A THEORETICAL MODEL OF PIANO SIGHTPLAYING COMPONENTS

A Dissertation
Presented to
The Faculty of the Graduate School
University of Missouri-Columbia

In Partial Fulfillment
Of the Requirements for the Degree

Doctor of Philosophy

By

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Dr. Wendy L. Sims, Dissertation Supervisor

MAY, 2005

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

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Thanks to ….

My advisor, Dr. Wendy L. Sims for her true inspirations, directions, opinions, advise and encouragement. Your devotion and who you are makes my 10-year journey become a life-long educational and moral nourishment.

My dissertation committee, Dr. Martin Bergee, Dr. Rebecca McCathren, and Prof. Karen Larvick, and Dr. Richard Robinson who generously gives me support and guidance. I will always be thankful for your contributions to this work.

My proofreaders Dr. Cathi Wilson and Chattavee Numtee who spent their valuable time on perfecting this dissertation.

Dr. Deborrah Carr, Teacher Development Program, College of Education and Dr. Melvin Platt, School of Music for granting me a clinical and a teaching position. This financial support ended up as one-of-a-kind experience that fosters me to become a better prepared person in the fields.

My students who make me love what I am doing and educate me how to become a good teacher.

My family and friends for their support, good thought and blessing

My father and mother, who are always in my heart to inspire, guide and protect me. I wish you are here to celebrate my accomplishment. I am a good person because of you.

My aunts and uncles, for their unconditional love to me and my sister. We are truly thankful for your devotions and scarifications.

My sister who always wish me the best for everything I do and belief in me

My husband, a true companion, a brother, and a guardian angel. You and your love complete my life in every way possible. Your understanding, mentor, trust, and encouragement are true sources of my accomplishment. I am thankful and blessed by your warm heart and beautiful mind.

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Abstract

The goal of this study is to provide a theoretical model regarding sightplaying phenomena based upon investigation, analysis, and synthesis from a large amount of research findings, observation results, theoretical ideas, teaching methods, and perspectives from various fields of study including psychology of music, music education, psycho-musicology, and neurological science. Specifically, the focus of the study is on an individual's ability to sightplay on the piano. As a result of an extended review of literature, the author proposed a generalized picture about the possible components shown to be involved in the process of sightplaying development as well as sightplaying performance. With a qualitative philosophy as the research methodology and multiple perspectives in mind, the author believes that the model describing the four sightplaying components, CAPE: physical Coordination, musical Awareness, musical Potential, and musical Experiences, is useful as an instructional and experimental guideline for investigating and understanding a unique sightplaying ability in each individual as well as sightplaying performance in different circumstances. When using this model, music educators and researchers need to be aware that variations among levels or differences in the strengths of the component have not been predicted by this model. Any generalizations and implications need to be drawn with appropriate caution.

TABLE OF CONTENTS

OVERVIEW

Music performance on piano as a result of reading music at first sight is a complex skill, where both cognitive processes and physical hand-eye-pedal coordination occur simultaneously. Furthermore, this skill plays an important role in music learning as well as in music performance settings. Performers and accompanists are required to learn a great deal of music quickly. Sight-reading skills increase the musician's ability to be more efficient and skillful when performing unlearned music. In the educational setting, where students learn music from notation, sight-reading is an important learning skill. The ability to sight-read music allows students to process and perform accurately, so that they may then proceed to the next level, that of mastering expression. Sight-reading also serves as an effective authentic assessment tool in music instruction, and is used to analyze and document a student's music literacy competency and music understanding.

Music performance by sight has been the focus of music training since the 11th century, during which sight-reading was most traditionally used in public performance. One reason for this was to protect against plagiarism by orchestral musicians in the 11th century (Lehman & McArthur, 2002). Musicians relied on their extensive knowledge and performance skill to interpret the music symbols and perform: *prima vista*, literally "at first sight." Beginning in the 19th century, some composer-performers, including Felix Mendelsohn and Clara Schumann, began new traditions in the art of public performing. It was at this time that "public performance" came to be known as the performances of well-rehearsed music, often to the point of memorization of the pieces (Lehmann & McArthur, 2002). Hence, memorization of performing pieces has gradually become a tradition in piano performance.

Contemporary literature has commonly referred to the term "sight-reading" as an ability to read and produce both instrumental and vocal music at first sight (Lehmann & Ericsson, 1996; Lehmann & McArthur, 2002; Sloboda, 1984). Primarily, the process of sight-reading involves the conversion of musical information from sight to sound. Some authors have used the term sight-singing for vocal sight-reading, while many others use the term sight-reading for instrumental sight-reading performance. Nonetheless, sight-singing and instrumental sight-reading performances are the result of two distinct competencies, music reading and music making. The terms music reading and music making cannot be used interchangeably, however, because each requires unique skills and abilities. To maintain clarity and consistency throughout this study, the term "*sightplaying*" will be used as a substitute for "instrumental sight-reading"; whereas the term *"sight-reading"* will be used as a generic term covering practices that involve reading music by sight including sight-reading, sight-singing, and sightplaying.

