. Hansen found that ability to detect errors in score reading significantly correlated with the following factors: piano as a performance medium, piano training for at least six years, ability to play hymns and simple accompaniments at sight on the piano, the ability to improvise piano accompaniments, and one or two years of theory. It may be significant for the present study that not only piano playing ability but the ability to improvise, which is often considered an extension of aural skills ability among

pianists, is also considered an important factor in score reading proficiency. It is another indication that aural skills ability and keyboard experience are connected. Hansen concluded that instruction on a keyboard instrument is the best background for high achievement in score reading.

Stecklein and Aliferis (1957) sought to investigate the status of applied music study in the United States and the relationship between a student's type of instrument (including voice) and his achievement in audio-visual discrimination. The subjects were 892 freshmen college music majors from 68 four-year colleges, universities, and conservatories that were accredited members of the National Association of Schools of Music. The students were tested using the Aliferis Music Achievement Test, which was standardized in 1950. The test was used to measure the degree to which students could detect discrepancies between notated and aurally presented music examples. Samples of string, woodwind, brass, percussion, piano, and voice students were tested. The Aliferis Music Achievement Test measures auditory-visual discrimination ability. This ability to discriminate differences in what you hear as you look at notation is one of the discriminations needed for sight-singing. The test contains information on validity and reliability and has been widely used in music education testing for many years. The test consists of three sections, melodic, harmonic, and rhythmic. The melodic section utilized the discrimination of two tones or melodic groups of four tones, the harmonic section consisted of single four-voiced chords or harmonic progressions of three chords, and the rhythmic section presented rhythmic figures of one-beat duration or two-beat combinations of rhythmic figures.

The results revealed that piano students ranked first in harmonic discrimination and a close second to violin students in melodic discrimination. Auditory-visual

discrimination is the skill that is involved in expert sight-singing. Stecklein and Aliferis concluded, "pianists on average possess a greater ability than do non-pianists to visualize music notation heard aurally" (Stecklein & Aliferis, 1957, p. 128). The study used a robust *N* of 892 and the procedures were well-controlled.

May and Elliott (1980) also investigated the piano in regard to aural skills development. They sought to determine the relationship among participation in public school performing ensembles, the skills measured by the Gaston Test of Musicality, the number of years of private piano study, and the number of years of private instruction on ensemble instruments. The subjects were 164 junior high school students. The Gaston Test of Musicality was administered to these students when they were in fourth grade. The test consists of a questionnaire, which elicits information about student preferences for various musical activities and the importance of music in the home, and a series of aural tasks. The first task consists of five items involving the sounding of a single tone followed by a chord. The subject is asked if the single tone is present in the chord. For the next five items, a melody presented aurally is compared with music notation. The student indicates whether the two versions are the same, whether the rhythm is different, or whether the pitches are different. There are five items in which a melody is played with the last note omitted. The student indicates whether the missing tone should be higher or lower than the last note sounded. The final seven items each consist of a melody that is repeated from two to seven times. The student indicates whether each repetition is the same as the original, whether the pitch changed, or the rhythm changed. Reliability for the Gaston measure is reported as .88 for grades 4 to 9 and .90 for grades 10 to12.

In seventh grade the students were assigned to band, chorus, or a combination group. They were again tested with the Gaston measure. There were no significant differences among students at the fourth grade level. However, at the seventh grade level the differences were significant. Years of private piano study were found to be a significant independent factor in the development of aural skills. The choir group was low scoring and private study of other instruments was not found to be a factor in aural skills development either. The researchers included piano training as only one of many types of instrumental training studied, however it emerged as the most significant factor in the development of the same aural skills that are needed for sight-singing.

Colwell (1963) conducted a longitudinal investigation of the music achievement of 4,000 students in one school system from grades 5-12 for one school year. The students were categorized as vocal, vocal-instrumental, or instrumental students. The students were tested with the Knuth Achievement Test, a measure with acceptable validity and reliability for the application that is widely used in music education testing. In addition Colwell administered the Aliferis Music Achievement Test and the Farnum Music Notation Test, also standardized measures. The auditory-visual discrimination element from each test was evaluated. In the Aliferis Test, students selected from music notation items heard played on the piano. The student chose which music notation out of four choices matched a melody, rhythm, or harmony heard played on a tape recording. On the Farnum Test, students looked at four-measure melodic phrases and determined which single measure in each score was different from what was heard. For the Knuth Test, students heard a four-measure phrase performed by piano. Their scores contained only two measures and the students were asked to select the correct last two measures from four choices provided. Additionally, the students were compared

regarding cumulative academic grade average, intelligence quotient, music aptitude, and attitude toward music.

One thousand two hundred ninety-eight 5th and 6th graders were included. Students classified as vocal received 90 minutes of general music per week plus a 45-minute chorus period. Students classified as vocal-instrumental received general music and 45 minutes of instrumental training. In addition, students studying piano privately were included for consideration and weekly practice records were kept for all students. Eight hundred thirty-two 7th- grade students were enrolled in a concentrated music course for one semester. A chorus program and an instrumental program could be elected for the full year. Students were categorized as instrumental, instrumental and vocal, and vocal. They were tested in fall and spring with the Knuth and Farnum tests. Six hundred eighty-two 8th graders and four hundred sixty-five 9th graders elected either choral or instrumental music. The effects of piano, outside practice, and outside musical experiences were considered. Students in high school elected either instrumental or vocal music. The Aliferis Test was administered in fall and spring to these 583 students. Results of the testing at all grade levels indicated that instrumental students showed higher achievement test scores than vocal students. However, students who received years of piano training, whether in instrumental or vocal groups, showed higher achievement than those who did not. In addition, academic grade average, I.Q., music aptitude, and attitude scores were highest for students studying instruments and piano. This is an early study indicating the value of piano instruction in musical achievement. "Throughout the entire study indications were present that piano training is the most significant factor in high achievement. For example, when sixth grade vocal-piano and instrumental students were compared, four items were not significantly different: grade

average, intelligence quotient, music aptitude, and attitude. In the area of achievement measured by the Knuth Tests and by the grades given in classroom music, however, the piano students were significantly higher" (Colwell, 1963, p. 128). The musical element evaluated in this study was auditory-visual discrimination, the ability to hear what is seen in notation. This is one of the components of sight-singing ability and it is clear from the study that the piano-trained students possessed this skill to a greater degree than vocal or instrumental students.

The following three studies investigated various aural skills through use of keyboard training at the elementary school level. Lyke (1967) used a program of keyboard experiences in elementary school to improve children's listening ability. The experimental group consisted of four classes of fifth graders (n=100) that met for 15 weeks. They studied melodic and harmonic music reading, improvisation and transposition, playing by ear, and sight-reading through use of the keyboard. The treatment consisted of studying the range of the keyboard; simple finger patterns; the lettering of the keyboard; sharps and flats; I, IV, and V chords; major and minor chords; scalar and chordal patterns in music reading; transposing; constructing scales and chords; thinking in phrase units; authentic and half cadences by sight and sound; analyzing music for melodic, harmonic, rhythmic and formal elements; locating non-harmonic tones; detecting performance errors; playing by ear; performing simple accompaniments with primary chords; playing back dictated melodic and harmonic patterns at the keyboard; aurally differentiating major and minor chords; and sight-reading beginning material. The control group of four classes sang and listened to music. All the students in both groups were pre-tested and post-tested using the Seashore Measures of Musical Talent, Drake Music Memory Test, Farnum Music

Notation Test, Colwell's Music Achievement Test, and the Lyke Keyboard Test. Validity and reliability information is available for all tests except the Lyke Keyboard Test. Results showed significantly higher test scores in the keyboard-trained group. Lyke concluded that keyboard instruction clarifies musical concepts and that "pitch discrimination and tonal memory can better be developed through keyboard study than through the vocal program as it now exists in elementary school" (Lyke, 1967, p. 76). The importance of this study is the emphasis on pitch discrimination (based on tonal perception) and tonal memory, two of the constructs of sight-singing skill, which were developed through the use of keyboards. The emphasis on scale and chord patterns in the treatment is similar to the sight-singing training of the present study.

Bodecker (1969) also worked with elementary school children and the keyboard. He studied the effect of teaching specified essential music skills through electronic piano keyboards to 860 third-graders in rural Kansas schools. The control group received regular music class activities while the experimental group of 535 students received keyboard training for 30 minutes a week in addition to 4 days of regular music activities. The experimental group read simple melodies, were introduced to primary chords, transposed to several keys, and practiced sight-reading skills. Bodecker utilized the Wood Boardman Test, an unpublished test designed to examine various music skills. Students were pre- and post-tested using all the seven subtests of the Wood Boardman measure. The experimental group scored significantly higher on five of the seven subtests. Exit surveys revealed a significant improvement in attitude toward school music among the keyboard-trained subjects. Bodecker concluded that the keyboard reinforces learning because chords and melodies can be seen, heard, and felt and that this facilitates better understanding. Because the subjects were all

disadvantaged rural youth who did not have access to piano lessons or other private musical training, the higher results for the keyboard group were likely the result of training. There is no validity and reliability information given for the test and generalization of the results is questionable. Nevertheless, the large number of subjects involved makes the positive results for the experimental group noteworthy.

Jones (1971) investigated the use of a vertically arranged keyboard to improve the vocal performance of uncertain singers in grades two and three of elementary school. The use of the keyboard was compared to the use of the horizontal keyboard and conventional vocal training for improving singing skill. Two boys and two girls from each grade level were selected for a total *N* of eight students. The students were given a teacher-constructed aural and vocal test. The test was constructed on the basis of previous research in auditory perception of children (Petzold, 1963). The vocal tasks on the measure consisted of matching a single tone or matching two or three tones in succession. Students were asked to sing wider intervals in later sections of the test. Aural sections of the measure asked the child to decide whether two tones sounded were the same or different or to listen to a phrase and determine how many tones were heard. A plan to help each child was devised by the researcher based on the results of the testing.

Sixteen lessons lasting 15 minutes each were given over four weeks. The training was given individually using a portable electric organ keyboard for the student. A color was assigned to each letter name on the instrument to help children locate the pitches needed. A light was installed beneath the keyboard, which could be manipulated by the researcher. Students were first taught concepts of high and low and specific letter names of keys. The teacher sang a melodic pattern using pitches the child could sing.

The child then played back the pattern and then sang it. The child always played first and then sang. Songs using *do-re-mi, mi-re-do, do-mi-sol, do-sol-do,* and the intervals of perfect fourth, major third, and minor third were utilized. The light was used to let the child know if his response was correct or incorrect. For instance, the researcher would play a pitch three times and sustain the sound on the third time. The student would then sing with the instrument. If the pitches matched the light would stay on. If the child sang incorrectly, the light went off and the student tried again. The emphasis throughout was on thoughtful listening and then accurate singing. Jones emphasized that the playing served to focus attention on the melodic pattern and tonal direction. At the end of the training, the test of vocal and aural skills was re-administered

A comparison of pre- and post-test scores indicated a marked improvement of all subjects in the performance of aural-vocal skill. The vertical keyboard was found to be more effective than the horizontal keyboard or the conventional vocal methods in aiding uncertain singers. Jones asserted that playing appeared to intensify concentration on the sound resulting in increased singing accuracy. The light increased concentration and reinforced the correct response. This original study indicated the possibility of using the keyboard to help uncertain singers in elementary school. Validity and reliability for the test was not documented, and the study was conducted with a very small sample so the results cannot be generalized. The students were tape-recorded and the tapes were judged by "qualified judges," but Jones gives no information on their qualifications. The measure written by the researcher was quite detailed and sequentially written and was based on prior music education research. The training method was tailored to the needs of each child, which was probably one reason it succeeded so well. Despite the relatively short training period of four weeks, the

keyboard was shown to improve aural skills development as well as vocal development in these elementary school children.

The following studies involved the use of keyboard to teach aural skills to older elementary and middle school students. Wig and Boyle (1982) compared the effects of a keyboard approach in sixth-grade general music and a standard general music approach on student attitudes toward music and their self-concept regarding their own musical ability. It was conducted over two school years from 1979 to 1981. In the first year students from 12 sixth-grade general music classes were taught in three 12-week cycles. Only four classes were involved in each cycle. The classes were randomly assigned to experimental or control groups and were instructed in 50-minute periods on alternate days for 12 weeks for a total of 18 lessons. The experimental group was trained in an electronic keyboard lab. The book, *Keys to Music, Book One* and the accompanying set of five instructional cassettes for 20 lessons as well as student books and instructor's guide were utilized. No information on author or publisher was given for these materials. Simple ensemble and improvisatory activities were written by the researchers to supplement the training.

The control group activities included singing, listening, playing instruments, studying musicians, and studying musical styles. The development of auditory discrimination skill was a focus of this training. The students were pre- and post-tested using the six subtests of Colwell's Music Achievement Tests, levels one and two. These tests assess pitch discrimination, major-minor discrimination, auditory-visual discrimination, and auditory-visual rhythm discrimination. The researcher wrote a measure of keyboard performance skills and understanding of notation, which was used to examine the achievement of the experimental group after training. The researcher

claimed a degree of content validity because the test was based on the material from the training. In addition, the researcher claimed the test was criterion-referenced because it evaluated objectives of the experimental program. The test-retest reliability was reported at .75 for the notation measure.

In year two, the study was repeated with students from two schools with a similar sample size and schedule as year one. The training in the second year relied more heavily on researcher-designed materials and less on the *Keys to Music* kit. The students were again tested with the same Colwell measures. An additional Music Attitude Survey, written by the researcher, was used to assess enjoyment of music, enjoyment of piano, student assessment of his own music skills and abilities, as well as creativity. The test-retest reliability coefficient reported for the measure was $r = .95$.

First-year data indicated a significant difference for the experimental group in meter discrimination and major-minor discrimination as well as the total test. Results for the second year indicate a significant difference for the experimental group on interval discrimination, meter discrimination, major-minor discrimination, audio-visual pitch discrimination and total test. The attitude measure revealed all positive changes in attitude for the experimental group and all negative changes for the control groups.

The second-year findings of improvement in interval discrimination and audio-visual pitch discrimination of the keyboard-trained students is supportive of the use of keyboards in the present study. Very little information is given about the training in this study since there is no publishing company given for the kit and no clear description of the researcher-designed materials. It is unclear why the students in the second year improved their discrimination ability when utilizing the researcher's materials. The positive attitude of the keyboard students could partially be explained by the Hawthorne

Effect; knowledge that they were involved in a special study. The control group's negative attitude could be a result of demoralization based on the belief that the other group was getting a special experience that they were being denied. Despite these concerns, this study does support the use of keyboards with groups of children to teach the types of discrimination skills that are involved in sight-singing training.

Finnell (1973) investigated the comparison between instruction using visual, tactile, and aural learning at the piano and instruction using aural, visual, and vocal training in general music class. The subjects were two 3rd grade and two 4th/5th grade classes in elementary school who were assigned to the two treatment groups: vocal training or piano training. Two additional 4th/5th grade classes from another school served as the control classes and received the post-test only. The training lasted for 8 weeks of nineteen 30-minute sessions.

The researcher taught the four randomly assigned experimental groups and the class teacher taught the two 4th/5th grade control classes. Colwell's Music Achievement Test, part one, which measures pitch interval and meter discrimination was utilized. The Background Test for Class Music, an unpublished musical achievement test written by Robert Pace, was used. It measured pitch discrimination, rhythm discrimination, and knowledge of the rudiments of music. The piano-trained students also received the researcher-devised test to measure knowledge of the piano keyboard and subjects ability to respond to melodic and rhythmic dictation at the keyboard. The researcher pre-tested the four experimental classes using these measures.

The piano-trained group was taught from the method book, *Music for the Classroom* by Robert Pace. Plastic keyboards with raised keys were utilized for each child as well as a dummy keyboard and several pianos. Laminated keyboards were used

with felt-tip markers, flashcards, and other teaching aids. The researcher used songs from the series book *Making Music Your Own* for grades three and five. The researcher videotaped a sample of her lessons to serve as an added control for teacher effect. Activities of the training included singing, clapping, identifying in notation a melody heard aurally, writing notation, playing five-finger patterns in several keys, playing intervals and matching them to notation, playing high and low on the keyboard, and playing melodic patterns and identifying them from notation. The students did not sing and play simultaneously. The vocally trained groups utilized the same materials and procedures but they did not play the piano. At the end of the training all groups, including the two control classes, were post-tested with the same measures.

The Analysis of Covariance revealed a significant improvement at the .005 level in the pitch discrimination ability of piano-trained groups. The piano-trained groups excelled in pitch discrimination ability in both the Colwell and Pace measures. The researcher attributed the significant improvement of the piano-trained groups to the sequential nature of the training, verbal praise, peer teaching to help the slower students, and the superior learning experience of aural, visual, and vocal training simultaneously rehearsed on the piano. "The piano would seem to aid the development of tonal concepts that may be acquired through the singing experience" (Finnell, 1973, p. 10).

The major weakness of the study was the use of the Pace and researcher-designed tests which did not contain information on validity and reliability. The lesson plans were sequential and interesting and it appeared that the only difference in the training between the two groups was the use of the piano keyboards.

Curt (1990) compared the music learning of seventh-grade general music students in two treatment groups; an experimental treatment using the electronic piano

laboratory and the control treatment using materials and equipment that were normally used in a general music course. Five hundred twenty-four 7th-grade students in three junior high schools in Kansas were taught by five different music teachers for 18 weeks. The 15 classes were all general music classes except for three vocal music classes. Eight general music classes in five additional junior high schools served as controls for a total of 763 students. The Gaston Test of Musicality served as the dependent measure.

The classroom teachers delivered the training. Materials included three 6-week units of plans written by the researcher under the heading Jazz, The Romantic Period, and Musical Rebels. Each teacher received a booklet of lesson plans, a daily schedule of instruction, a tape of musical examples, slides, sheet music, and sheets of musical examples for the students.

The Gaston Test of Musicality, a standardized measure, was given to all the experimental subjects and to the control subjects before training. The 524 experimental students were also given a test to measure the cognitive aspects of the learning in the course materials. Three tests were devised according to Bloom's Taxonomy of Educational Objectives. Half of the experimental group was tested each six weeks and all were post-tested at the conclusion of the training. The control group training utilized the materials and media in the plans. The experimental group used the same materials but they were designed to engage the students with the pianos.

All students were post-tested using the Gaston Measure. The musicality tests were compared by Analysis of Covariance (ANCOVA) and the cognitive tests were compared in three operations according to the Solomon Four Group Design by means of a two-way Analysis of Variance (ANOVA). Results showed that the students who learned while using pianos scored significantly higher on both musicality and cognitive

measures than did control groups. The pre-test scores of experimental and control groups were equal but the post-test scores of the experimental groups were significantly higher than the control groups ($p<.01$). For all three cognitive test comparisons students using electric pianos scored significantly higher than the control groups ($p<.01$).

Since both groups used the same plans, the improvement of the piano-trained groups is compelling. However, no information was reported on I.Q. or musical aptitude of the learners. Were the students in the piano-trained groups brighter or more musically gifted? There is no mention of random assignment so we do not know how classes were assigned to treatment or control. There were five different teachers in the study. Perhaps the teachers in the piano groups were better instructors or the material may have been presented in a more engaging manner for the piano groups than for the general music groups.

Martinez (1975) developed a piano curriculum program and investigated its effectiveness in improving the music reading skills in fifth-grade general music students. The subjects were 48 students from two intact fifth-grade classes at the Developmental Research School at Florida State University. One class served as the experimental and one class as the control group for the 9-week study. The control group received their usual general music class instruction from basal texts. The experimental group received the piano curriculum developed by the researcher. The two groups were pre- and post-tested using the Iowa Tests of Music Literacy, level one, which measure tonal and rhythmic skills.