Many components are involved in the process of sightplaying including an individual's cognitive ability, knowledge, and experiences. Multiple cognitive processes are engaged simultaneously when performers read music by sight (Grutzmacher, 1987; Wolf, 1986). Specifically, unlearned musical notation is read, decoded, analyzed, and integrated with the reader's prior music knowledge and experiences, leading to the production of sound. A performer's knowledge and understanding of musical concepts and theories affect the musical quality of sightplaying outcomes. Additionally, the more experience a person has in music reading and performing, the more fluent sightplaying performance will result (Lehmann & Ericsson, 1996).

Rationale for the Study of Sightplaying

Piano sightplaying has been a major element in the requirement of musicianship proficiency embedded in most music programs throughout all levels. The author believes that through practicing sightplaying and learning musical concepts, one can improve sightplaying competency immensely, but other components also contribute to sightplaying performance and development. Furthermore, some skills and knowledge are gained through formal music education, whereas others are acquired through exposure to informal music experiences. Informal music experience can result from leisure music performance and activities. Thus, a thorough examination of all the components involved in this ability to perform unlearned music will aid our understanding regarding the components of this phenomenon and enable us to draw educational implications.

The expected sightplaying outcomes may vary on different levels based upon their purpose and function. Moreover, preciseness and accuracy are expected in music assessment settings and directly affect sightplaying outcomes. In the performance setting, producing an artistic sound as a whole or synchronizing with other instruments may be the priority. Also, it should be noted that functionality and accuracy in sightplaying have been regarded differently in sightplaying performance across different eras. During the Baroque period, priests and church attendees synchronized their hymns by sight-singing (Lehmann & McArthur, 2002). Preciseness was not the emphasis for such performances. In contrast, Mozart was internationally revered not only for his musicality, but his precision of sound in his sightplaying skill (Lehmann & McArthur, 2002).

While the performance setting emphasizes the synchronization of sound, the instructional setting tends to emphasize accuracy in sight-reading performance. As a learning activity, music teachers use sightplaying to promote high levels of cognitive thinking as well as bodily/kinesthetic coordination of fine motor skills (Clark, 1998, Uszler, 1991). Sightplaying also allows a person to express his or her aesthetic affection through music performance. In addition, sightplaying allows students to enjoy music in a meaningful way; while exploring new music and expanding their repertoire efficiently, the activity enables the student to become a more independent learner.

Another benefit of sightplaying includes its ability to serve as a valid and effective assessment tool, where a student's music knowledge and performance skill can be measured authentically. Most piano proficiency curricula include sightplaying as an important step in developing literate pianists (Betts & Cassidy, 2000). Thus, it is crucial for piano educators to understand sightplaying and its elements clearly so they can educate their students on how to increase their sightplaying ability. However, when sightplaying is utilized as an assessment tool, more components could affect the accuracy of the performance. Specifically, the length of preparation time (Lehmann & Ericsson, 1996) and expected tempo of the performance (Anderson, 1995) could affect the quality of the outcome either positively or negatively. Hence, using sightplay as an assessment tool should involve caution.

In the professional music setting, sightplaying is a critical skill used in the daily routine. For example, sightplaying is utilized to browse through musical pieces in order to make a selection. Additionally, sightplaying is an authentic way to transfer written notation into sound, allowing musicians to hear the actual sound of the piece during the process of analyzing, composing, or arranging music. Musicians who are competent accompanists and live performers tend to be skillful sightplayers.

Among the most complex instruments in the live performance arena are keyboard instruments. Compared to other instrumentalists, keyboardists do not have to worry about adjusting intonation and have no limitation of seeing the instrument while performing. However, keyboard sightplaying is more distinct in many ways when compared to sightplaying on other instruments. The keyboard's wide range of pitch production and its capability to produce multiple pitches simultaneously are among the prominent components.

This study's main focus is to examine sightplaying on the piano. The piano topography is complex, comprising a series of 88 black and white keys on a keyboard, with a wide pitch range including all diatonic pitches in seven complete octaves. The construction of the piano allows the instrument to produce multiple pitches at a time. By maneuvering the pedals effectively, the musicians not only control the dynamic, but also manipulate and emphasize subtle harmonic and melodic components. Thus, the piano's ability to produce a comprehensive array of pitches makes it a most versatile instrument.