Familiar music examples were used in the piano training so that students could play with limited knowledge of notation. Rhythmic, melodic, and transpositional skills

were taught by ear using a non-musical-notation-approach to staff notation. Students were taught to harmonize melodies using tonic and dominant seventh chords only.

An ANCOVA using the pre-test as a covariate discovered significant differences at the .05 level between the two groups on the tonal subtest only, with the keyboard-trained group scoring significantly higher on this subtest. The researcher credited his sequential instructional approach and the piano keyboard experience for the improvement.

The study uses a very small *N* so it is impossible to generalize from these findings. Very little information is given about the control group training while the researcher's lesson plans for the keyboard training are included in the study. It is noteworthy that the test area that showed improvement after keyboard training was the tonal subtest, which involved melodic discrimination and tonal memory, two of the constructs involved in sight-singing training. This improvement took place in only eight weeks, a relatively short training period.

The following studies involve issues surrounding the sight-singing abilities of high school chorus students. Daniels (1986) investigated factors related to sight-singing ability in the mixed choirs of 20 high schools. The factors were related to four categories: school, music curriculum, teacher characteristics, and individual characteristics of the students. A multiple regression analysis revealed that the best predictor of sight-singing accuracy was ethnic makeup and locale of the school, followed closely by the presence of a piano in the home. Other factors (in order of importance) were rural school, occasional use of rote procedures to teach, a large percentage of choir students in All-State Chorus, a large proportion of choir students with experience playing a musical instrument, a large high school, and a chorus teacher

who believes in the importance of sight-singing instruction in chorus. She concluded that the fact that students have a piano for experimentation and practice was a significant factor in their success. The most successful school programs were those in which sight-singing was treated as a major goal of the chorus. She found that high school sight-singing instruction was inadequate and that this curriculum needed considerable improvement.

Several studies were conducted in the 1990s involving sight-singing in high school choirs in Texas. Henry and Demorest (1994) measured the individual sight-singing abilities of students in two Texas high school choirs with records of outstanding sight-singing accomplishments in the Texas state choir contests. Students individually read two unfamiliar melodies selected from Ortmann's book *Music for Sight-Singing* (1967). The average score for singers in both choirs was 9.87 out of 15 points, or 66%. The researchers considered this a mediocre showing for choirs noted for sight-singing achievement. The result may indicate that students often follow one or two leaders within their section and so rely on other student's abilities during these adjudications. Their individual lack of sight-singing ability goes undetected if directors do not individually test students in the choir (Bennett, 1984; Demorest, 1998). Henry and Demorest also found that the students who scored 83% or higher on the sight-singing test had had years of prior piano instruction.

Demorest and May (1995) studied eight Texas high school choirs. They examined 414 members of the most advanced choir and intermediate choir from each school to determine their level of sight-singing skill and to determine what background factors the best sight-singers had in common. Students were randomly selected to sight-sing two melodies, one slightly more difficult (containing accidentals), and both in F

Major. The researchers were interested in obtaining information about the background variables of successful sight-singers, whether the presence of accidentals in the second melody would hinder reading, and whether there were differences associated with the type of sight-singing system they had been taught.

A multiple regression analysis revealed that years of choral experience, years of piano experience, years of private voice lessons, and years of outside choral experience were the top four factors, in order of significance, related to sight-singing excellence. Instruction on other instruments was only important to sight-singing skill when taken in tandem with piano or voice. The sight-singing scores for the melody without the accidental were significantly higher than the one containing the accidental, indicating that training utilizing music with these signs may have been inadequate. Students in the movable *do* choirs also scored significantly higher than the fixed *do* choirs for both melodies. Demorest and May cautioned that the success of the movable *do* group may have related to the fact that they were taught this method K-12 and those schools also individually tested students periodically and tied this testing to their chorus grade. Fixed *do* training only took place from grade 5 onward in the fixed *do* schools. Consistency, rather than system, was suggested as the most important element in success. Demorest and May also pointed out that keyboard instruction was significantly related to sight-singing in a number of studies. "The emergence of piano instruction as a significant positive background variable in numerous studies suggests that this type of training may help students of all ability levels improve their sight-singing. If this is the case, then perhaps keyboard instruction needs to become a more central part of the vocal general curriculum"(Demorest & May, 1995, p. 164).

Students taped themselves in the Demorest and May study. They listened to tape recorded instructions that told them to study the melody for 30 seconds and then taped themselves singing. Since the students were alone in the room there is no way to be sure they only used 30 seconds. Since the researchers were interested in determining the student's level of sight-singing skill, it is questionable whether two melodies constitute enough music to make that assessment.

Demorest reiterated his belief in the need for keyboard research in his book, *Building Choral Excellence: Teaching Sight-Singing in the Choral Rehearsal* (2001). After making a strong case in chapter 2 for including sight-singing instruction in the choral rehearsal, he reviewed the many studies linking aural skills acquisition to piano training. "Perhaps choral directors should seek to incorporate some basic keyboard training into their choral programs through the use of electronic keyboards. They are compact and portable and provide a very accessible medium for learning basic concepts of key and scale relationships. Students could work in groups where more-experienced students help the less-experienced students. Keyboard instruction may be an important component of a more comprehensive choral music education, and this is certainly an area in which more research is needed" (Demorest, 2001, p. 32).

From 1960 to the present there have been persistent hints that the piano or portable electronic keyboard can be a powerful tool for aural skills acquisition. The previous sixteen studies were conducted at the elementary (grades 3-5), junior high (grades 6-8), high school (grades 9-12) and college or adult levels. At each age level the piano keyboard was found to be a significant factor in the improvement of melodic discrimination skills. Despite this research, the portable electronic piano keyboard continues to be under-utilized in public school music education. None of the surveys or

studies of choral programs conducted in the past five decades indicates any use of keyboard training in conjunction with sight-singing training (Carey, 1959; Dwiggins, 1984; Ernst, 1957; Hales, 1961; Johnson, 1987; Szabo, 1992). The present study may be the first attempt to use portable electronic piano keyboards with the high school chorus to accompany and reinforce sight-singing training.

Theories Supporting Keyboard-Enhanced Sight-Singing Training

The following section will summarize the theories that support the use of portable electronic piano keyboard experience with sight-singing training in the present study. Information processing, multiple modality learning, and perceptual motor learning will be related to portable electronic piano keyboard experience.

Information processing theory states that information from the environment is held in sensory stores, one for each of the five senses, for short periods of time. This information is lost unless a cognitive operation or thought process is applied to it. It can then be retained in long-term memory for months or years. Keyboard performance and sight-singing constitute procedural knowledge skills which are carried out in performance. One of the memory strategies useful in moving information from short-term to long-term memory is rehearsal. In the present study there was much rehearsal as tonal patterns were heard and seen in notation while simultaneously being sung and played on the keyboards. The fingers measured the intervals through the tactile sense and the voice measured the intervals with the vocal mechanism while the eye saw the distance of notes on the page. This overlapping sensory information being acted upon by the motor rehearsal of the hands and voice may speed the learning of tonal patterns that is necessary in the formation of the aural imagery needed for sight-singing.

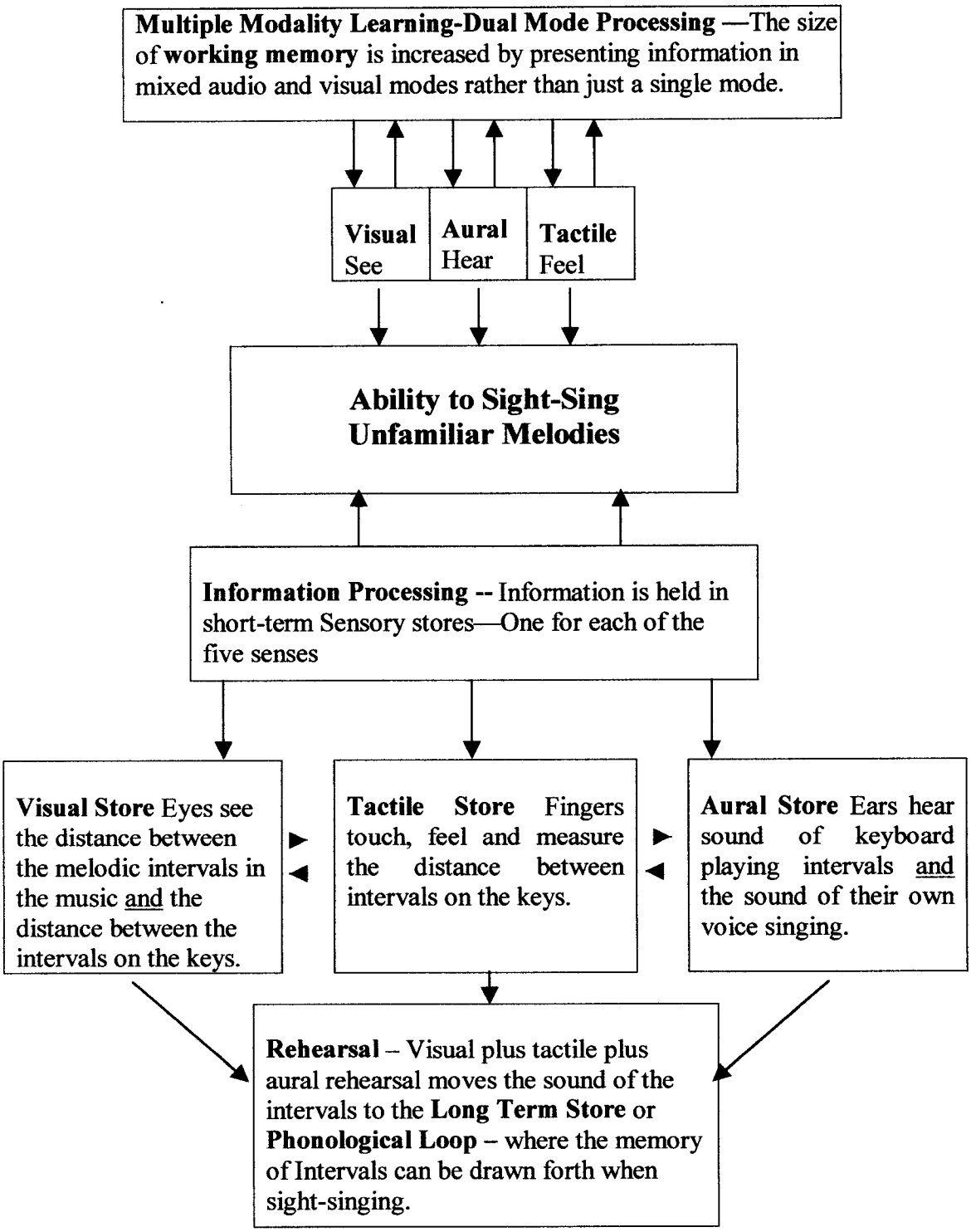
Another information processing strategy that may be relevant to the present study is the picturing of the keyboard, an elaboration strategy. This is valuable in remembering the arrangement of pitches during melodic dictation or in imagining fingering the instrument when sight-singing intervals to help in pitch placement. External devices such as spatial cards, notation cards, and hand signs served as memory aids to tie the sound of intervals to the notation symbols that represent them.

Theories of multiple modality also inform the present study. The Dual Mode Processing Theory posits that the size of working memory is increased by presenting information in a mixed (auditory and visual) mode rather than a single mode. Singing while looking at notation and playing while hearing your own voice as well as the keyboard, represents multiple auditory and visual signals received simultaneously. Moreno and Mayer (1999) stated, "more information is likely held in both auditory and visual than in just one working memory" (Moreno & Mayer, 1999, p. 366). If this is true, singing from notation while playing keyboards may allow students to increase their working memory capacity resulting in faster, stronger learning.

The study by Hargiss (1960) seems to support the formation of long-term memory for aural sound through singing and playing at the keyboard. She stated, "The understanding of music fundamentals and the development of several kinds of imagery, which are provided by the keyboard, are important in themselves and may enable many persons to sing at sight to some extent; but the addition of vocal practice (sing and play) and its motor imagery enables them to develop the ability much more rapidly and effectively (Hargiss, 1960, p. 72).

The theories supporting keyboard enhanced sight-singing training can be seen in Figure 1 on the following page.

Figure 1. Theories supporting sight-singing training with keyboard experience.



Summary

The Kodály Method, designed to develop music literacy from nursery school to adulthood, was developed by the Hungarian educator, Zoltán Kodály. Music Learning Theory, a group of ideas about how children learn music, was developed by American researcher Edwin Gordon. Both the method and the theory have implications for the acquisition of sight-singing skill. Tonic solfa, movable *do* with *la*-based minor solfège, and the Curwen hand signs are techniques utilized in connection with aural skills training in the Kodály approach. This method aims for the progressive development of aural imagery or inner hearing through repetition of groups of tones in the context of tonality. The Kodály Method relies on a sequenced presentation of tones related to the tonic in both major and minor modes. Songs, games, and materials are also sequenced to provide material for preparation of each concept, presentation of the concept, and further practice in the concept. The use of authentic Hungarian folk songs is a feature of the method in Hungary. Mary Helen Richards and other American music teachers brought the approach to America and researched American folk songs for use with the method in American music education. Martin (1991), Cassidy (1993) and MacKnight (1974) each researched aspects of the theory and practice of the Kodály Method.

Audiation, the basic tenet of Music Learning Theory, is related to sight-singing. Notational audiation involves reading and writing music using notation. The reading and writing reinforce the ability to hear what is seen in notation. Edwin Gordon's hierarchy of tonal and rhythm patterns is used to train children in developing a vocabulary of tonal patterns and rhythm patterns that can be recalled when audiating unfamiliar music. The stages of discrimination and inference learning and how they relate to the development of audiation skill were discussed.

A number of research studies by Gordon are listed as well as the many music tests that were written and researched by Gordon. His 1985 study to substantiate aspects of the stages of audiation revealed information about the differences in the readiness to engage in audiation among kindergarten children. In addition, studies by Jones (1985) and Feierabend (1986) investigated the use of tonal pattern training in the high school choir and with first grade students. The major similarities and differences between the Kodály Method and Music Learning Theory were enumerated.

Research involving context in melodic perception has implications for sight-singing training. Cuddy (1982), Deutsch (1980), and Krumhansl and Keil (1982) all made discoveries about the dynamic relationships between and among tones that affect our knowledge about sight-singing. Boyle and Lucas (1990), Killian (1991), and Lucas (1993) looked at various aspects of context in sight-singing training.

Distinctions between instrumental sight-reading and sight-singing have been drawn. The research of Grutzmacher (1987) and Elliott (1974) made use of vocalization or vocal training using solfège with band students of various ages as an aid in sight-reading skills acquisition. Vocalization techniques led to improved sight-reading by fifth- and sixth-grade band students in the Grutzmacher study. Elliott (1974) found that training in vocalization of pitches aided band students in melodic discrimination and tonal memory to some degree. However, the piano-trained band students made the largest sight-reading gains in Elliott's study. Those who had received prior piano training were better sight-readers regardless of their research grouping.

The concept of keyboard experience was first introduced at the MENC convention in 1950. This concept was developed under the leadership of Raymond Burrows and Robert Pace, MENC presidents during the 1950s. Keyboard experience is

the label chosen for the experimental treatment in the present study. The Information Processing paradigm of human cognition and its relationship to keyboard reinforced sight-singing training is important to the present study. Memory strategies of rehearsal, categorization, and elaboration are utilized within keyboard-reinforced sight-singing training. Studies in multiple modality by Alport, Altonis, and Reynolds (1972), Mayer and Anderson (1995), and Moreno and Mayer (1999) led to the dual mode processing theory of Moreno and Mayer (1999), which states that learning is stronger when presented in both aural and visual modes simultaneously. A similar finding was discovered in the music education research of Shehan (1987).

. Finally, numerous research studies have established a connection between keyboard performance and aural skills acquisition. Hargiss (1960) and Bogard (1983) noticed a significant improvement in sight-singing skill among students who sang and played simultaneously all their sight-singing, ear-training, theoretical material, and piano pieces in an interrelated teaching experiment at the college level. They attributed the improvement to the overlapping sensory input involved in singing, reading, hearing, touching, and measuring intervals at the keyboard.

Bodecker (1969), Finnell (1973), Jones (1971), Lyke (1967), and Martinez (1976) found that systematic training at the keyboard led to greater improvement in aural discrimination and sight-reading abilities in elementary children than the vocal-general music program could provide. At the junior high level (grades 6 and 7) keyboard training or piano study was superior to general music class training in teaching melodic discrimination skills in the studies of Curt (1990), May and Elliott (1980), and Wig and Boyle (1982). Daniels (1986) called for improved teaching of sight-singing in the high school chorus. She discovered that the top two indicators of

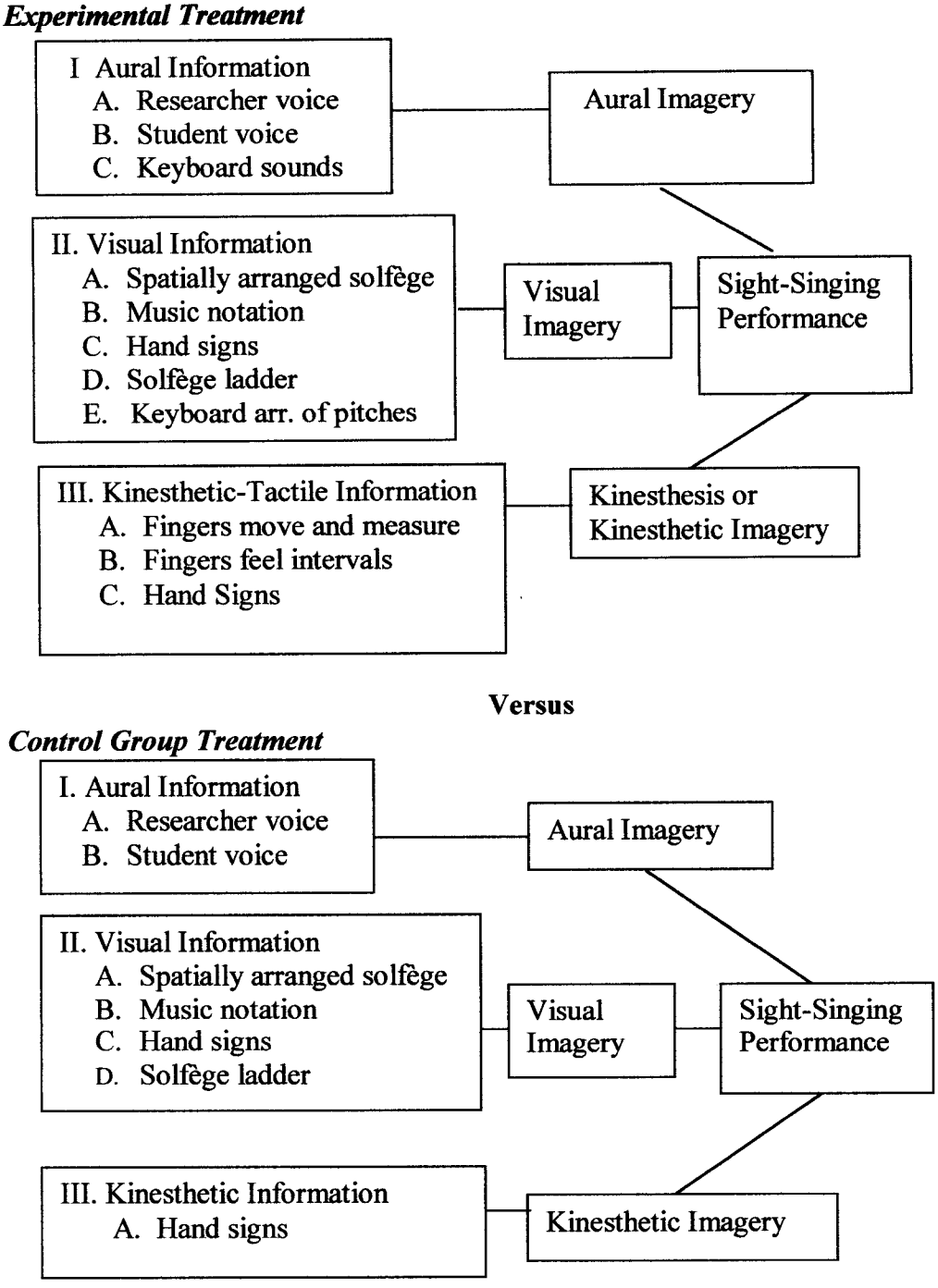
sight-singing excellence were location and ethnic makeup of the school and the presence of a piano in the home for experimentation and practice. Henry and Demorest (1994) studied individual sight-singers in two Texas high schools with a reputation for sight-singing proficiency at state competitions and recorded low individual scores. The significant factor that the best sight-singers had in common was years of piano training. Demorest and May (1995) studied eight high school choirs in Texas and found that the top two factors leading to sight-singing excellence were years of chorus training followed closely by years of piano training. Demorest (2001) called for the inclusion of keyboard training in the high school choral program as an expanded curriculum offering to aid in aural skills acquisition. At the college level, Hansen (1960) and Stecklein and Aliferis (1957) noted that students with years of piano training in their background possessed higher levels of melodic discrimination and score reading ability than other instrumentalists.

The present study was designed to teach sight-singing skills to novice high school chorus students through the use of two methods. One method utilized multiple repetitions of melodic intervals in which students heard the researcher's voice and repeated with their own voice. The intervals were presented in relation to the tonic pitch. Students then saw solfège letters spatially arranged as they heard the researcher's voice and then they sang. Next, they saw notation as they heard the researcher's voice and sang. Finally, they saw notation and sang using their own aural imagery to guide them.

The second method involved hearing, seeing, singing, and playing. Students heard the researcher's voice and then sang and played the intervals on the keyboard simultaneously over many repetitions. Next, students sang and played from spatially

arranged cards and then from notation, first echoing the researcher and then reading from notation. Opportunities for individual rehearsal using headphones were given. Students performed by singing and playing as a total group during every class session. These students heard the sound of the researcher's voice, then their voices and the sound of the portable electronic piano keyboard simultaneously. In addition, they saw the spatial distance of the intervals on the letter cards and in notation as they saw the intervallic distances on the keyboard. They then measured and touched the intervals with their fingers. Additionally, the keyboard provided a picture of the arrangement of pitches that they could imagine as a mental aid during melodic dictation exercises. After much rehearsal they saw the notation and sang using their own aural imagery to guide them. For further information see Figure 2 on the following page.

Figure 2. Sensory input that leads to the formation of imagery in the two treatments.



Chapter Three

Methodology

Purpose

The purpose of the study is to determine whether a method of sight-singing training that combines aural and visual vocal training with a program of portable electronic piano keyboard experience is more effective in teaching sight-singing skills to novice high school chorus students than a method that combines aural and visual vocal training alone.

Introduction

The study took place at three high schools in a suburban school district comprised of 38 schools in an eastern state in the United States. Students in one of the novice choruses of each high school were selected to participate. The training lasted for 14 weeks and was conducted on an alternate-day schedule. The two training groups were taught sight-singing skills either by a completely aural-vocal method or an aural-vocal method that included portable electronic piano keyboard experience. Students filled out a survey (see Appendix D) to elicit information about prior piano, instrumental, and chorus training. They were pre-tested with a musical aptitude test and a sight-singing test and then post-tested at the end of training with the same sight-singing test. Exit surveys were distributed to students and teachers at the end of training to garner information on student enjoyment and teacher assessment of the educational experience. The exit surveys can be found in Appendices E and F.

The Sample

Demographics. The study took place in a suburban county-wide public school system in the eastern United States that enrolls over 28,000 students. School A, a new

school in its third year of operation, was located in a moderately large town with a population of 16,731. The median income for a household in this town was $40,477 and the median income for a family was $50,899. The school had a population of 1200 students with a racial makeup of 93% Caucasian, 5% African American, 1% American Indian, 1% Asian, and 1% Hispanic. Chorus I was composed of 19 incoming freshmen, 4 sophomores, and 2 juniors. The chorus sample consisted of 9 males and 16 females.

School B, housed in a forty-year-old building, was located in a moderately large town with a population of 27,741. The median income for a household in this town was $70,851 and the median income for a family was $75,848. The school population of 1,218 students was made up of 95% Caucasian, 3% African-American, 1% American Indian, 1% Asian, and 1% Hispanic. Chorus I was composed of 23 freshmen and 1 sophomore. There were 6 males and 18 females in this sample.

School C was located in a rural agricultural area of the county. The small town most closely located to the school had a population of 989. The median income for a household in this town was $36,250 and the median income for a family was $37,500. The school building was new and the school had been in operation for five years. The 1,155 student school population was comprised of 97% Caucasian, 2% African American, 1% American Indian, 1% Asian, and 1% Hispanic students.

Because of scheduling changes which took place over the summer, Chorus I, the most novice group in the school was changed to the spring semester necessitating the use of Chorus II, a second year chorus, for the present study instead. Chorus II was comprised of 26 sophomores and 1 junior. There were 6 males and 21 females in this sample but one male dropped out before post-testing due to serious illness. The *n* for this sample was then 26. Over half of this group did not participate in chorus during

their freshman year. They constituted a novice high school group for the purposes of this study.

Music education in this school system. The elementary general music class is taught by a qualified music educator during two 30-minute classes each week for grades one through five. In some schools, the fourth- and fifth-grade classes meet once a week for an hour. The curriculum supports the use of solfège, hand signs, and rhythm syllables as well as Orff instruments. Teachers are free to choose the series book they wish to use for their school. The elementary chorus is open to all students and meets one hour per week during the school day at most schools. It may be taught for one hour for students in grades 4 and 5 or a half hour each for grades 4 and 5. One school has an audition-only chorus with a second-chance opportunity for those who aren't accepted the first time.

Grades six, seven, and eight are housed in a middle school. General music is taught in a rotating schedule alternating with other fine arts offerings. Students may receive 30, 36, or 45 days of general music, depending on the school schedule, and then rotate to the other arts. There is a required curriculum that teachers strive to cover in the three years of middle school music. Laboratory units within the curriculum include practical experience on electronic keyboards, guitars, and bells or dulcimers. Chorus and band are electives at the middle school level. If students choose chorus or band they do not participate in general music, and if they choose general music they cannot participate in chorus or band. Many of the ninth-grade males in the present study did not participate in chorus during the middle school years. The lack of singing in those years when the voice changes may have resulted in the many pitch problems that were encountered in their singing in the present study.

Since 2001 there has been a new emphasis on sight-singing in the high school chorus following the addition of a sight-singing requirement to the county choral adjudication. Sight-singing is being taught routinely in at least two rehearsals per week in the advanced chorus at the high schools. The music supervisor reported that elements of the sight-singing training are being introduced in the middle school choruses as well. In addition, the Advanced Placement Music Theory classes have begun a new sight-singing component utilizing the text *Music for Sight-Singing* (6th edition) by Robert Ottman.

Design

The present study utilized a pre-test post-test control group design in which the control group functioned as a comparison group that received an alternate treatment. The experiences of the sight-singing training were kept similar in the two groups in order to test the specific impact of electronic piano keyboard experience. The design procedure involved the random assignment of subjects to the two groups, the administration of a pre-test to both groups, aural-vocal training in sight-singing to the control group, aural-vocal training that included electronic piano keyboard experience to the experimental group, and post-tests to both groups. The diagram of the design can be found in Table 2.

Table 2

Pre-test Post-test Control Group Design

GROUP A	GROUP B
Random assignment	Random assignment
Pre-test	Pre-test
Experimental Treatment	Control Treatment

Table 2 (continued)

Post-test	Post-test

Participants

The sample participants were students in grades nine through eleven who were enrolled in Chorus I or Chorus II. Chorus I is considered a training choir for entering freshmen and others with limited chorus experience. Chorus II is comprised of students who completed Chorus I and others with limited chorus experience who could not fit Chorus I into their schedules. Since these choirs are training choirs for the advanced chorus, sight-singing is a skill that fits into the training and prepares students for the increasingly difficult choral literature they will encounter as they continue in chorus.

The total *N* for the study was 75 students. There were 37 students in the experimental group and 38 students in the control group. There were 10 males and 27 females in the experimental group while 10 males and 28 females made up the control group. School A had 12 students in the keyboard experimental group and 13 in the non-keyboard control group. School B had 12 students in the keyboard experimental group and 12 in the non-keyboard control group. The keyboard experimental group for School C contained 13 students and the non-keyboard control group contained 13 students. Students at School A had previous musical experiences in the following percentages: Nine years or less of piano lessons, 16%; Chorus experience, 88%; Instrumental lessons, 40%; Voice lessons, 12%. Students at School B had previous musical experiences in the following percentages: Seven years or less of piano lessons, 35%; Chorus experience, 84%; Instrumental lessons, 46%; Voice lessons, 15%. Students at School C had previous musical experiences in the following percentages: Four years or

less of piano lessons, 26%; Chorus experience, 92%; Instrumental lessons, 74%; Voice lessons, 11%.

Background, facilities, and instructional period

Six months prior to the commencement of the study, a letter was sent to the superintendent of the school system describing the study in detail and including all the materials previously written for the Institutional Review Board of the university. The superintendent approved the study and passed it on to a subordinate who contacted the researcher and instructed her to contact principals and choral directors to seek permission to work in their schools. Principals and directors at the three schools granted permission. All three schools operated on an alternate-day schedule and fortunately their schedules meshed so that one school was taught on A day and two schools were taught on B day.

The facilities at the three schools differed. School A had a separate room attached to the chorus room that was vacant and available for use during Chorus I's rehearsal module. Unfortunately, it was adjacent to the band room and there was little soundproofing between the rooms. The training took place at the same time the woodwind and brass sections of the band were rehearsing on the other side of the wall. The group was very loud and could be clearly heard at all times. For this reason, it was not an ideal place to teach aural skills. The room was, however, large and contained a dry erase board, chair-desks, and tables that were pushed to the center to hold the keyboards. School B's facility was a small chorus room and one separate practice room. The cooperating teacher secured four large tables, which barely fit on the top step of her tiered room. Keyboard group students were required to carry their chorus chair to their assigned keyboard each period. There was little room for movement and everyone had

to maneuver carefully. All students faced in different directions so it was difficult to get them to look at the researcher or at a central chart during training. They could not see the blackboard so the entire group had to move down and stand in front of it when there was instruction that required its use. The cooperating teacher taught the other group in the hallway for each 15- to 20-minute segment and then the groups switched locations. This was done so the groups would not hear each other's training.

School C was taught in the afternoon. A separate and very quiet room attached to the chorus room was available for the training. The room contained a dry erase board and enough chair-desks for the entire group. Keyboards were duct-taped to the desk arm, which eliminated the need for separate tables. Of the three schools, School C had the most ideal teaching environment for aural skills training.

The study proceeded from September 1, 2004 until the completion of post-testing on January 19, 2005. The instructional period covered 14 weeks beginning September 20 and ending December 22. The lessons were taught on an A- day or B-day schedule, which resulted in three lessons in one week followed by two lessons the following week. Because of school holidays and teacher workdays scheduled in the fall, there were several weeks in which only one lesson occurred. A total of 28 lessons were taught in the 14-week period. Each chorus was taught during a 90-minute module with each treatment group receiving a 15- to 20-minute lesson each instructional day. The lessons comprised 30 to 40 minutes total or 17% to 22% of the instructional period. School A was taught at 9:45 a.m., School B was taught at 7:45 a.m., and School C was taught at 1:30 p.m.

Materials

The melodies used in both the vocal and keyboard training were American folk tunes, hymn tunes, popular melodies, and researcher-composed tunes. The researcher constructed the cards used in the syllable and notation training from white tag board measuring 11x14 inches and lettered in black marker. Musical examples and the solfège ladder were placed on large tag board rectangles measuring 21x28 inches. Staves were drawn with black marker and red marker was used for solfège syllables. The researcher purchased white removable labels measuring 5/16 x 1/2 inch at an office supply store. These gummed stickers were marked with solfège syllables and worn on the fingers of keyboard students during the training.

The researcher purchased 40 Yamaha electric keyboards, model PSR-172 (including power pack and headphones) for the study. They were placed in a secure, locked location at each school and were set up on tables or desks each instructional period and then taken apart and stored at the end of each period. Extension cords, power strips, a roll of duct tape, and a large drop cloth were purchased for use with the keyboards also. A binder containing all the exercises and melodic examples for the semester was provided for each keyboard student. In order to prevent cross-contamination of the groups, the researcher distributed and then collected the binders each class period. They were kept in a rolling suitcase and brought to class each day by the researcher to ensure that no student could copy the music and take it home to share with other students.

Measures

Musical Aptitude Profile. The Musical Aptitude Profile (MAP) was used to measure prior knowledge of melody in the present study. The test was researched and

written by musician, teacher, researcher, and author Edwin Gordon. The stated purpose of the test is "to act as an objective aid in the evaluation of students' basic musical aptitude so that the teacher can better provide for individual needs and abilities" (Gordon, 1965, p. 2). The test is divided into three sections labeled Tonal Imagery, Rhythm Imagery, and Musical Sensitivity. The Tonal Imagery section is further subdivided into Melody and Harmony while the Rhythm section is subdivided into Tempo and Meter.

The rationale statement for the test contains multiple elements. The test is constructed so that students are not required to be familiar with facts about music or music history but a degree of musical memory is necessary to achieve a high score. The music used was composed for the test, was performed by professional musicians, and was designed to be enjoyable for listening by students of all ages. In order to maintain student interest, test items were arranged so that difficulty varied throughout the test. "There was an 'in doubt' response included so that students are not pressured to guess when they are unsure" (Gordon, 1965, p. 6).

When taking the test, a student is asked to compare a musical answer to a short selection, which is performed on violin. The selection and the answer may consist of one or more phrases of music, but the answer always contains more notes than the selection. The student must decide if the answer is like the selection because it is a variation of it or different than the selection because the selection melody is not heard within the answering melody.

The test measures knowledge of musical contour as well as pitch discrimination. Students utilize tonal memory when they compare through memory the answer with the selection. In order to create variety in the listening experience, the music is presented in

many keys and meters. "Students who have difficulty establishing tonality, who sing out of tune, or are problem singers will have difficulty on the melody test." (Gordon, 1965, p. 37).

It was decided to use only the Melody subtest for the present study because it best represents the skills needed for individual sight-singing. Pitch discrimination, tonal memory, and melodic memory are all tested to some degree and these skills are all constructs of the skill of sight-singing. Since rhythm was not evaluated in the present study, measuring rhythm aptitude was deemed unnecessary.

Edwin Gordon conducted six years of research at the University of Iowa before publishing the MAP. Construct validity was evaluated based on longitudinal studies of children conducted to gain insight into children's musical capabilities at various ages. These studies led to the construction of preliminary versions of the test. Revisions were tested on thousands of students in geographically diverse parts of the country. The students ranged in age from grade one through junior college. A test was written for each grade level as well as for musically-select groups such as audition-only choruses. The Melody subtest of the Tonal section (grade 9) yielded split halves reliability of r =.80.

The final edition of the test contains 250 items in the three sections and 40 items in the Melody subtest of the Tonal section. The test items ultimately chosen were included on the basis of level of difficulty and item-to-test correlation (Gordon, 1965). Each item has a difficulty level of at least .58, meaning that at least 58% of all students who took the test chose the correct answer for the item. In addition, each item had to correlate .20 with the raw score for that subtest (Gordon, 1965).

The MAP was nationally standardized in the 1964-65 school year. Tests were administered, as suggested in the manual, to a representative sample numbering 15,000 students in the U.S. The answer sheets were scored, frequency distributions prepared, and standard scores derived. Percentile norms were derived from the distribution of standard scores for each grade level and for the musically select groups. Gordon computed reliability coefficients, standard error of measurement, and inter-correlations among tests for the entire sample (Gordon, 1965). Even though the copyright of the test is 1965, the material is not dated and it remains the leading musical aptitude test in use today.

Vocal Sight-Reading Inventory—dependent variable. The Vocal Sight-Reading Inventory (VSRI), developed by Michelle Henry (2001), was used as the pre-test and post-test in the present study. Henry developed the VSRI with four purposes in mind. First, the test is a tool intended to individually assess sight-singing skills at the high school level. Second, administration and scoring of the test can be accomplished quickly and efficiently. Third, the test can assess current sight-singing achievement of students or provide evidence of growth as a result of instruction. Fourth, the test provides information on validity and reliability (Henry, 2001, p. 23). A copy of the test can be found in Appendix G.

Henry constructed the nine melodies of the test on the basis of component skill tonal patterns. These pitch skills were derived from patterns found in tonal music and were identified by their function within the harmonic framework of the music. "The tonal patterns appear as chunks of information in each melody due to their tonal and harmonic function"(Henry, 2001, p. 24). She identified seven skill categories for melodic patterns. The conjunct melodies consist of repeated tones or scales spanning

three, five, or seven pitches either ascending or descending. The tonic melodies are combinations of the three notes in the tonic chord. Octave jumps from low *do* to high *do* are included in this category. The dominant and subdominant melodies include all combinations of the pitches in the dominant or subdominant chords. The cadential melodies surround the tonic cadence and include *ti-do*, *re-ti-do,* and *sol-la-ti-do*. Modulatory melodies include accidentals that encompass secondary dominant functions and minor functions. Finally, chromatic functions include accidentals that denote upper and lower neighbors or passing tones (Henry, 2001).

Pitch accuracy is the only skill judged on this test. Rhythm, tone quality, or other vocal skills are not judged. Because a strongly tonal context was desired, only complete melodies were used instead of isolated intervals. Henry desired to save teacher time so she developed an alternate scoring in which only the pitches in the composite skill patterns were scored with the rest of the melody not evaluated.

Two similar forms of the VSRI, containing eight melodies each, were pilot-tested in 1997 at one high school using 42 ninth- through twelfth-grade students. Both tests were written in the keys of C, F, and D Major in both treble and bass clefs. Scores on the pilot ranged from 1 to 23 out of 27 points: the mean score was 10.12 with a standard deviation of 5.4. A *t*-test performed on the two test forms indicated no significant difference between forms (Henry, 2001).

A second scorer scored 24 of 42 tests using the component skill scoring method. There was a .91 correlation between the two scoring methods. A chi-square coefficient was used to compare scores on the component skills items. This information led to the rearrangement or elimination of some items before the main study.

One hundred eighty-three students from five high school choruses were randomly selected for the main study. The students were given 30 seconds to peruse each item. The key and first pitch were established and they were given an additional 30 seconds to peruse and practice the item before they were recorded. The two different forms of the test were used alternately with each student (Henry, 2001).

The test was judged both by the component skills method and by the note-to-note scoring method. The two scoring systems were correlated to determine if the new scoring produced results similar to the old. The correlation between subject scores on the two tests was $r = .96$. A *t*-test revealed no significant differences between the two versions of the test. A chi-square analysis exposed a significant difference between the two tests for 6 of the 28 component skill items. The inter-scorer reliability between judges was $r = .97$. A multiple regression analysis of such factors as grade or choral experience that might correlate with success on the VSRI showed that keyboard experience had the highest correlation with VSRI success (Henry, 2001).