Scope of the Study

The purpose of this study is to identify and classify the essential components of sightplaying performance on the piano. To better identify the scope of this study, an operational definition of sightplaying created should be taken under readers' consideration. Issues regarding the problems within Western standard notation will be discussed in this section to call readers' attention to characteristics of Western standard notation that could create obstacles in the sightplaying process at the outset.

Definition of Sightplaying

Sight-reading and sight-singing have been used to refer to the act of performing music by sight for instrumental and vocal settings by current authors. For the purpose of this study, instrumental sight-reading will be substituted with the term *sightplaying* to better differentiate between instrumental and vocal settings. I created a definition of the term sightplaying, as a result of my review of the related literature. Therefore, sightplaying in this study is strictly referred to as

> An ability to produce accurate musical outcomes through performing on an instrument including as many of the musical components (pitch, rhythm, dynamics, tempo, articulation, and expression) as possible from Western standard music notation that has not been seen or studied, but still is within a person's music reading ability or a reasonable reading level of difficulty, at the first time a person attempts to play.

Explanation for the Components of the Definition

Accurate musical outcomes. This term refers to precision and exact musical outcomes according to what was written on the standard notation. In traditional Western culture, musical outcomes tend to depend heavily on the knowledge of musical syntax and grammar (Bernstein, 1981; Rubinstein, 1950). Unlike jazz performance and many aural-based cultures, music reading allows individual interpretation including personal improvisation through style of performance and music components. However, in Western tradition, music reading is engaged within specific traditions of interpretation, which tend to be more conservative. For the purpose of this study, accurate musical outcome refers to that applied in Western tradition.

Notation that has not been seen or studied. This term refers to never-before-seen/ unlearned musical pieces. However, the novel piece may be familiar to the player based upon their prior musical background knowledge and experience.

A person's music reading ability. This is to be assessed beforehand, thus clearly defining the player's reading competency level. Also, sightplaying experience becomes impaired if the difficulty level of musical material is far more advanced than the reader's music reading competency.

At the first time a person attempts to play. This refers to the first time the sightplayer attempts to perform the piece with a sense of musicality and connection of sound. However, when it comes to sightplaying assessment, adequate time should be permitted to allow for study of the novel music piece, otherwise the examination will have lost its validity.

Sightplaying has many uses in the music arena, but for the purpose of this study, we will focus on sightplaying as both a learning and assessment tool, where the accuracy and the artistic outcome of sightplaying production is the main concern over the improvisational elements.

Problems within Western Standard Notation

To ensure objectivity in making scientific judgments or analyses in this study, it is necessary to discuss some aspects related to the appropriateness, complexity, and validity of standard Western notation. The practicality and versatility of Western standard notation has proven its functionality since its development around 1200 B.C. (Kamien, 1990). The early invention of such notations came from a four-line staff with square note heads, which then developed into the grand staff notation with different types of note heads, stems, and flags to represent their corresponding rhythmic values. Also, musicians have undergone centuries of creating, developing, and implementing the syntax and structure of Western standard notation in order to suit their needs. Western standard notation seems to be the most accepted notation in professional and educational musical fields. Furthermore, it is the most appropriate notation system especially for instrumental and vocal pieces that are born of the Western classical tradition. However, there are some causal effects that are directly driven from the characteristics of standard notation that need to be addressed.

Format Complexity

The format of standard musical notation can be confusing and considered too complicated for many people, including those who have less experience in reading music, as well as those whose intellectual perception is impaired, or those who may have problems with spatial reasoning ability (Jaarsma, et al., 1998; Milner, 1962). Many leaders in piano teaching methodology agree that the complexity of standard musical notation may suggest the need for an optional notation system, in order to solve the problem of reading a complicated musical language (Clark, 1998). Primer music reading pieces for beginning piano students show that early notations should contain only the most vital information necessary to prevent confusion and to foster a positive reading experience for the reader. Reading notes without the staff or reading music maps are examples presented in some beginning piano methods books (Clark, 1993; Schockley, 2001). Moreover, letter chord symbols, numeric notation, and letter note notation, which require less syntactical understanding (Udtaisuk, 2002) may be more approachable to the readers, due to their simplicity and appropriateness. Some adults who have minimal reading experience may have difficulty reading standard music notation due to its variance in the spatial presentation of written notes, where the amount of rhythmic division on the written page does not always precisely reflect the value of each note.