The mean score was 10.7 out of 28 or 38% accuracy. There is no information given about the skill level or prior sight-singing training of the students who participated in the main study. "Their low scores may have been a result of the wide sample population, exclusive focus on pitch, and the broad range of difficulty of the VSRI" (Henry, 2001, p. 32).

Test reliability was determined through comparison of parallel forms and through inter-scorer reliability correlation. No significant difference was found for overall scores between the forms. Henry reported that the high correlation between scorers indicates that scoring procedures for the VSRI are reliable for determining sight-

reading success. All skills received a positive discrimination correlation indicating that success on a given skill was related to overall success (Henry, 2001).

Content validity was based on previous research that attempted to identify component patterns in tonal music as well as the researcher's perusal of high school choral octavos to identify patterns most often seen (Davidson & Scripp, 1988; Davidson, Scripp & Meyaard, 1988; Gordon, 1997; Kazez, 1992 as cited in Henry, 2001). The high correlation between the component skill scoring method and the note-by-note scoring demonstrated that the identified component skills are an "adequate representation of the skills required to sight-read vocal music" (Henry, 2001, p. 31). This correlation provides a degree of construct validity for the test. Henry also claimed process validity based on the fact that the component skills scoring method allows for fast and efficient scoring of the test.

Test administration. The following test procedures were adapted from procedures used in previous research studies (Boyle & Lucas, 1990; Carey, 1959; Demorest & May, 1995; Henry & Demorest, 1994; Killian, 1991). Each student accompanied the researcher to a practice room containing piano, tape recorder, and music stand. The student was given a copy of the VSRI and received 30 seconds to preview the first melody before singing. At the end of 30 seconds, the tape recorder was turned on and the researcher identified the recorded segment by school number, student number, and item number. The researcher then played a I, IV 6/4, I, V, I cadence on the piano and played and sang the starting pitch with the correct solfège syllable. The students then sang the melody into the tape recorder. For the pre-test, students used the neutral *la* or *loo* because they were unacquainted with any other sight-singing system. A few students at School C attempted to use scale degree numbers for the first few items

but when they were unsuccessful, reverted to a neutral syllable. For the post-test students were encouraged to use the solfège syllables they had been taught during the training. Most students used solfège and a few used neutral *la*. The students were told that rhythm would not be counted on the test, therefore they could pause if they needed to decipher an interval or recall a syllable and then reenter singing. They were also advised that they were allowed to start over once, but that the second attempt had to be counted. At the completion of each item the tape recorder was turned off and the student was given 30 seconds to view the next item. The process continued for the nine melodies of the test.

Pilot study—scoring. A pilot study was conducted four months prior to the start of the main study to determine inter-judge reliability and to refine test procedures. Six students from Chorus I at School A were selected by their director on the basis of her estimate of high, medium, and low sight-singing ability. Three vocal music teachers judged the tape-recorded performances.

The test was scored by the interval-to-interval scoring method. Two pitches in a row are required to be sung correctly in order for the student to be awarded a point for the interval. This is a variant on the note-to-note scoring method used previously by many researchers (Boyle & Lucas, 1990; Carey, 1959; Demorest & May, 1995; Henry & Demorest, 1994; Killian, 1991). Some of the scoring procedures of the present study were also used in the previous studies. Sliding into a pitch and stuttering were allowed if the main portion of the note was deemed correct. Modulation was allowed; at the point of departure the interval was judged incorrect but subsequent intervals could be judged correct in the new key. Students were allowed to use any word or syllable they chose when singing. Students were not penalized for singing an incorrect syllable or

number if the pitch was correct. Rhythm and tempo were not judged and students were allowed to pause momentarily for thought and then re-enter. Students who gave up or did not sing received a zero score from the point where they stopped. A percentage success rate was determined by dividing the number of intervals performed correctly by the number of intervals contained in the test. The scores for the three judges were correlated using Cronbach's alpha. Alpha for the three judges was .98.

Pre-test and post-test—VSRI—judging. The researcher sought to improve judge consistency by implementing the following guidelines drawn from previous research. Several recorded examples were scored in practice and discussed with the researcher. The same guidelines applied to the post-test.

Judges were directed to play each item on the piano or keyboard before scoring the item. Then they were instructed to write the number from the tape recorder at the beginning of the item. They then played the recording circling all notes performed correctly. If students wobbled on a pitch but at some point sang it correctly, or if the pitch was slightly flat or sharp it could be judged correct. Students were judged to have sung incorrectly if a modulation occurred. At the point of modulation, the interval was judged incorrect, but all subsequent intervals sung correctly in the new key could be judged correct. Judges were directed to rewind to the number they wrote at the beginning to hear the selection again. Two circles in a row resulted in a correct interval and a point was given. Random solitary circles received no points because they do not constitute intervals. Judges counted the number of correct intervals and recorded the number at the end of each item. It was recommended by the researcher that judges score no more than five students at one sitting to avoid monotony, which could lead to errors

in judging. The post-test scoring of the judges was correlated using the Pearson Product Moment Correlation. The correlation was r=.98.

Content validity—VSRI and lesson plans. An analysis of the nine melodies of the Vocal Sight-Reading Inventory reveals the following usage of intervals: 15 unisons, 86 major seconds, 30 minor seconds, 13 major thirds, 23 minor thirds, 5 perfect fourths, 1 augmented fourth, 6 perfect fifths, and 2 octaves for a total of 181 intervals in the test. A similar analysis of the 28 lesson plans revealed time spent on each of the intervals in the following numbers of lessons: minor third (28 lessons), major second (28 lessons), perfect fourth (28 lessons), major third (26 lessons), perfect fifth (22 lessons), minor second (20 lessons), octave (20 lessons), unison (14 lessons), and augmented fourth (10 lessons). All the intervals were covered in at least half of the lessons with the exception of the augmented fourth. The most frequently occurring intervals (major second, minor second, minor third, and major third) were covered in at least 71% of the lessons.

Training Procedures—Independent Variable

The researcher met with the students at each school during the first week of September to explain the purpose of the research and their role in it. The length of the study, procedures, benefits to students, and the importance of the study were discussed. The researcher distributed parental permission forms and student consent forms for students to have signed and returned within the week (see Appendixes B and C). Students then filled out a ten-question survey to determine their previous musical experience, particularly prior piano training (see Appendix D). Students were then tested using the Melodic portion of the Music Aptitude Profile written by Edwin Gordon. The Music Aptitude Profile was administered to discover prior achievement in melodic skills. This score was used as a covariate to account for within-group

differences. Following this, the students were individually tested using Michelle Henry's Vocal Sight Reading Inventory (see Appendix G). Since the students had had no prior sight-singing training, they were instructed to follow the contour of each melody singing on a neutral "la". Students were recorded on a Lennox portable CD player and tape recorder using normal bias Maxell audio-cassette tape. Separate tapes were used for each school.

The students were randomly assigned to the two treatment groups. The participants' names were first placed in an un-alphabetized list. A table of random numbers was generated on the computer and each name received a number from the table. The numbers were then placed in numeric order and the resulting list of names was placed one by one into the two groups. The names of students with five or more years of private piano study were placed in a box, pulled one at a time, and distributed evenly between the two groups. There were only four of these students. This assured that the experienced piano students would not be placed in the same group. Tucker enumerated a hierarchy of experiences that lead to sight-singing excellence in his 1969 study which emphasizes the importance of piano study. The first three items from his list include "a wide variety of instrumental and vocal experience with approximately six years of piano experience, instrumental experience with approximately six years of piano experience, and vocal experience with approximately six years of piano experience" (Tucker, 1969, p. 96). Because the six years was approximate and because the majority of students in the present study are in their first year of high school, the researcher chose five years of piano as a reasonable length of time for the probable development of aural skills.

The experimental group was called Red Group and the control group was called Blue Group. There were 10 males and 27 females in the experimental group and there were 10 males and 28 females in the control group. The groups were physically separated during the training and could not hear the other group practicing. Even though the keyboards were present in the room during the control group training, the researcher arranged the chairs to face away from the keyboards and the control group did not play any instruments during the training. The researcher used one keyboard to give starting pitches but all the training was done a cappella in both groups.

Lesson plans for the study can be found in Appendix A. Each training session lasted from 15 to 20 minutes. Care was taken to cover the same amount of vocal music with each treatment group and rehearse the same skills. Because playing and singing was a more complex process requiring coordination of eyes, hands, and voices, it was found that the experimental group required an extra five minutes on some days to accomplish the same objectives as the control group. Each group received the same number of lessons and all the objectives were met for each group. The total training (both groups) comprised about one-third of the 90-minute chorus period. When students were not being trained in sight-singing, they were practicing choral repertoire in large group or small groups with their directors. Their directors spent additional time on vocal warm-up activities and listening to choral recordings, but did not engage in any sight-singing activities.

Students in the control group echoed the researcher by singing combinations of solfège syllables accompanied by Curwen hand signs until the diatonic major scale was completed. The training followed the sequence of interval presentation in the book *The Kodaly Method I: Comprehensive Musicianship* (1999), by Lois Choksy. Students

echoed from cards with the first letter of solfège syllables placed spatially to indicate high and low pitch. Students later echoed from notation cards with some of the syllables present in the keys of C, F, and G Major. Eventually only notation cards were used. After students began to gain proficiency with the notation cards, four-measure melodic examples were studied from tag board charts. These often took the form of "mystery songs" which the students would recognize by ear if they sight-sang correctly. These examples progressed to eight-measure melodies performed from song sheets.

Curwen hand signs were taught in order to reinforce the spatial arrangement of pitches in the scale. Care was taken to position low *do* at waist level and high *do* at forehead level in order to allow space for the other scale tones to be arranged between them. Students were encouraged to imitate the teacher and then begin signing for each other.

Students participated in a melodic dictation of two lines of music once during the semester in which they wrote on staff paper the notation of tones sung and played by the researcher in the keys of F and C Major. These were checked and returned to the students with corrections made if needed. Each student sang individually for the researcher once about halfway through the training and individual help and encouragement was given at that time.

The finger sticker technique used with the experimental group was designed by the researcher to allow all students to meet with tactile success regardless of prior piano experience. The internal design of muscles and tendons within the hand results in some of the fingers possessing greater strength and manipulative ability than others. The keyboard treatment was planned to make use of the stronger fingers, 1,2,and 3 in the beginning stages of the study and utilize fingers 4 and 5 later, after students had met

with initial success (see page 156). The emphasis on *Sol, Mi, La,* and low *Do* in the early stages was performed using the stronger fingers. The weakest finger in both hands, finger 4, was reserved for the leading tone *Ti,* which was not introduced until later in the study. Over time, all tones of the diatonic scale were introduced as well as tones below *Do.* Many students had learned finger placement at this point and were ready to discard the stickers, but for purposes of control the researcher requested that sticker use be continued to the end of the study. The stickers were worn on the top of the knuckles in order to be seen when playing.

The experimental group signed and echoed three-note patterns after the researcher in the same procedure used with the control group. Experimental group students were then given the gummed finger stickers identifying the tones in the three-note patterns and instructed which fingers to use with the stickers. Students learned to place their hands in C Major position first because it contains no black keys and so is an easier key for beginning performance. They practiced all intervals in this key and later learned F Major and G Major positions. Following the echo-play activity, students found the exercises notated in their workbook. They echoed the researcher while looking at the notation, playing and singing. Additional intervals were added over time until students could play and sing the diatonic major scale. They then moved on to four-measure melodies composed of the intervals under study. The procedure for each new melody was to identify the tonic, sight-sing the melody, play the melody, and then sing and play numerous times. Eventually they progressed to eight-measure melodies. Students were taught to sing and play the outline of the tonic, dominant, and subdominant chords in C Major, F Major, and G Major. The control group also sang these chords.

Both groups were taught the chromatic scale syllables (ascending and descending) and the symbols for sharps and flats. Keyboard students were taught to play and sing the chromatic scale. Both groups were taught the interval names second, third, perfect fourth, augmented fourth, perfect fifth, and octave for the purpose of identifying and discussing the intervals in notation. They were taught to identify *do* in the keys of C, F, and G Major, and to identify these keys from the key signature.

In the latter part of the study a typical warm-up for both groups included singing and signing the diatonic major scale (ascending and descending), singing by thirds (ascending and descending), singing by perfect fourths (ascending and descending), singing by perfect fifths (ascending and descending), and singing octaves from low *sol* to low *do*. Students rehearsed the augmented fourth interval from *fa* to high *ti* and from *fa* to low *ti*. Students also sang rolling thirds ascending and descending during the warm-up period as well as the chromatic scale syllables. The experimental group played and sang this warm-up. Three weeks before the holiday break, mystery songs and sight-singing examples often consisted of familiar holiday melodies. After the break, students were again individually tested using the nine melodies of the VSRI. The study concluded in all schools by January 19, 2005. A sample of the lessons in all three schools was videotaped to serve as a control for teacher bias. In addition, the lesson plans were critiqued by several Kodály-trained music educators in order to validate construct validity. Copies of these critiques can be found in Appendix H.

Exit Surveys

At the end of the training period all students and teachers were given an exit survey to complete and return to the researcher. The information was given for the purpose of helping to determine their degree of enjoyment in playing the keyboards, an

assessment of their own improvement in sight-singing ability, and their general enjoyment of the training. The teachers were asked to assess the improvement of their chorus as a result of the training and their own attitude about their experience as a cooperating teacher. The student exit survey and teacher exit survey can be found in Appendices E and F.

Internal validity

"The goal in designing an experiment is to create a set of conditions such that any observed changes can be attributed with a high degree of confidence to the experimental treatment rather than to extraneous variables" (Gall, Borg and Gall, 1996, p. 473). The following paragraphs detail ways in which the design of the present study controls for threats to internal validity.

History is a threat involving outside events that could occur and influence the outcome of the study over and above the treatment. The questionnaire handed out prior to the study elicited information about previous private piano study, private voice study, instrumental study, and choir or chorus participation which might impact student sight-singing abilities. Students with 5 or more years of piano study were then equally placed in the groups to control for the effect of prior piano training. During data analysis the effect of years of musical training was considered in conjunction with MAP scores, pre-test scores, and post-test scores. It is unlikely that student post-test scores were impacted by outside training taking place concurrent with the study, but this could not be controlled.

The effect of maturation, or the physical and psychological growth and development of students, may have been an advantage in the present study. As students worked with the researcher singing and playing keyboard while simultaneously working

on choral music with their chorus director, uncertain singers may have improved vocally and all students may have gained additional self-confidence in singing. This may have enhanced the chances of all students gaining sight-singing skill throughout the study and improving their post-test score.

It is unlikely that the pre-test sensitized students to the post-test. None of the students had prior sight-singing training so they were very unsure when taking the pre-test. It is unlikely that they would remember items from a test that was so difficult for them. The challenge was to convince them to try the pre-test at all. Some did not complete all items.

The phenomenon whereby students whose scores fall at either extreme on a test tend to approach the mean on retesting is called statistical regression. Statistical regression did not appear to be a factor in this study. Only three students received a lower score from pre-test to post-test and 72 students improved their scores.

Differential selection is a threat when students are not randomly assigned to treatment groups, which causes confounding variables to affect the treatment. Differential selection was not a threat in the present study because students were assigned according to a table of random numbers.

Experimental mortality occurs when students drop out before the end of a study, miss the pre-test or post-test, or are excessively absent from treatment sessions. Most students seemed content with their participation because two treatments were given and all students perceived that they were learning. Attendance was good and no subjects quit the study. However, one student was not post-tested because of serious illness.

Selection-maturation-interaction can be a threat when one group is older than another. There were students from grades nine, ten, and eleven in all three choruses, but

two choruses were preponderantly freshmen and one chorus preponderantly sophomores. In the present study students had received no prior sight-singing training so they were judged equal as novice sight-singers for the training. It would have been desirable to have subjects all the same age but this could not be controlled. There were 42 freshmen (age 15), 30 sophomores (age 16), and three juniors (age 17) in the sample.

Experimental treatment diffusion occurs when members of the control group seek access to the experimental treatment. After several initial complaints about not being able to play keyboards, control group students stopped complaining when they realized they were learning to sight-sing. Members of the control group did not seek access to the keyboard training and results of the exit survey indicate that experimental students did not teach or share their keyboard experience with control group students. The fact that the researcher kept the music at all times served as an effective control. In addition, the groups were trained separately in different rooms so they could not hear each other's training. Some control group members did express the desire to play keyboards in chorus in the future if the opportunity arises.

There did not seem to be any rivalry between the two groups as in the "John Henry Effect." This is the phenomenon whereby the control group perceives themselves as in a competition and tries to top the other group. Both groups seemed interested in improving their sight-singing ability and both groups were focused and diligent. The control group did not become demoralized and seemed to become more interested as the study progressed.

External Validity

External validity of a study can be increased if enough description is provided to allow the study to be replicated in the future. A complete description of the sample was

provided including information on racial characteristics, socio-economic conditions, school description, number of males and females, age of the students, and grade levels. In addition, complete lesson plans for both groups were provided along with a comprehensive description of materials and procedures.

There is the possibility that the keyboard was viewed as a novelty in the beginning of the study and students in that treatment felt special initially. This experimental group advantage was temporary. Many students found it challenging to sing and play simultaneously and for some, initial enthusiasm waned. The control group by contrast warmed to their treatment as time progressed. External validity is also increased by the fact that the post-test was not given immediately. Students experienced a break of 3 to 4 weeks between the last treatment and the post-test. This gave them ample opportunity to forget and the fact that 96% of students posted a positive gain score on the post-test is an indication of retention of learning.

This experiment was carried out in a field setting. Students freely asked questions and made comments as the study progressed. Students were administered an exit survey which gave them an opportunity to share their attitudes and feelings about their own learning, the treatment, use of keyboards, and sight-singing in general. The researcher kept a separate journal for each school, in which interactions, either positive or negative, were recorded. An additional control was provided by a videotape of the researcher teaching at all three schools, which was reviewed by other music educators as a control on teacher bias. Treatment fidelity was not an issue because the researcher served as trainer. The lesson plans were examined by two experienced Kodály educators. Their qualifications and comments can be found in Appendix H.

Analysis

Descriptive statistics including mean, mode, median, range, and standard deviation were calculated for both treatment groups on the pre-test and post-test scores of the VSRI. Average gain scores from pre-test to post-test on the VSRI for students in both treatment groups were compared according to high and low musical aptitude scores. Significant differences between and within groups were calculated using ANCOVA with MAP scores serving as the covariate. A repeated measures ANOVA was used to discover interactions between post-test score, treatment group, and musical aptitude group. All statistics were calculated using SPSS 6.1 for Windows Student Version.

Assumptions underlying ANCOVA include randomness, independence of observations, normal distribution, homogeneity of variance, the independent variable not affecting the covariate, homogeneity of within group correlations, and linearity. Significance was determined using a two-tailed test at the $p = .05$ level.

Summary

The study was conducted to test the relative effectiveness of two methods of aural training in teaching sight-singing skills to high school students. The participants were 75 students from grades nine through eleven enrolled in the training choirs of their schools. At two schools Chorus I was utilized and at one school Chorus II was selected. There were 37 students in the experimental group and 38 students in the control group. The sample included 42 freshmen (age 15), 30 sophomores (age 16), and 3 juniors (age 17). The experimental group included 10 males and 27 females while the control group included 10 males and 28 females.

After parental permission forms were signed and prior to training, the students were tested with the melodic portion of the Musical Aptitude Profile written by Edwin Gordon, for the purpose of determining prior melodic knowledge. Students were additionally tested in sight-singing with the nine melodies of Michelle Henry's Vocal Sight-Reading Inventory and then randomly assigned to either the vocally trained Blue Group or the piano keyboard-reinforced Red Group. Students with five or more years of piano training were evenly placed between the two groups.

The students received 14 weeks of training that included echoing of patterns of melodic intervals with solfège, singing of short melodies in solfège, exercises using Curwen hand signs, sight-singing of mystery songs, and signing in small groups. The keyboard-experience group was encouraged to play and sing all exercises as they echoed the researcher and as they read from notation. Both groups participated in one melodic dictation exercise and one individual training experience with the researcher. At the end of 14 weeks, students were again tested with the same nine melodies of the VSRI. All students and the cooperating teachers completed exit surveys designed to elicit information concerning student enjoyment in playing the keyboard, student perception of their improvement in sight-singing ability, overall impressions of the training, and teacher assessment of the educational experience.

The pre-test post-test control group design was utilized in the study. The control group functioned as a comparison group and received a similar treatment that did not include the variable under study, a program of portable electronic piano keyboard experience. The data was analyzed by use of descriptive statistics and the ANCOVA and repeated measures ANOVA procedures.

Chapter Four

Data Analysis

Null Hypothesis

There will be no significant statistical difference at the .05 level on the Analysis of Covariance using the Musical Aptitude Profile, Tonal Imagery, part A as the covariate between the post-test sight-singing scores on the Vocal Sight Reading Inventory of novice high school chorus students receiving aural and visual vocal training for sight-singing that includes portable electronic piano keyboard experience and the post-test sight-singing scores of high school students receiving only aural and visual vocal training for sight-singing.

Findings

The null hypothesis cannot be rejected. There is no significant statistical difference at the .05 level on the Analysis of Covariance using the Musical Aptitude Profile, Tonal Imagery, part A as the covariate between the post-test sight-singing scores on the Vocal Sight Reading Inventory of the experimental and control groups (See ANCOVA Summary in Table 3). Analysis of descriptive data reveals that the experimental group achieved a lower pre-test average than the control group but made up that difference during training. The gain score was, therefore, larger for the experimental group. The two groups scored evenly on the post-test (See Tables 4 and 5). Overall, 96% of students improved their sight-singing scores from pre-test to post-test regardless of grouping. The only difference between the training of the two groups was the program of electronic piano keyboard experience. The larger gain for the experimental group might reliably be attributed to the keyboard training.

Table 3

ANCOVA Summary—Tests of Between-Subjects Effects

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Eta Squared
Corrected Model	27664.7	2	13832.4	13.90	.00	.28
Intercept	395.3	1	395.3	.39	.53	.01
Apt. Test	27664.6	1	27664.6	27.80	.00	.28
Grouping	10.9	1	10.9	.01	.92	.00
Error	71409.9	72	991.8			
Total	372083.0	75				
Corrected Total	99074.6	74				

Table 4

Pre-test Data—Vocal Sight-Reading Inventory

	N	*M*	*SD*	*Mdn*	Range
Experimental	37	23.6	27.2	9.0	91
Control	38	27.3	30.7	12.5	102

Table 5

Post-test Data—Vocal Sight Reading Inventory

	N	*M*	*SD*	*Mdn*	*Range*
Experimental	37	60.3	37.9	64.0	126
Control	38	60.3	35.7	62.0	125

After determining high and low aptitude groups by a median split, a repeated measures ANOVA was used to examine the interaction between post-test score,

treatment group, and musical aptitude group. The interaction between post-test score and musical aptitude group was significant ($p < .006$). High aptitude students benefited from the training more than low aptitude students. Comparing average gain scores on the VSRI from pre-test to post-test of high aptitude students and low aptitude students in both treatment groups revealed that the high aptitude experimental (keyboard-trained) students made a greater average gain than did the high aptitude control group. The larger mean gain score of the high aptitude experimental group was compared to the mean gain score of the high aptitude control group and the 8.67-point difference was not statistically significant. Low aptitude experimental group students made a lesser average gain than did low aptitude control group students (See Table 6).

Table 6

Average Gain Scores Pre-test to Post-test—VSRI by Aptitude Group

Treatments	MAP scores—30-40	MAP scores—0-29
Experimental	47.00	24.89
Control	38.33	28.40

Sub-problem

Do students enjoy playing keyboards in chorus as a reinforcement experience in sight-singing training?

Findings

Overall, 92% of the experimental group responded "yes" to the exit survey question as to whether they enjoyed playing keyboard in chorus as a reinforcement experience in sight-singing training. At school A, 92% of experimental students responded positively to playing keyboards in sight-singing training. School B gave an 83% positive response to keyboard playing and School C gave a 100% positive

response to keyboard training. When asked if they would like to see keyboards included as part of chorus in the future, 41% of experimental group students responded favorably at School A, 25% responded favorably at School B, and 75% of students responded favorably at School C. Overall, only 40% would favor including a keyboard component in chorus in the future. The reason most often given was the belief that it takes too much time away from singing (See Table 7).

Table 7

Responses to Exit Survey by Treatment Group and School

School A	Experimental	Control
1. Believe their sight-singing ability improved.	75%	75%
2. Believe their understanding of music notation and how it relates to higher and lower sound improved.	67%	50%
3. Believe their attitude toward sight-singing improved	25%	15%
4. Would like to see keyboards become part of chorus in the future.	41%	16%
5. Enjoyed playing keyboard	92%	
School B	**Experimental**	**Control**
1. Believe their sight-singing ability improved.	75%	92%
2. Believe their understanding of music notation and how it relates to higher and lower sound improved.	67%	67%
3. Believe their attitude toward sight-singing improved	25%	42%

Table 7 (continued)

School B	Experimental	Control
4. Would like to see keyboards become part of chorus in the future.	25%	33%
5. Enjoyed playing keyboard.	83%	
School C	**Experimental**	**Control**
1. Believe their sight-singing ability improved.	100%	74%
2. Believe their under-standing of music notation and how it relates to higher and lower sound improved	83%	53%
3. Believe their attitude toward sight-singing improved.	42%	63%
4. Would like to see keyboard training become a part of chorus.	75%	45%
5. Enjoyed playing keyboard.	100%	
Total	**Experimental**	**Control**
1. Believe their sight-singing ability improved.	83%	74%
2. Believe their understanding of music notation and how it relates to higher and lower sound improved.	72%	57%
3. Believe their attitude toward sight-singing improved.	30%	40%
4. Would like to see keyboards become a part of chorus in the future.	47%	31%
5. Enjoyed playing keyboard	92%	

Additional Findings

Piano training and aural skills development. Prior research has indicated that students who have had six or more years of piano training are likely to have developed the aural skills needed for sight-singing (Hansen, 1961; May & Elliott, 1980; Tucker, 1969). Only two students in the present study had 6 or more years of piano training and both scored in the top half of scorers on the VSRI post-test. A student with 9 years of piano training scored 105 and a student with 7 years of piano training scored 85.

There were 181 possible points on the VSRI and the best score obtained was 127 or 70% correct. Of the 13 highest scorers on the VSRI eight had from 1 to 9 years of previous piano training (See Table 8).

Table 8

Highest VSRI Post-test Scores and Years of Piano Training

Student	Treatment	Post-test	Piano
59C	Control	127	0
69C	Experimental	126	0
40B	Experimental	126	2.5
18A	Experimental	121	3
49B	Control	118	2
70C	Experimental	118	2.5
65C	Control	110	0
61C	Experimental	108	1
68C	Control	108	3
10A	Experimental	105	0
14A	Control	105	9

Table 8 (continued)

Student	Treatment	Post-test	Piano
51C	Experimental	105	0
74C	Control	95	3

Sixteen out of the 19 piano-trained students scored in the upper half of scorers on the VSRI post-test (See Table 9). These students had received from 1 to 9 years of prior piano training. Six or more years of training did not result in the largest sight-singing scores in this group. The highest scorer had only 2.5 years in their background.

Table 9

Piano-Trained Students in the Upper Half of the Distribution—VSRI

Student	Treatment Group	Post-test	Years of Piano Study
40B	Experimental	126	2.5
18A	Experimental	121	3
70C	Experimental	118	2.5
49B	Control	118	2
68C	Control	108	1
61C	Experimental	108	3
14A	Control	105	9
41B	Control	99	1
28B	Experimental	95	1
74C	Control	95	1
54C	Control	93	2
20A	Control	90	1
31B	Experimental	85	7

Table 9 (continued)

Student	Treatment Group	Post-test	Years of Piano Study
36B	Experimental	79	1
67C	Control	67	4
29B	Experimental	64	1

Ten out of the 19 were also high aptitude for melody (30-40 on MAP) (See Table 10).

Table 10

High Aptitude Piano-Trained Students and VSRI Post-test Scores

Student	MAP	Post-test	Years of Piano Study
40B	32	126	2.5
70C	32	118	2.5
49B	32	118	2
68C	38	108	3
61C	32	108	1
14A	38	105	9
41B	31	99	1
20A	35	90	1
36B	37	79	1
67C	30	67	4

Choral directors' responses.

In response to the exit survey, two directors noticed their students spontaneously using Curwen hand signs and solfège syllables during warm-ups, rehearsals, and even tryouts for an after-school vocal group. All three directors credited the training for

improvements noticed in boys who were uncertain singers. All three directors reported that their novice chorus showed faster improvement in vocal sound, musicality, pitch-matching ability, and especially sight-singing ability than in previous years. Some improved abilities mentioned that were attributed to the training of the present study included knowledge of keys, knowledge of solfège, knowledge of intervals, and pitch accuracy. All three directors considered sight-singing to be a very important part of chorus and all would consider using keyboards as an adjunct activity in the future.

Uncertain singers. An unexpected problem in the study was the large number of students in the novice choruses at schools A and B who could not accurately match pitch. Eight boys at schools A and B were mostly unable to match pitch as well as five girls at school A. The 13 uncertain singers represent 17% of the sample, a substantial number for this small study (See Tables 11 and 12).

Table 11

Non-Singing Males

Student	MAP	Gain	Treatment
3A	18	13	Experimental
4A	26	34	Experimental
12A	26	1	Experimental
42B	28	14	Experimental
43B	22	3	Control
44B	21	1	Control
47B	14	30	Control
48B	29	21	Control

The non-singing males were equally distributed between experimental and control groups while four of the non-singing girls were in the control group and all five were members of the same chorus at school A.

Table 12

Non-Singing Females

Students	MAP	Gain	Treatment
2A	22	-13	Control
7A	15	2	Control
13A	25	9	Control
16A	23	14	Control
17A	18	0	Experimental

Noise Distraction. Another problem that may have affected the result was the very high noise level in the training room at school A. Both groups complained that they could not block out the sound of the band on some days. The average gain score for the control group at school A was considerably lower than the scores of schools B and C. Their lower scores might be partially attributed to the noise distraction (See Table 13).

Table 13

Average MAP and VSRI Gain Scores by School and Treatment Group

School	MAP	Gain
School A Experimental	26	36.4
School A Control	28	29.8
School B Experimental	28	35.6

Table 13 (continued)

School	MAP	Gain
School B Control	27.3	35
School C Experimental	29.7	37.8
School C Control	29.9	37.6

Summary

There was no significant statistical difference at the .05 level on the Analysis of Covariance using the Musical Aptitude Profile, Tonal Imagery, part A as the covariate between the post-test sight-singing scores on the VSRI of novice high school choir students who received aural and visual vocal training for sight-singing that included portable electronic piano keyboard experience and novice high school students who received aural and visual vocal training alone for sight-singing.

Of the total group, 96% of students improved their sight-singing scores from pre-test to post-test regardless of grouping. A repeated measures ANOVA revealed a significant interaction between post-test and aptitude group. High aptitude students in both groups improved their sight-singing ability more than low aptitude students. An analysis of the gain scores from pre-test to post-test on the VSRI divided between high aptitude (30-40 on MAP) and low aptitude (0-29 on MAP) students revealed that the high aptitude experimental group (keyboard-trained) students attained an average gain score that was 8.67 points higher than the high aptitude control group students. The difference in the mean gain scores between high-aptitude groups was not statistically significant. The low aptitude control group students attained an average gain score that was 3.51 points higher than the experimental group.

In response to the sub-problem regarding enjoyment of keyboard playing in the training, 92% of experimental group students reported that they enjoyed playing keyboards in sight-singing training. However, only 40% of experimental group students would favor adding a keyboard component to chorus in the future. The reason most often given was that keyboards would take too much time away from singing.

The two students with six or more years of prior piano training scored in the top half of scorers on the post-test of the VSRI. Of the 19 piano-trained students in the sample, 16 scored in the top half of scorers on the post-test of the VSRI. Ten out of the 19 piano-trained students demonstrated high aptitude for melody as measured by the Musical Aptitude Profile, Tonal Imagery, part A. Of the 13 highest scorers on the post-test of the VSRI, eight had from 1 to 9 years of previous piano training.

Choral director surveys revealed that all three directors considered sight-singing a very important component of choral education and all would consider using keyboards in the future as an adjunct in sight-singing training. The directors credited the study with improvement in such diverse abilities as pitch matching, knowledge of keys, knowledge of solfège, and knowledge of intervals.

One of the unexpected problems was the large number of students who were either non-singers or uncertain singers. Thirteen students fit into this category. Since pitch-matching ability is one of the constructs of sight-singing, they had little chance to succeed in the training. Another problem was noise distraction at school A where the students were forced to listen to the band rehearse during their sight-singing training. The average gain score for the control group was lower at school A than for the other schools studied.

Chapter Five

Summary, Conclusions, and Recommendations

Summary

Introduction. For the past fifty years there have been persistent suggestions in the music education research literature that piano or keyboard training is positively correlated with the development of the musical ear. Stecklein and Aliferis (1957) noticed that among all instrumentalists, pianists possessed the best melodic and harmonic discrimination skills. Hansen (1961) and Tucker (1969) noted that students with six or more years of piano training possessed greater ability than other instrumentalists to hear music seen in notation and to visualize music heard. Hargiss (1960) utilized a unified training approach with college freshmen in which music theory, ear training, sight-singing, and piano were all taught in the keyboard laboratory. Students who played and sang all their music excelled in sight-singing after 15 weeks of training. Improvement in such diverse skills as tonal memory, vocal development, melodic discrimination, and melodic perception were reported among elementary school children in the studies of Lyke (1967), Finnell (1974) and Martinez(1976) after weeks of training using electronic piano keyboards. Wig and Boyle (1982) and Curt (1990) reported similar improvement in the aural skills abilities of middle school students after utilizing a program of electronic piano keyboard training. May and Elliott (1980) in a three-year longitudinal study of students from grade four to grade seven discovered that private piano study was a significant independent factor in aural skills development. Daniels (1986) and Demorest and May (1995) reported the factors most positively related to sight-singing excellence in the high school choir including a piano in the home, years of piano training, and years of chorus training. Henry and Demorest

(1994) tested the individual sight-singing abilities of students in several choirs with a reputation for sight-singing excellence at state adjudications and discovered that the highest scorers had years of piano training in their background. Several studies involving beginning band students suggested a connection between singing and playing in the improvement of melodic discrimination, tonal memory, and notational understanding (Elliott, 1974; MacKnight, 1975; Grutzmacher, 1989).

Despite the suggestions of a link between keyboard training and aural skills ability, there are no prior studies utilizing portable electronic piano keyboards in connection with sight-singing training at the high school level. Surveys of choral directors in the past five decades indicate no use of portable electronic keyboards to teach sight-singing in the high school chorus (Carey, 1959; Dwiggins, 1984; Ernst, 1957; Hales, 1961; Johnson, 1987; Szabo, 1992). Because electronic keyboards seem to be under-utilized in the high school chorus, the present study attempted to determine if sight-singing training that included reinforcement experience using portable electronic piano keyboards would result in faster, more effective learning for novice high school chorus students.

Cognitive theories such as Information Processing and Multiple Modality Learning suggest that learning is improved in the presence of rich sensory experiences in which several of the primary senses take in information simultaneously. In the present study, hearing a vocal model and then singing and playing after the model may have helped to maintain the sounds of intervals in working memory. Further rehearsal by hearing the model, seeing notation of the intervals, and then singing and playing the intervals simultaneously may have moved the sound of intervals to long-term memory or the phonological loop where the memory of the sounds could be utilized when

singing the unfamiliar test melodies. The researcher reasoned that the overlapping aural, visual, and tactile information emanating from the electronic piano keyboard experience might result in faster and more effective sight-singing training for the high school choral program. Evidence suggests that for many high aptitude students in both treatment groups the repetitious rehearsal enabled the sounds of intervals to be placed in long-term memory where they were successfully utilized in sight-singing test performance. The fact that some keyboard-trained students made the largest test gain scores suggests that measuring intervals through tactile performance at the keyboard while simultaneously singing may speed the learning in some high-aptitude students. The results also support the dual mode processing theory because students in both treatment groups successfully used audial and visual information simultaneously to support sight-singing success.

Keyboards and sight-singing. The training of the present study resulted in a positive gain score for 96% of students regardless of treatment group. The experimental (keyboard-trained) group made a larger overall average gain score since their pre-test score was lower than the control group and the two groups post-tested evenly. The keyboard experience did not interfere with the learning of sight-singing and the results suggest that the portable electronic piano keyboard can be an effective tactile reinforcement experience in the aural vocal sight-singing training of high school choral students, especially those with high melodic aptitude. While the keyboard training may take slightly more instructional time in the early stages, that time will likely be off-set in later years when the students can read new repertoire with ease.

First-time study of the piano can be daunting because of the need to decode notational symbols in order to arrive at note names that are connected to certain keys

that are depressed by certain fingers. The researcher designed the simplified keyboard approach of this study to allow vocal students to transfer their solfège knowledge to the keyboard. Finger stickers marked with solfège syllables turned each finger into a tone of the major scale, thereby allowing students to measure intervals by touch as the intervals were simultaneously sung. In addition, the student could transfer the major scale hand position to different major key placements on the keyboard, thereby utilizing the concept of relative solmization at the piano keyboard. The simplified system allowed students with no piano background to meet with tactile success. Students could instantly transfer the training in relative solmization to the keyboard, where they could see and measure the intervals through touch and relate them to the tonic pitch in each key studied. The preset arrangement of the sticker-clad fingers could be easily moved among the three keys. The understanding of flats or sharps as lower or higher sounds was reinforced by the movement of fingers down or up to the black keys.

Curwen hand signs appeared to be useful in helping students distinguish among higher and lower pitches in the initial stages of the treatment. Most keyboard students had no problem adjusting to the right-left orientation of the high-low on the keyboard. They also made the next connection of higher and lower on the staff with right to left on the keyboard. The solfège ladder was very helpful in establishing the distance between intervals, especially larger ones, aurally and visually before performing them on the keyboard.

Many students commented that they could "hear the pitch" more easily through use of the keyboard. The keyboard allowed students to center, concentrate, and focus their attention more intensely on the sound. Since keyboard timbre is different from vocal timbre it may serve as an amplification of the sound that a student can use for

vocal support. Piano timbre is distinct but does not overpower the vocal sound. It allows students to hear their own voice distinctly, apart from the keyboard. It may actually be easier to hear your own sound in relation to a keyboard than it is to hear your own sound within a group of other singers. The keyboard always produces an accurate in-tune sound whereas it is possible to be surrounded by inaccuracy in the chorus. Uncertain singers remarked that the keyboard helped them hear the pitch better and the modest gain scores made by four of the non-singers in the experimental group may add confirmation to this claim. While several control group students made a negative gain score or made no gain, all experimental group students made a positive gain score except one non-singing female.

High aptitude gain scores might reliably be attributed to the keyboard training since the two treatment groups received the same aural vocal training. The high aptitude experimental group students were able to make the connections among the keyboard arrangement of tones, the sound of the intervals heard aurally, the sight of the intervals in notation, the feel of the distance between tones through touch, and the placement of the hands in the three positions for the keys used. Those who experienced success worked quietly, asked few questions, played and sang simultaneously with no difficulty, and generally worked independently to learn from the keyboard. When considering the short training period (28 lessons at 15 minutes each or approximately 7 hours) it is encouraging that the average gain score for high aptitude experimental group students was 8.67 points higher than the average gain of the high aptitude control group. The results suggest that the portable electronic piano keyboard does aid in the formation of aural imagery in high aptitude students and, in addition, it allows some students to learn faster than aural-vocal training alone.

Experimental group students who experienced success through keyboard training came from varied musical backgrounds. Some had few previous musical experiences. One student who made a gain of 96 points was participating in chorus for the first time and had no formal musical training except a few months of voice lessons. Another student who made a 105 point gain had 5 years of instrumental training, 3 years of piano training, and 2 years of chorus training in his background. Other students had several years of instrumental training, a few had from 1 to 7 years of piano training, and many had multiple years of chorus experience.

The results for students with low musical aptitude were less conclusive. It was unfortunate that 17% of the low aptitude group could not match pitch and therefore had a lesser chance of learning to sight-sing (See Tables 11 and 12). Some low-aptitude students had difficulty remembering basic facts regarding finger sticker placement, location of *do*, and movement among the three hand position placements. These students needed more individual attention and it was impossible to adequately assist them due to the fast pace of the study and the short training period. Low-aptitude students needed more repetitions of the melodic intervals than did the high-aptitude students. They were not self-starting, needed reminders, didn't retain the learning, and needed one-on-one help. The students who did not sing and play simultaneously in a consistent manner scored lower. Lower aptitude students often were concentrating so hard on the keyboard that they did not sing simultaneously without reminder. In a chorus classroom, these students could be aided by higher aptitude classmates, they could be allowed time for more repetitions, and the director could arrange time to hear each student perform individually.

The entire sample of chorus students was interested in playing keyboards and there was initial disappointment among many control group students when they learned they would not be playing them. Over time those students realized that they were learning to sight-sing and they appreciated their aural skills training. Many control group students, however, expressed the hope that they could play keyboards in the future.

Enjoyment of keyboard training. While 92% of keyboard students enjoyed playing keyboards in chorus, there was a concern that it took an excessive amount of time from learning their choral repertoire for programs. This finding was curious when one considers the 90-minute module available for rehearsal, which would seem to allow adequate time for aural skills training. Each training group was only absent for 15 minutes of each rehearsal so it is doubtful that it impacted the rehearsal negatively. Perhaps if their director had conducted the sight-singing training they would have more greatly appreciated the value of the cognitive skill of sight-singing in increasing the overall musicianship of the choir. Increased musicianship should make it possible to learn repertoire more quickly in the future.

Kodály training. Sight-singing is, essentially, memorization of melodic intervals that are placed in long-term memory after repetitious rehearsal. Students who thought the repetitive training was boring initially were surprised to find that they could sight-sing seconds and thirds when they appeared in the first mystery melody. The alternation of periods of repetitive training in melodic intervals with the sight-singing of unfamiliar melodies containing those intervals was important in giving the students and the researcher knowledge-of-results feedback. The periods of rote training were thus alternated with periods requiring thinking in action. Their sight-singing success

encouraged the students to continue to learn more intervals until the major scale intervals were covered (except for sixths and sevenths).

During the pre-test almost all students indicated to the researcher that they feared sight-singing. Many believed they could not do it and some would not try. The fact that 96% of all students posted a gain from pre-to post-test indicates that training using Kodály techniques was effective sight-singing training for the high school students. The sequential presentation of intervals sung with solfège syllables tied to tonic and the repetition of the sounds through imitation of the researcher model provided effective training for most students. The use of solfège syllables was very effective in providing a different word for each sound. It is critically important that the person who serves as the vocal model in this training has accurate aural skills and a clear singing voice. This person must not only serve as vocal model but also provide immediate feedback to students for correction of errors.

It was apparent during the pre-testing that many students had no understanding of notation as it relates to higher and lower sound. The spatially-arranged solfège cards moving to notation combined with the use of Curwen hand signs resulted in marked improvement as measured by the post-test. The tonic solfa approach was also extremely successful. During post-testing most students had such a strong aural image of tonic that even when they modulated within the vocal line they found their way back to end on tonic in the original key. Additionally, students demonstrated an awareness of incorrect vocal tones sung during the post-test. This was demonstrated by their ability to recognize their own incorrect singing and correct these errors in performance. Kodály techniques, whether combined with keyboard experience or not, were effective in providing aural imagery and some notational understanding in 96% of students.

Conclusions

Testing. None of the students mastered all of the intervals on the VSRI in the 14 weeks of the study. The best showing was 127 out of 181 points or 70% correct. The VSRI seemed to be a difficult test for the novice choir. The inclusion of chromatic intervals was especially difficult for students who were struggling with diatonic scale intervals. Fourteen weeks may not have been a sufficiently long period of time for the development of the complex aural skills needed for success on the VSRI. The test might be more appropriately used with the advanced high school choir or after at least a full year of systematic sight-singing training. Many students commented to their directors after the post-test that the test was very difficult.

Musical aptitude and sight-singing. Edwin Gordon has written extensively about musical aptitude and has devised several musical aptitude tests, among them the Musical Aptitude Profile. Gordon defined musical aptitude as "a measure of a student's potential to learn music" (Gordon, 2003, p. 41). Gordon believes that some people are born with more aptitude than others "because it originates in the cells and genes" but that everyone can learn music to some extent (Gordon, 2003, p. 41). Musical aptitude is believed to be malleable up to age 9 because of a child's musical environment and training but it then remains throughout life what it was at that time. "Musical aptitude is then a product of both innate potential and environmental influences" (Gordon, 2003, p. 42).

The Musical Aptitude Profile, Tonal Imagery, part A was a good predictor of potential to achieve in sight-singing as measured by the VSRI. Of all students with high MAP scores, 81% scored in the top half of the distribution on the VSRI post-test. Administration of the MAP, Tonal Imagery, part A to novice chorus students would

allow directors to immediately identify students who will learn to sight-sing quickly. These students can then become leaders within their sections where they can serve as vocal models for less able students. Decisions about seating, level of choral repertoire, sight-singing materials, and sight-singing training procedures could be made on the basis of test results. The information from this test would allow directors to quickly discover students whose melodic potential will allow them to contribute most to the group in terms of sight-singing ability and overall musicianship.

Gordon's comments regarding tactile learning and its relationship to high musical aptitude appear to have some validity. While it is true the high aptitude students scored higher on the sight-singing post-test, individual low aptitude keyboard-trained students made gains of as much as 50 points and all but one keyboard-trained student made a gain from pre-test to post-test. Low-aptitude students probably need more repetitions, more treatment time, and some individual help, but indications are present that all students can learn through the electronic piano keyboard regardless of aptitude.

Uncertain singers. One of the constructs of sight-singing is the ability to match pitch. An unexpected problem in the study was the 13 students who could not match pitch at all or were very uncertain. The eight boys had elected the general music class track in middle school, in which students rotate from a few weeks of general music class to other arts offerings each year. Students in this track do not sing and are not allowed to elect chorus. These students, therefore, do not sing during the critical years when the voice is changing. When they elect chorus in grade 9, it can take considerable time for them to learn to sing again. The sight-singing construct that is lacking is ability to match pitch and pitch perception problems may also be involved. Some of the boys made progress and several commented that the keyboard "helped me hear the pitch."

Despite this fact, their gain scores were modest after 14 weeks of the training and their MAP scores were also in the lower half of the distribution (See Table 11).

The non-singing girls, all from school A, lacked confidence at the start of the study as evidenced by very soft singing or reluctance to sing at all. Improvement in confidence was seen in both treatment groups, but five girls never really learned to sing on pitch and one frankly declared that she "didn't like to sing" (See Table 12). The 13 uncertain singers represent 17% of the sample, a substantial number for this small study.

Noise distraction. It was very difficult to teach at school A due to the lack of soundproofing in the walls between the band room and the training room. The chorus director refused to allow the researcher to use her room for the half hour required even though the need for a quieter environment for aural skills training was emphasized. The control group complained that they could not block out the sound on some days. The keyboard group had an advantage because the sound of the keyboard reinforced their vocal sound making it easier to sing over the distraction. The average gain score for the control group at school A was 29.8 points, considerably lower than the 35 point average for the control group at school B or the 37.6 point average for the control group at school C (See Table 13). Aural skills training should ideally happen within the walls of a well-sound-proofed choral classroom.

Feasibility of portable electronic piano keyboard use in chorus. Portable electronic piano keyboards combined successfully with chorus activities in the present study. The keyboard laboratory of from 12 to 13 instruments had to be set up and taken down each chorus period because the training room was used for other activities all day. The researcher, working alone, set up the laboratory in 30 minutes and took it down in

20 minutes at school B. With the help of two or three students it was set up and taken down in 15 minutes at schools B and C. The laboratory was successfully utilized on tables, rolling carts, and chair desks. In addition, the laboratory took up little space and could have been utilized in any of the three chorus rooms if a separate room had not been available.

Prior musical experiences. Data from the initial questionnaire gave information about prior experiences of the sample. In the present study, 99% of students with high melodic aptitude have had years of choir experience in combination with years of piano and/or years of instrumental lessons and/or years of private voice lessons. Among the top half of scorers on the VSRI post-test, 76% had choir combined with either piano training or instrumental training or voice training.

Exit survey responses. Student responses to the exit survey questions generally reflect the personality, aptitudes, and attitudes of each group (See Table 7). School A's experimental group started slowly but made great improvement beginning in October. Their singing was stronger by then and only two students had to be reminded to sing. By December the researcher's notes reflected an awareness that many of the experimental group boys had shown pitch improvement and the girls were singing with more confidence. The control group at school A consisted of four strong-singing boys while all the girls except one were weak and hesitant singers. Researcher notes indicate steady improvement in confidence over the course of the study despite the complaints about the noisy room environment. Their director, who was somewhat uncooperative initially, was not willing to share her room with the researcher and did not share positive comments or observations with the researcher even though positive things were known to be happening. However, she became very supportive about halfway through

as she observed students using solfège and hand signs to help as they tried out for extra-curricular vocal groups and their progress as they sang new repertoire in class.

School B's experimental group was conducted in a small cramped area and it was a more stressful situation for the researcher. Initially the group worked hard and made progress on the smaller intervals. In October it was clear that some students were having problems and needed one-on-one help that could not adequately be given in the time allowed. Low-aptitude students had difficulty singing and playing. Only five students out of twelve in this group were high aptitude. The control group by contrast was comprised of strong singers with higher musical aptitudes who were interested and hard working. Their attitude was more positive and they made good progress. The teacher at this school was not particularly helpful or supportive. She did not share any comments with the researcher and offered no help in setting up and taking down the keyboard laboratory. Her attitude may have affected the group to some extent.

School C's chorus was enthusiastic about the project. Their director was excited about the possibility of sight-singing improvement for her group. She provided verbal feedback about the students and provided help each week for the keyboard laboratory setup. The atmosphere of school C, however, was not as disciplined as the researcher preferred. The control group was initially more boisterous than desired but they performed everything asked of them. Most students improved over the course of the training. The experimental group worked hard and enthusiastically throughout the training and seemed to enjoy playing keyboards a lot. Their director was absent about once a week during the semester but the students worked well despite disruptions to the routine. Their positive responses are a reflection of their experience.

Student comments made during pre-testing indicated initial fear of sight-singing. However, most students indicated an increased confidence in their ability to succeed after the study. Students in both groups reported an increased understanding of music notation and its relationship to higher and lower sound. The majority of keyboard students enjoyed playing keyboard in chorus.

Recommendations

Sight-singing training utilizing the portable electronic piano keyboard as a tactile reinforcement was shown to be equally effective in teaching sight-singing skills to novice high school chorus students as a method that used aural and visual vocal training alone. Some of the high aptitude keyboard-trained students made very large gains in sight-singing skill regardless of their prior musical training. This indicates that tactile reinforcement in association with aural and visual vocal training can be used effectively to develop the aural imagery needed for sight-singing in some students. Since the ability to match pitch is a melodic prerequisite skill for sight-singing, the group keyboard experience might be more effectively taught in the intermediate or advanced high school choir where all students would reasonably be expected to possess pitch-matching skill. If it is replicated with advanced students the researcher recommends 30-minute lessons utilizing the finger sticker technique and a simplified sight-singing measure.

If the keyboard experience is used again with the novice high school chorus, it is recommended that only intervals of the diatonic major or minor scale be taught within a 14- or 15-week training period. This would allow time for a sufficient number of repetitions to allow these intervals to become secure in long-term memory before progressing outside the octave or teaching chromatic intervals. One half-hour of training

for the novice choir might be more appropriate, at least in the early stages of training. It would allow time for the instructor to briefly aid students individually who need help while allowing talented learners to engage in creative or improvisational activities alone or in small groups. In addition, a less complex sight-singing test should be used as the dependent measure. Since Kodály training typically introduces major and minor scale intervals simultaneously, research on a program of portable electronic keyboard experience that would teach major and relative minor intervals simultaneously is recommended. The study could also be redesigned so that all students receive the aural vocal treatment together and some students additionally receive the keyboard experience.

Many uncertain singers in the present study reported that the keyboard experience helped them hear and match pitch more easily. More research is needed on the use of keyboards with uncertain singers in the novice high school chorus. Research involving the development of computer software containing sight-singing lessons with a recorded vocal model that students could access through a midi keyboard is recommended. This would allow students to listen, play, and sing without the need for the teacher's presence. The simplified finger sticker system of the present study could be used in conjunction with the software to allow students to work independently while needing very little piano-playing skill. A few minutes of independent work each chorus period might result in improved pitch matching skill over time.

A concern in formulating the present research study was the lack of published sight-singing tests available for use with the high school choir. More research in sight-singing testing is needed to design valid, reliable, and graded sight-singing tests for use with various age and ability levels. Tests for diatonic major intervals, diatonic minor

intervals, and a combination of the two would give directors a variety of easier testing options before using a more complex tool such as the VSRI.

The Musical Aptitude Profile, Tonal Imagery, part A was found to be very predictive of sight-singing potential in the present study. The researcher recommends the administration of this short test at the beginning of the school year as a diagnostic tool in high school chorus to assess the individual potential of students for sight-singing training. The extra knowledge about individual abilities could aid choral directors in decisions about grouping, seating, choice of sight-singing materials, choice of music, and the most appropriate methodology and techniques to use. The use of this test as a stratifying variable in future music education research is also recommended.

Finally, systematic training using the solfège syllables, spatially arranged solfège cards, notation cards, and hand signs associated with the Kodály Method were found to aid both treatment groups in the development of both the notational understanding and the aural imagery needed for sight-singing. More research is needed on the use of these techniques in conjunction with sight-singing training in choral groups of all ages.

Appendix A

Lesson Plans

Week One—Blue Group

Materials: *S-M-L* spatial cards, *S-M-L* notation cards in C Major, Curwen hand sign cards displayed in the room.

Lesson 1:

1. Students echo three-note patterns of *S-M-L* vocally after instructor.
2. Students echo the same patterns while viewing spatial cards.
3. Students learn the Curwen hand signs for *S-M-L.*
4. Students learn the position of the notes on the staff in C Major
5. Students echo from the staff cards in C Major, singing and signing.

Lesson 2:

1. Students echo and sign patterns using *S-M-L.*
2. Students sign for a partner in groups of two.
3. Students individually sign for the class to follow, each doing one sign.
4. Students echo from notation cards in C Major.
5. Teacher gives the first pitch and students sing from notation cards.

Week One—Red Group

Materials: Electronic keyboard, pre-marked gummed finger stickers, *S-M-L* spatial cards, notation cards in C Major.

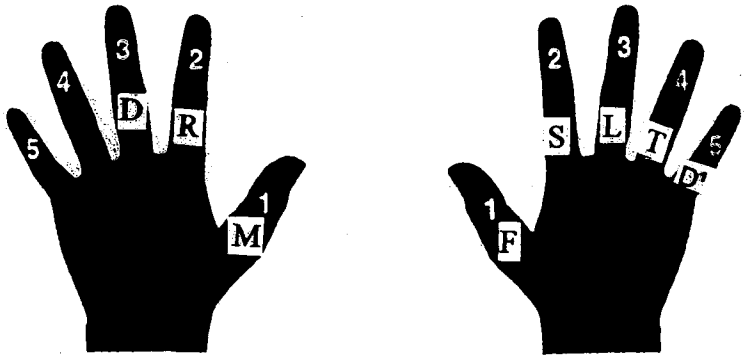
Lesson 1:

1. Students echo three-note patterns of *S-M-L* vocally after instructor.
2. Students learn the Curwen hand signs for *S-M-L.*
3. Students sing and sign while viewing the spatial cards.
4. Students echo from notation cards in C Major.
5. Students learn the hand position for C Major and which fingers to use for *S-M-L.* Students affix finger stickers.
6. Students sing and play after the instructor patterns of *S-M-L.*

Lesson 2:

1. Students echo three-note patterns of *S-M-L* after instructor, signing and singing.
2. Students echo from notation cards in C Major, singing and playing after viewing the card.
3. Men learn to play in a position one octave lower that coincides with the pitch of their voices.
4. Students turn to their binder, page 1. They look at notation and perform one measure at a time after the instructor, playing and singing. Finger stickers are in place for *S-M-L.*

Figure 3. Numbers used to identify fingers and location of syllables for the major scale.



Week Two—Blue Group

Materials: Spatial cards *D-M-S-L*, blackboard staff, notation cards in C Major, mystery song chart—"Ring Around the Rosy".

Lesson 1:

1. Students are taught new pitch—low *do*.
2. Students echo three-note patterns of *D-M-S-L*.
3. Students learn the hand sign for low *do*.
4. Students sing and sign from spatial cards, combinations of *D-M-S-L*.
5. Students echo from notation cards in C Major—singing and signing.

Lesson 2:

1. Students sign for each other in pairs combinations of *D-M-S-L*.
2. Students stand in a circle and sign one sign for the class to sing.
3. Students sing notation cards in C Major after instructor.
4. Instructor shuffles cards, establishes *do*, and students sing from cards.
5. Students observe mystery song chart in C Major. Instructor works aloud with them counting rhythm. Students figure out the solfège with instructor's help.
6. Students learn the rule: When *do* is on a line *mi* and sol are on the next two lines. When *do* is in a space, *mi* and *sol* are on the next two spaces. Instructor gives the first pitch. Students sight-sing and identify the tune.

Week Two—Red Group

Materials: **Songs in binder** using *D-M-S-L*, spatial cards of *D-M-S-L*, notation cards of *D-M-S-L*, mystery song chart, "Ring Around the Rosy".

Lesson 1:

1. Students sing from instructors hand signs—*M-S-L*.
2. Students learn the new pitch—low *do*.
3. Students sing three note patterns using *D-M-S-L* from spatial cards.

4. Students affix stickers including low *do* on proper fingers.
5. Students sing and play patterns of *D-M-S-L* in C Major position after instructor.
6. Students are oriented to the staff in C Major. They sing and play from the notation cards in C Major after the instructor.

Lesson 2:

1. Students sing and sign after instructor patterns of *D-M-S-L*.
2. Students are oriented to the staff in C Major with particular attention to the position of *do* for Treble and Bass clefs.
3. Students learn the rule: If *do* is on a line, *mi* and *sol* are on the next two lines. If *do* is in a space, *mi* and *sol* are in the next two spaces.
4. Students turn to pages 1 and 3 in the binder. Students play and sing one measure at a time after the instructor, looking at the notation.
5. Students observe the large mystery song chart on the blackboard. The instructor counts the four measures with them and helps them figure out the solfège syllable they will need. Students then sight-sing the four measures and identify the tune.

Week Three—Blue Group

Materials: *D-M-S-L* spatial cards, *D-M-S-L* notation cards in C and F Major, four measure song chords in C and F Major.

Lesson 1:

1. Students sing and sign from instructor's hands.
2. Students sign individually for the class to sing.
3. Students sing and sign *D-M-S-L* from the spatial cards.
4. Students sing and sign from the cards individually and in small groups.
5. Students orient to the staff by reviewing the rule: When *do* is on a line, *mi* and *sol* are on lines. When *do* is in a space, *mi* and *sol* are in spaces.
6. Students sing from notation cards in C Major.
7. Students learn the key signature and placement of *do* in F Major. They echo patterns from the notation cards in F Major.

Lesson 2:

1. Students echo from notation cards in C and F Major, singing and signing.
2. Instructor shuffles the cards and students sing with no help from instructor.
3. Students view an unfamiliar four-measure melody in C Major on a chart. Instructor helps with counting of rhythms. Students figure out solfège syllables needed. Reading rules are reviewed. Students sight-sing the melody.
4. Students view an unfamiliar different four-measure melody in F Major. The key signature and location of *do* are reviewed. Students count the rhythm with the instructor. Students figure out the solfège syllables in consultation with instructor if needed. Students sight-sing the melody. Instructor gives advice and encouragement as needed.

Week Three—Red Group

Materials: *D-M-S-L* spatial cards, *D-M-S-L* notation cards in C and F Major, four-measure melodies on pages 4 and 5 of the binder.

Lesson 1:

1. Students sing from instructor's signs as a group and in small groups.
2. Students affix stickers and sing and play *D-M-S-L* patterns after instructor in C Major hand position.
3. Students learn the new hand position for F Major.
4. Students play *D-M-S-L* patterns after instructor in F Major.
5. Students observe the 4-measure melodies on page 4 of the binder notated in C Major and F Major. Students sight-sing one melody at a time with the instructor noticing any measure that is a problem. Students then play the melody at the teacher sings the syllables. Next students play and sing with the instructor several times and then play and sing alone. The same procedure is followed for the rest of page 4.

Lesson 2:

1. Students affix stickers and play and sing patterns in C Major position.
2. Students play and sing patterns in F Major after instructor.
3. Students practice moving back and forth between the two positions as the instructor walks around the room and observes, helping as needed.
4. Students turn to the four-measure melodies on page 5 of the binder. Students sight-sing each melody in turn with the instructor. Two melodies are in C Major and two and in F Major. Students play each one as the instructor sings the solfège syllables. Then the students sing and play each several times.
5. Students rehearse silently using headphones as the instructor walks around the room checking individual progress.

Week Four—Blue Group

Materials: Spatial cards *D-R-M-S-L*, notation cards, four-measure song charts for "Camptown Races", "Hot Cross Buns", "Up on the Housetop" and "Jingle Bells", which utilize *D-R-M-S-L*.

Lesson 1:

1. One half the class at a time sings and signs after instructor.
2. Individuals sign one at a time for the class to sing.
3. Students learn the new tone *re* and the hand sign.
4. Students echo patterns of *D-R-M-S-L* from spatial cards.
5. Students learn to orient *re* on the staff in C Major. They learn the rule: If *do* is on a line then *re* is in the space above it. If *do* is in a space then *re* is on the next line above it.
6. Students echo from notation cards in C Major using patterns of all combinations of *D-R-M-S-L*.

Lesson 2:

1. Students review notation cards in C Major echoing combinations of *D-R-M-S-L.*
2. Instructor shuffles the cards and students sight-sing notation cards in C Major.
3. Students view charts of four four-measure mystery songs in C Major.
4. Instructor helps students count rhythm and students figure out solfège. Instructor gives starting pitch and students sight-sing each and identify the tunes.

Week Four—Red Group

Materials: Spatial Cards *D-R-M-S-L*, notation cards *D-R-M-S-L*, melodies from the binder in C and F Major using *D-R-M-S-L*, 4 four-measure song charts for "Camptown Races", "Hot Cross Buns", "Up on the Housetop" and "Jingle Bells".

Lesson 1:

1. Students affix stickers for *D-M-S-L.*
2. Students review the melodies from lesson 3 on pages 4 and 5 of the binder.
3. Students learn the new tone *re* and the hand sign.They echo patterns of *D-R-M-S-L* singing and signing.
4. Students sing and play patterns of *D-R-M-S-L* after the instructor in C Major and F Major hand positions. They add the sticker for *re* to fingers.
5. Students orient re to the staff in C Major and learn the rule: If *do* is on a line then *re* is on the space above it. If *do* is in a space then *re* is on the line above it.
6. Students play and sing from notation cards in C and F Major after the instructor.

Lesson 2:

1. Students affix stickers for *D-R-M-S-L.* They sing and play patterns of *D-R-M-S-L* after looking at notation cards.
2. Students sight-sing Melody 1 on page 7 of the binder. Students then sing and play several times.
3. Students view the mystery song charts in C Major. The instructor helps them count the rhythm. They figure out the solfège syllables needed for each and then sight-sing each one identifying the familiar tunes.

Week Five Lesson One—Both Groups

Materials: Staff paper, pencils, blackboard.

Lesson 1:

1. Students echo patterns of *D-R-M-S-L* after the instructor, signing and

singing.

2. Students learn to draw treble clef, bass clef, 4/4 time signatures, quarter notes, half notes, and quarter rests. They learn to draw *do* in C Major on their clef.
3. Students take melodic dictation in C Major using *D-M-S-L*. They hear one measure repeated three times for a total of four measures in all. The melody is sung by the instructor using solfege syllables. Students try to notate correctly. Students check their own work with instructor.
4. Students take another dictation of four measures but are shown how to draw the key signature for F Major and place *do* in F Major. Students review the rule: If *do* is on a line, *re* is in the next space etc. Students check their work with the instructor.

Lesson 2—Blue Group

Materials: Spatial cards using *D-R-M-S-L*, unfamiliar song chart of 8 measures in ¾ time utilizing *D-R-M-S-L* in C Major, notation cards in C and F Major.

1. Students echo patterns of *D-R-M-S-L* from spatial cards, singing and signing.
2. Students sing from the spatial cards and discuss the size of intervals with the instructor.
3. Students observe the unfamiliar song. They count the rhythm with the instructor noticing the dotted half note of 3 beats. Students sight-sing the melody. Students sing from notation cards in C and F Major with no help from instructor.

Lesson 2—Red Group

Materials: Spatial cards using *D-R-M-S-L*, melodies on page 6 of the binder, notation cards in C and F Major.

1. Students echo the spatial cards of *D-R-M-S-L*, singing and signing.
2. Students sing and play page 6 of the binder, first echoing the instructor one measure at a time. Next half the class sings and played a measure at a time with no help from the instructor.
3. Students sing from notation cards in C and F Major. Instructor points out how *D-R-M-S-L* look in both keys and the skip on the staff from *M* to *S*.

Week Six—Blue Group

Materials: Spatial cards *D-R-M-S-L-D'*, notation cards using *D-R-M-S-L-D'* with syllables added below the notation, the same notation cards without syllables beneath the notes, melody drawn on the board featuring an octave jump, song chart of "Take Out to the Ball Game".

Lesson 1:

1. Students sing and sign from the instructor's hand. Students learn sign for

high *do*.

2. Students sing from 3 note patterns on spatial cards in the following order; *D-M-S, M-S-D', D'-S-M, S-M-D', S-L-D', D'-L-S, D'-L-M, M-L-D', D'-M-R, R-S-D', D'-S-R, D'-S-D, D'-R-D, M-L-D, D-D'-S, D'-D-S, S-D'-D.*.
3. Instructor discusses octave and other large intervals as they occur.
4. Students sing same intervals from notation cards with the syllables under them.
5. Students sing same intervals from notation cards without syllables under notes.
6. Students sing an unfamiliar melody from the board. Instructor points out the octave jumps and students sight-sing the rest.

Lesson 2:

1. Echo from notation cards with syllables beneath.
2. Sing independently from notation cards without syllables.
3. Sign around the room and include high *do*.
4. Sing from the instructor's hands using high *do*. Divide the group in half and sing from two hands in two parts.
5. Observe mystery song in ¾ time. Count rhythm together. Point out the octave jumps. Students sight-sing and identify tune as "Take Me Out To The Ball Game."

Week Six—Red Group

Materials: Spatial cards *D-R-M-S-L-D'*, notation cards of the same syllables in C Major and F Major, melodies from page 7 in binder, mystery chart of " Take Me Out to the Ball Game."

Lesson 1:

1. Teach the new tone high *do* and the sign for it.
2. Sing and sign three note spatially arranged cards in the same order as Blue Group.
3. Discuss octave and other large intervals.
4. Put on finger stickers including high *do* marked *D'*.
5. In C Major position play what I sing at slow tempo.
6. Repeat this activity with students playing and singing.
7. Turn to page 7 in the binder. Sight-sing each, play each and sing and play each several times.

Lesson 2:

1. Affix finger stickers for all syllables learned.
2. Play and sing from notation cards in C Major.
3. Play and sing from notation cards in F Major.
4. Review moving back and forth between C and F Major positions.
5. View the large mystery song chart. Instructor will assist in counting ¾ rhythm, especially dotted half note. Students are asked to locate the octave intervals in the song. Students will sight-sing the melody and

identify the tune.

Week Seven—Blue Group

Materials: F Major exercise in ¾--three notes per measure and a measure of rest between them with syllables beneath. Same exercise with no syllables beneath, song sheet of four melodies in F Major, eight-measure folk song chart in F Major.

Lesson 1:

1. Sing exercise from the board in F Major. It starts on low *do* and works up to high *do* with octave jumps included. All students are encouraged to sing high F with good breath support and in falsetto if necessary.
2. Instructor erases syllable letters and students sing from board with notation only—one half the class at a time sings a measure with no syllables.
3. Sing four melodies from the worksheet in F Major. Each is four measures long.

Lesson 2:

1. Review F Major exercise from board with and without letters.
2. View large chart in F Major. Identify high *do* and low *do*. Instructor helps students count rhythm. Students figure out solfège syllables and sight-sing eight measures.
3. Students sing mystery song containing high *do* in F Major. It is the first four measures of "Somewhere in My Memory".

Week Seven—Red Group

Materials: Page 8 exercises #1, 2, 3 in student binder, folksong chart in F Major—eight measures.

Lesson 1:

1. Affix stickers *D-R-M-S-L-D'*
2. Echo 3 note patterns starting with low tones in the left hand and moving to the right hand. Students first play what instructor sings, then do again singing and playing.
3. Students stand and sign for each other around the room using all the syllables we learned including high *do*.
4. Students sight-sing p.8 # 1 in student binder in F Major. Students then play and sing several times.

Lesson 2:

1. Students review 3 note patterns in F Major from notation cards starting on low *do* and working to high *do*.
2. Students sight-sing p.8 # 2 and # 3 in student binder. Students then rehearse with headphones for 5 minutes or so both melodies as instructor

walks around and assists as necessary. Sing and play many times.
3. Students view the eight-measure folksong chart in F Major. Instructor helps students count the rhythm. Students sight-sing and then play.

Week Eight—Blue Group

Materials: Work sheet reviewing keys of C and F Major, quarter note, half note, and eighth notes, song sheet with five 4-measure melodies for sight-singing.

Lesson 1:

1. Students are given a worksheet and pencils. Students label given melodies with solfège letters or are given solfège syllables and they draw in the notes in the keys of C and F Major.
2. Instructor hears students sight-sing individually from a sheet of melodies. Student is given 30 seconds to peruse the melody. They are given the I, IV6/4, I, V7, I chords and the instructor plays and sings the starting pitch with solfège syllable. At the conclusion instructor gives help with whatever intervals were missed and encouragement.
3. Instructor collects worksheets at the end of the period.

Lesson 2:

1. Students are introduced to *fa* and its hand sign.
2. Class echoes 3-note patterns of *D-R-M-F-S-L-T-D'*.
3. Instructor distributes worksheets for class to finish from lesson 1.
4. Instructor individually works with remaining sight-singers.
5. Teacher collects worksheets to check and return later with corrections.

Week Eight—Red Group

Materials: Pages 3,4,5,9, in student binder, headphones, individual sight-singing song sheets.

Lesson 1:

1. Students learn *fa* and its hand sign.
2. Students echo three-note patterns containing *fa* in combination with the other syllables learned.
3. Students don headphones to silently practice p. 3,4,5,9 in the student binder with the goal of playing anything on p. 3, 4 that instructor asks for later.
4. Students come one-by-one to be individually tested on a melody from the sight-singing song sheet. The procedure is the same as Blue Group.

Lesson 2:

1. Warmup—One half the class holds low *do* while the other half follows instructors hand signs being careful to frequently include the new *fa*.
2. Students continue to rehearse p. 3,4,5,9 from binder while instructor completes the individual testing.

Week Nine—Blue Group

Materials: Solfège Ladder, song chart in G Major, song sheet in G Major

Lesson 1:

1. Students learn *ti*—leading tone and hand sign for it.
2. Students sing and sign the C Scale ascending and descending.
3. Using the solfège ladder, students sing the scale and then instructor points to individual tones for them to sing. Instructor sings only if needed. Scalewise movement and thirds are emphasized.
4. Students view unfamiliar song in G Major—Discuss new key signature of one sharp and how to find *do* from it (next space up from the one sharp).
5. Students count rhythm and sight-sing in G Major.

Lesson 2:

1. Sing and sign the G Major Scale.
2. Sing the intervals as instructor points to the solfège ladder—students sing 2nds, 3rds, 4ths, emphasizing low *do* up to *fa*.
3. Sing unfamiliar melody from chart in G Major and ¾ time. Students count rhythm, discover syllables, and sight-sing.
4. Students learn *Do-Sol* Song in C Major from chart. It utilizes all the tones of the major scale and mostly stepwise motion. Students sing it several times from notation

Week Nine—Red Group

Materials: Solfège ladder, p.14 ex. # 1,2, in F Major and G Major.

Lesson 1:

1. Students learn the last tone of the major scale—leading tone *ti* and its hand sign.
2. Sing and sign the C Major Scale.
3. Standing in a circle each student signs one note of the scale around the circle both ascending and descending.
4. Students put on stickers for the entire scale.
5. Students play the three note patterns the instructor sings in both C and F Major hand positions. Students learn to use the black key for *fa*, which is a flat in the Key of F Major.
6. Students learn the position for G Major and how to play the black key sharp which is *ti*, the leading tone in G Major.
7. Instructor shows how these black keys are reflected in the flat of the F Major key signature and the sharp of the G Major key signature.
8. Students sight-sing p.14 ex.# 1 in F Major and Ex. # 2 in G Major. They practice playing and singing each.

Lesson 2:

1. Instructor shows what half and whole steps look like on the keyboard.

2. Students discover the major scale pattern of W-W-H-W-W-W-H.
3. Students play and sing the major scale in C, F, and G Major positions.
4. Students play and sing the outlines of the I, IV, and V chords in C Major. Students are shown how to finger low *ti* with left hand finger 4.
5. Students turn to p. 14 in the binder. Students sight-sing together and then play ex. 1,2,3,4.

Week Ten—Blue Group

Materials: Solfège ladder, Chord chart, *Sol-Fa* Song, *Do-Re-Do* Song, Song sheet of melodies that outline chords.

Lesson 1:

1. Students sing the major scale ascending and descending while instructor points to solfège ladder.
2. Students sing thirds ascending and descending as instructor points and sings with them.
3. Students sing again and sign.
4. Students sing the outlines of the I, IV, and V chords after instructor while viewing the notation on the chord chart.
5. Students review *Do-Sol* Song from chart singing without the instructor several times. Students sing song as a 2-part round.
6. Students learn *Do-Re-Do* Song aurally while instructor points to solfège chart.

Lesson 2:

1. Instructor divides class in two parts. Each half follows one of the instructor's hands to sing in 2 parts using the tones of the major scale performed in harmony.
2. Students sing the major scale ascending and descending from the ladder.
3. Students sing thirds ascending and descending from the ladder.
4. Students sing *Do-Sol* Song from memory as a round in 2 and then 3 parts.
5. Students sing outlines of chords from the chord chart.
6. Students view the song sheets of melodies that outline chords.
7. Students discover with instructor where melodies outline I, IV, or V chords.
8. Students are encouraged to try to hear those chords internally before sight-singing the first melody.

Week Ten—Red Group

Materials: *Do-Sol* Song, P. 14 # 3 in the keys of F and G Major in the binder, chord song sheet, p.17 melody #1 in G Major in the binder.

Lesson 1:

1. Students learn *Do-Sol* Song from a large chart while standing in front of it. Instructor asks them to point out scalewise motion and identify the larger interval—perfect fourth. Student sight-sing several times.
2. Students affix stickers and play major scale in keys of C, F, and G Major. Instructor reviews which tones are black keys.
3. Students play and sing chord outlines after instructor in this order I, IV6/4, I, V, I.—*D-M-S-S-M-D, D-F-L-L-F-D, D-M-S-S-M-D,* low *T-R-S-S-R*-low *T, D-M-S-S-M-D.*
4. Students play *Do-Sol* Song on the keyboard echoing the instructor by phrases until they can play it by ear.
5. Students turn to p.14 # 3 in the binder. After sight-singing it together they play it in F Major and then G Major.

Lesson 2:

1. Students stand and sing and sign the *Do-Sol* Song from memory.
2. Students affix stickers and play *Do-Sol* Song while singing if possible.
3. Students play I, IV, I, V, I chords alternating half the class for each chord. Then they play sequentially altogether as instructor plays an accompaniment on the piano.
4. Students sight-sing P. 17—Melody #1 in G Major and then repeat several times playing and singing. Play it in F Major.

Week Eleven—Blue Group

Materials: Solfège ladder, chord chart, *Do-Sol* Song chart, worksheet of melodies outlining chords, chart for tones below low *do*, Ditto of tones below *do*, mystery song sheet of tones below *do*.

Lesson 1:

1. Students sing and sign C Major scale ascending and descending.
2. Student sing thirds ascending and descending from solfège ladder as instructor points.
3. Students sing perfect 4ths ascending and descending from ladder as instructor points.
4. Students sing augmented 4^{th} echoing the instructor as she sings and points to ladder—*fa* to *ti* and *fa* to low *ti*.
5. Students sing *Do-Sol* Song in three parts from memory.
6. Students sing the outline of the I, IV6/4, I, V, I chords with the instructor.
7. Students continue to sight-sing from the worksheet of melodies that outline chords.

Lesson 2:

1. Students sing the scale in F Major by thirds, fourths, and fifths ascending and descending as instructor points.
2. Students sing tones below low *do* in F Major after instructor in this order:

Low *sol*, low *la*, low *ti*, *do*. Low *sol*, low *sol*, *do*. Low *la*, low *ti*, *do*. Low *ti re do*. *Re*, low *ti*, *do*. Low *sol*, low *la*, *do*. Low *sol*, low *ti*, *do*. Low *la*, low *ti*, *do*.

3. Students view the chart that shows how the tones low *sol*, low *la*, low *ti*, *do* appear in F major and G Major—the two keys that will be part of the sight-singing test.
4. Students are given an easy ditto of measures with tones below *do* and measures of rests between them. The class sings by halves alternating measures to sight-sing.
5. Students sing the scale from low *sol* to *sol* and then instructor helps with rhythm of mystery song # 1 ("Here Comes the Bride"). Students sight-sing and identify the tune in F Major.
6. Students read rhythm with instructor for mystery song # 2. They sight-sing and identify tune ("Reveille").
7. Students work on # 3 tune in small groups and then sight-sing together ("Swing Low Sweet Chariot").

Week Eleven—Red Group

Materials: Solfège ladder, chord chart of chords in C, F, and G Majors, Melodies that outline chords worksheet, chart of tones below *do* in C F and G Majors, p. 19 in binder, mystery song sheet of tones below *do*.

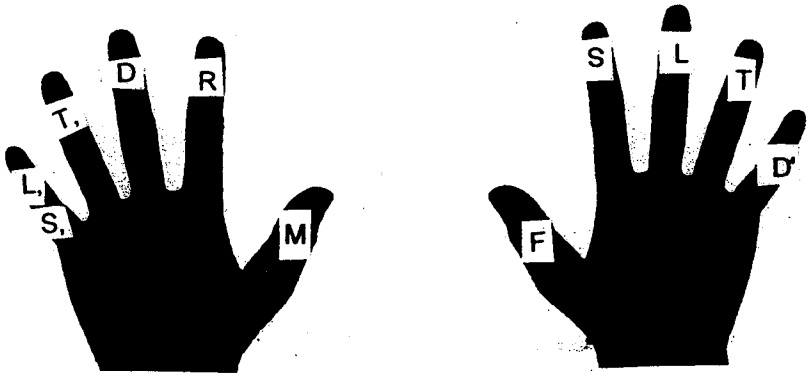
Lesson 1:

1. Students affix stickers for low *sol*, low *la*, low *ti*, *D-R-M-F-S-L-T-D'*
2. Students sing and play C scale, thirds, perfect fourths, and perfect fifths ascending and descending.
3. Students play and sing the augmented fourth from *fa* to *ti* and *fa* to low *ti*.
4. Students play and sing the outline of chords from chord sheet in binder.
5. Students view the chart on board that shows how these outlined chords appear in C, F and G Major.
6. Students sight-sing each melody on Melodies that outline chords work sheet and then play each and then play and sing each with instructor.

Lesson 2:

1. Students affix only left hand stickers, low *sol*, low *la*, low *ti*, *D-R-M*.
2. Students play and sing three note patterns of tones below *do* after instructor in F Major position—very slowly.
3. Students repeat this procedure in G Major position.
4. Students again view the chart showing how the tones look in F Major and G Major.
5. Students turn to p. 19 in binder—They echo singing and playing each measure after instructor—first in F Major then G Major.
6. Students view Mystery song sheet using low tones. Students count aloud with instructor and then sight-sing # 1 and # 2. Students play and sing several times as a group.
7. Students work independently to sing and play #3.

Figure 4. Fingers with syllable letters including tones below *do*.



Week Twelve—Blue Group

Materials: Chromatic Scale ladder, chart of major scale with sharp or flat symbols to place before tones of scale, chromatic song sheet, "What to do Before Sight-Singing Chart".

Lesson 1:

1. Instructor demonstrates half steps of chromatic scale by pointing to chromatic ladder and singing.
2. Students sing syllables ascending and descending—*do, di, re, ri, mi, fa, sol, si, la, li, ti do, do, ti, te, la, le, sol, se, fa, mi, me, re, rah, do.*
3. Instructor emphasizes that students are singing sharps ascending and flats descending.
4. Instructor places large C Scale chart in notation next to chromatic ladder. Instructor puts a sharp or flat symbol before random pitches and students tell what syllable to sing. Next the instructor sings the scale pitch and students must sing the sharp or flat with correct pitch and syllable.
5. Students look at chromatic song sheet. Working in small groups they figure out rhythm and solfège syllables for melody #1. Each group sight-sings melody #1 for the class.
6. A similar procedure is used for melody #2.
7. Students perform "White Christmas" from melody sheet with syllables under the notes as teacher accompanies on piano.

Lesson 2:

1. Students sing major scale, thirds, fourths, fifths and octaves from solfège ladder.
2. Students echo instructor singing tones below *do* using hand signs.
3. Instructor introduces chart of what to look for before sight-singing. What key? Where is do located? What is the syllable of the first pitch? Do any measures outline chords? Are there any tones below *do*? Are there any chromatic tones?

4. Students look at worksheet of four musical examples. Students answer the questions of what to look for in each piece. Students sight-sing each.
5. Students sing chromatic scale from chromatic ladder.
6. Instructor points to a diatonic tone. Students sing it then instructor holds up a sharp or flat symbol and students sing up or down a half step using correct syllable. Example: point to *sol*—sing—hold up sharp—sing *si*.

Week Twelve—Red Group

Materials: Chromatic Scale ladder, paper keyboard chart, chromatic song sheet, solfège ladder, chart with tones below *do* in C, F, and G Major. Song sheet of mystery songs using tones below *do*.

Lesson 1:

1. Instructor sings and points to syllables on chromatic scale ladder. Instructor tells them that chromatic tones ascending are sharps and chromatic tones descending are flats.
2. Students sing several times with instructor.
3. On large paper keyboard, instructor demonstrates how to finger the chromatic scale with right-hand using fingers 1 and 3 for white to black key movement and 1 and 2 for white-to-white key movement.
4. Students practice while instructor walks around and helps as needed.
5. Instructor explains that in a song however, whatever finger plays the diatonic tone also plays the chromatic tone. Example *sol* and *si* would be played with the same finger. Students then affix all stickers from low *do* to high *do*.
6. Students view chromatic song sheet #1. Students find and identify the chromatic tone and which finger will play it. Students sight-sing #1 and then play it several times. They play and sing several times.

Lesson 2:

1. Warmup—Students sing 2nds, 3rds, perfect 4ths, augmented 4ths, perfect 5ths and octaves as instructor points to solfège ladder.
2. Students sing tones below *do* following instructor's voice and then just from instructor's hand signs.
3. Students view the chart of tones below *do* in keys of C, F, and G Major.
4. Students look at mystery songs using tones below *do* worksheet. In groups of 4 students they work together to figure out the rhythm and syllables of whichever song the instructor assigns them. Each group sight-sings their example for the class and class identifies the tune.
5. Students place their hands in C Major position. The instructor sings a pitch. Students play and sing that pitch. The instructor holds up a sharp or flat and student plays and sings with correct chromatic syllable. Example *sol*, sharp, *si*.

Week Thirteen—Blue Group

Materials: Chromatic song sheet, key signatures on blackboard, rolling thirds chart,

chromatic ladder, chromatic song sheet, Holiday song sheet, "Solfège Round", "What to look for Before Sight-Singing Chart".

Lesson 1:

1. Students sing diatonic major scale ascending and descending, thirds, perfect 4ths, augmented 4ths, perfect 5ths, and octave ascending and descending from solfège ladder as instructor points.
2. Sing rolling thirds ascending and descending from chart (*D-M, R-F, M-S, F-L*, etc.)
3. Students sing chromatic scale from chromatic ladder ascending and descending.
4. Students figure out rhythm and syllable for chromatic songs # 2 and 3. They sight-sing each.
5. Students view holiday song sheets of eight familiar melodies. Students work in small groups to discover solfège on their own. Each group then sings one for the class to identify.

Lesson 2:

1. Warmup with 2nds, 3rd, 4ths, 5ths, octaves and rolling thirds.
2. Sing *Do-Sol* Song as a three- part round.
3. Sing *Do-Re-Do* Song as a 2 part round.
4. Sight-sing "Solfège Round" from sheet using "What to look for Before Sight-Singing Chart" as a guide.
5. Using Holiday Song Sheet, students must give key and starting pitch syllable for each example. Class sings each.

Week Thirteen—Red Group

Materials: Rolling thirds handout, chromatic song sheet, "White Christmas" song sheet, Mystery songs with tones below *do* sheet, Holiday Song Sheet.

Lesson 1:

1. Students affix stickers low *S*, low *L*, low *T*, *D-R-M-F-S-L-T-D'*.
2. Students play and sing scale, thirds, fourths, fifths, octaves in C, F, and G Major.
3. Students play and sing tones below *do* after the instructor. Students play octaves from low *S* to *D*.
4. Students play and sing rolling thirds from handout.
5. Students review chromatic song sheet #1 playing and singing.
6. Students figure out rhythm and chromatic syllables needed for Chromatic sheets #2 and 3. Students sight-sing and then play # 2 and 3. They sing and play.
7. Students practice singing and playing "White Christmas" on their own. It contains many chromatic tones. Music has the syllables written underneath.

Lesson 2:

1. Students affix all stickers.

2. Students play and sing in F Major position, 2nds, 3rds, 4ths, 5ths, octaves.
3. Students play and sing rolling thirds in F Major from handout.
4. Students play and sing chromatic scale.
5. Looking at chart of what to look for before sight-singing, students answer questions together before sight-singing "Solfège Round".
6. Students play and sing "White Christmas" together several times.

Week Fourteen—Blue Group

Materials: Rolling Thirds chart, "Solfège Round" sheets, Holiday Sheets, phrases on board, chromatic ladder, sight-singing sheet.

Lesson 1:

1. Students stand and say the scale syllables in order ascending and descending around the room one student at a time—fast and no stops.
2. Sing scale and all intervals ascending and descending.
3. Sing octaves low *S* to *D*.
4. Sing rolling thirds in two parts.
5. Students divide in half and each half follows one of instructor's hands to create two-part harmony.
6. Students sing "Solfège Round" as a two-part round.
7. Students sight-sing the last two melodies of Holiday Song sheet with no help from instructor.

Lesson 2:

1. Instructor draws key signatures for C F and G Major on board in treble and bass clef. Students must describe where *do* is located in each clef and instructor draws it. Example—bass clef in 2nd space.
2. Instructor draws phrase of music on board that could present sight-singing problems and students sing them. Examples are notation only with first syllable given. For example: In C Major—*Do-Fi-Sol* in notation with only *D* marked. Students talk their way through the problems and then sight-sing.
3. Students sing scale and all intervals learned ascending and descending.
4. Students sing outlines of chords.
5. Students sing rolling thirds in unison and thirds.
6. Students sight-sing three examples from Sight-Singing Song Sheet in keys of C, F, and G Major with no help from instructor.

Week Fourteen—Red Group

Materials: Solfège Round, Rolling Thirds Sheet, Sight-Singing Song Sheet.

Lesson 1:

1. Students stand and say scale syllable names ascending and descending around the room one at a time fast and no stops.
2. Students affix stickers and play scale and all intervals in C, F, and G Major.
3. Students sing and play rolling thirds from handout.

4. Students perform rolling thirds as a round singing and playing.
5. Sing and play "Solfège Round" in unison and as a round.

Lesson 2: Same as Blue Group. No keyboards used this day.

Appendix B

Parental Permission Form

The Effect of a Program of Portable Electronic Piano Keyboard Experience on the Acquisition of Sight-Singing Skill in the Ninth Grade Chorus

I state that as the parent of the minor child_____,I am granting permission for this child to participate in the program of research being conducted by Judith E. Parks, doctoral student in the Music Education Department under the Department of Curriculum and Instruction at the University of Maryland, College Park.

The purpose of the research is to determine the best methods of delivering sight-singing training to high school choral students.

The procedure involves two methods of sight-singing training taught for the first fifteen minutes of the chorus instructional period over the course of fifteen weeks beginning in September 2004 and ending in January of 2005. One method involves only singing and the other method involves singing while playing an electronic piano keyboard. Students will be administered a short music aptitude test and a short sight-singing test before the training begins. The music aptitude test consists of one 25-minute paper and pencil test designed to determine prior skills in melodic perception. The sight-singing test will be administered again at the end of training. These tests will provide numerical data for the study. For the sight-singing test, students will sight-sing nine unfamiliar musical examples into the microphone of a tape recorder. They will be identified only by number on the recordings. The recordings will be numerically scored by two music teachers. All information collected in this study is confidential to the extent permitted by law. No participant will be identified by name at any time and the school name will not be published.

I understand that the research is designed to help the investigator learn more about the best methods for teaching sight-singing to high school students. I understand that my child is free to ask questions or withdraw from participation at any time and without penalty.

Name of student_____Parent signature and date_____

Appendix C
Student Assent Form

The Effect of a Program of Portable Electronic Piano Keyboard Experience on the Acquisition of Sight-Singing Skill in the Ninth Grade Chorus

I state that I wish to participate in a program of research being conducted by Judith E. Parks, a doctoral student in the Music Education Department under the Department of Curriculum and Instruction at the University of Maryland, College Park.

The purpose of the research is to determine the best methods of delivering sight-singing training to high school choral students.

The procedure involves two methods of sight-singing training that will be taught for the first fifteen minutes of the chorus instructional period over the course of fifteen weeks beginning in September 2004 and ending in January 2005. One method involves only singing while the other method involves singing while playing the electronic piano keyboard. I understand that I will take a short aptitude test and a short sight-singing exam before the training begins. I will repeat the sight-singing exam at the end of training. I will be identified only by a number and the scores from these exams will provide data for the study.

I understand that the research is designed to help the investigator learn about the best methods for teaching sight-singing to high school students. I understand that participation in this study will not affect my chorus grade. I understand that I am free to ask questions or withdraw from participation at any time without penalty.

___I agree to participate in the study.

Student name_____

Appendix D

Student Questionnaire

1. How many years have you studied piano with a private teacher?
2. How many years have you performed with a chorus or choir?
3. What instrument or instruments other than piano do you play?
4. How many years of private lessons have you had on this instrument?
5. How many years of private voice lessons have you had?
6. What middle school did you attend?
7. Who was your middle school choral director?
8. What elementary school did you attend?
9. Who was your elementary school music teacher?
10. What was the last grade in which you sang in chorus?

Name_____ School_____

Appendix E

Student Exit Survey

Please answer yes, no, or uncertain to the following questions.

1. I believe that my sight-singing ability improved as a result of this training.
2. I have a better understanding of music notation and how it relates to higher and lower sound as a result of this training.
3. My attitude toward sight-singing is more positive as a result of this training.
4. I would like to participate in keyboard class as a part of chorus in the future.
5. I enjoyed playing keyboard.

Please answer these with short answers.

6. Keyboard training helped me with sight-singing because_____.
7. Keyboard training was not helpful because_____.
8. Do you have a keyboard at home and did you try the exercises at home?
9. Did you teach the keyboard exercises to anyone in the other group?

Appendix F

Teacher Exit Survey

1. Did you notice any students using solfège in chorus rehearsals or during any other choral activity?
2. Did you notice students using Curwen hand signs during rehearsal?
3. Did you notice any improvement among boys who were previously having pitch problems as a result of the keyboard training?
4. Did this year's Chorus I show any faster improvement in vocal sound, musicality or sight-reading ability than choruses from previous years?
5. After watching the sight-singing demonstration do you have any thoughts about student sight-singing abilities, sound of the group, musicality etc? Would you consider teaching sight-singing using solfège with Chorus I in the future?
6. Would you consider using keyboards as an adjunct activity in chorus to teach intervals and improve pitch accuracy in the future?
7. Circle the word that best describes your opinion of the need for teaching sight-singing skills in the high school chorus.

   Very important Important Somewhat important Unimportant
8. Briefly, how would you describe your experience as a cooperating teacher in this sight-singing project?
9. Additional comments?

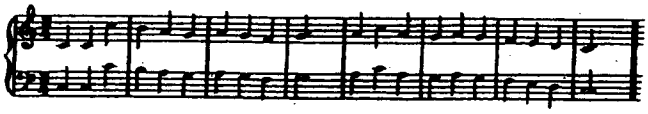
Appendix G

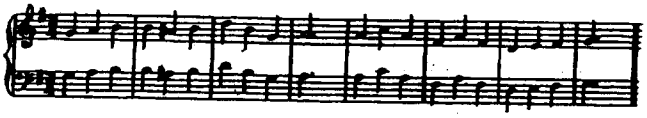
Michelle Henry's Sight Reading Inventory

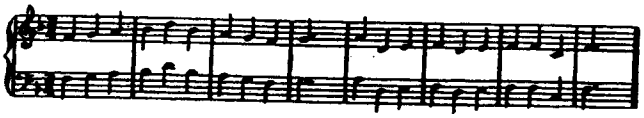
1. 

2. 

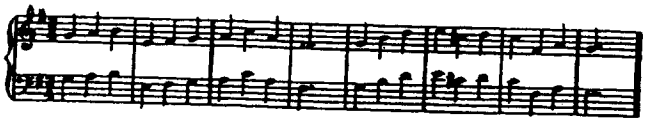
3. 

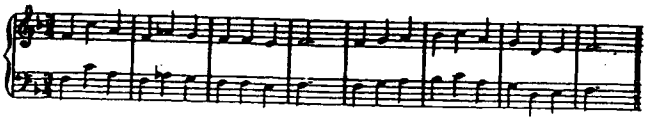
4. 

5. 

6. 

7. 

8. 

9. 

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Appendix H

Lesson Plan Critiques

The lesson plans were submitted to two experienced Kodály educators for their general comments. Educator One holds degrees in music education and conducting as well as a level 1 Kodály certificate. His review follows:

"The overall approach evident in the lesson plans reflects the Kodály philosophy. This is most obviously demonstrated in the use of moveable *do* solfège, Curwen hand signs, solfège ladders, sequential teaching of tonal elements, and various specific teaching strategies. It is, of course, an accelerated approach, not advisable for elementary school, but maybe workable with the high school-aged target groups. In elementary school, more preparation time is necessary before concepts/elements are presented. The red group's use of the piano to reinforce their singing is an interesting idea. In the end, I would like to know how they did in relation to the blue group.

The order of tonal patterns/elements used in the lessons, with a few exceptions, adheres to the traditional model introduced in America a few decades ago by Hungarian Kodály enthusiasts. Most Kodály-inspired teachers refrain from presenting *la* until after *sol-mi* has been mastered. In addition, many Kodály-inspired teachers place low *sol* and low *la* earlier in the sequence (in these lessons, they are presented after high *do*). Representing a newer trend, John Feierabend of The Hartt School contends that American students should begin with *do-re-mi*. However, Feierabend is not a traditionalist.

The lessons utilize many traditional Kodály-inspired teaching strategies. Repeating by rote patterns performed by the teacher using solfège allows students to bond tonal (and rhythm) patterns with aural labels. Elementary students need much

more time to do this than these lessons allow, but with high school students, this accelerated approach might prove effective. I just don't know. The strategies for reading notation are common practices in the Kodály-inspired classroom, e.g., rote singing of notation, use of spatial cards, and melodic dictation (e.g., the teacher sings patterns using solfège and the students write the patterns in traditional notation). In the area of harmony, various strategies used in these lessons are commonly found in the Kodály-inspired classroom as well. These strategies include singing with solfège the members of I, IV, and V chords, having one section of a class sing a drone, e.g., low *do*, while another section sings melodic patterns as shown with hand signs, singing canons, and dividing the group in half and singing in two parts by responding to hand signs." Submitted February 23, 2005.

Teacher Two holds degrees in music education and Kodály level one training. He is a high school choral director and his review of the lessons follows:

"In Kodály-based instruction, teachers typically follow the process of "prepare-present-practice". Students first experience new concepts through songs they sing. After students can identify the new concept they are made aware of its name (the presentation). In subsequent lessons students practice the concepts they have learned. The materials you've sent along provide adequate opportunity for students to practice what they learn. In order to completely follow this model you need to provide ample preparation opportunities via the other materials the class is using (performance literature)." Submitted April, 2005.

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