The *Klavarskribo* notation system is one example of that is considered to be practical for piano music and approachable for all ages, because it requires less musical background to read. Klavarskribo (or Klavar) is an alternative method of music notation, introduced by Cornelis Pot (1985-1977) in 1931 (http://www.klavarskribo.nl/oud/english/). In Klavar notation, the pitch is written horizontally instead of vertically and the rhythm is written vertically from top to bottom. Klavar is often seen as a tabulature system for piano and other instruments. In this system, an entire keyboard pattern or a section of a keyboard is presented with dots on the actual keys, representing which keys need to be played. The written notation in Klavarskribo is a direct geometric visual representation of the notes to be pressed on the keyboard. It requires less spatial decoding ability, and it is therefore claimed to promote better performance (see Appendix A).

Validity of Standard Notation

Standard notation is most useful when the musical content is in the appropriate range of complexity and is based upon the Western musical style (Kamien, 1990). For instance, documenting folk music may not require standard five-line music notation, but instead a visual representation of Solfége syllables may be adequate (Kodaly, 1971, 1974). At the same time, a five-line music notation may not be the most practical way to notate music created from sound waves or music that originated outside the Western standard. In other words, five-line notation is most appropriate to represent and document Western music under Western scale structure rather than music from other cultures. Specifically, characteristics of Western music are different from those of other cultures, and therefore not all musical elements can be notated in Western standard notation. For instance, it is impossible to notate a pitch that is higher than middle c for a third of a step using standard notation because that pitch does not exist in Western culture. In this case, traditional non-Western notation has to be implemented. Therefore, non-Western music notational systems need to be preserved in order to accurately document music of these cultures. This example of multicultural variation in music illustrates the limitations of Western standard notation, as well as inherent cultural biases of the system.

Problem Statement

Many studies have been conducted in the areas of instrumental sightplaying and sight-singing (Grutzmacher, 1987; Lannert & Ullman, 1945; McPherson, Bailey, & Sinclair, 1997; McPherson, 1994). The results and implications from these studies contributed greatly to the improvement of teaching methods and techniques to perfect sightplaying performance. However, most statistical studies based upon scientific methodology can only focus on a few components of sightplaying at a time due to limitations of the research design. At the same time, suggestions from philosophical methods and models from experts and theories provide in-depth descriptions of the sightplaying phenomenon, but should be deliberated with caution due to their lack of scientific measurements. The bulk of research findings in music and related fields and psychological theory contribute equally to our understanding of sightplaying. A careful balance between the two aforementioned types of literature could prove to be beneficial in drawing conclusions about sightplaying components. Therefore, the author of this paper synthesized the results, knowledge, and suggestions from previous literature in order to provide a thorough explanation for the paradigm of sightplaying on the piano. The sources for this study are drawn from current scientific studies, well-accepted psychological theories, teaching methods, and pedagogical techniques from experts in the field.

Outline of the Study

The remainder of this study is organized as follows: Chapter two is an overview of the literature in the field of sight-reading, sight-singing, and sightplaying necessary for a complete understanding of this particular phenomenon on various musical instruments. Chapter two also includes a discussion of historical practices and strategies, as well as how previous literature has led to the current understanding and present state of the field. Research in the areas of music education, pedagogy, neurological science, brain function, and psychology are addressed.

Chapter three outlines the methodologies that will be applied in order to analyze and synthesize the current literature. A detailed description of the study's methodology and database software that were used to cross reference between each sub-category of the topic are included.

Chapters four to seven provide an extended analysis of literature extracting the four components contributed to piano sightplaying competency: physical <u>C</u>oordination, musical <u>A</u>wareness, musical <u>P</u>otential, and musical <u>E</u>xposure. These chapters serve as the main body of this study.

Chapter eight contains the results of the investigation of this study, which are presented through a proposed sightplaying model. The model will be explained by key themes including the procedural elements in sightplaying, the issue of external versus internal components, and the issue of reading components versus performing components.

Chapter nine provides instructional and research implications drawn upon the model as well as the related findings. These implications should be applicable to both sight-reading as well as sightplaying instructions.

AN OVERVIEW OF LITERATURE

The purpose of this study is to provide a theoretical model explaining the components of sightplaying. Information from current literature in related fields is a crucial resource for the theoretical analysis leading to construction of the model. The content in this chapter serves as a brief overview of the sight-reading literature, including both sight-singing and sightplaying. An analysis of the literature will be discussed in-depth in chapters four to eight, each of which chapters focuses on a specific component of sightplaying.

In many music practices including conducting, composing, arranging, singing, or performing, the ability to read and comprehend unlearned music by sight has been studied with various foci. Studies from different musical practices provide valuable information from multiple perspectives, which allow us to better understand the phenomena. For instance, conductors, composers, vocalists, and instrumentalists execute their reading content through different modes of music making, ranging from mental rehearsal and vocal performance to instrumental performance. Each path of the sight-reading process is distinct; however, they share some similarities. Those similarities can be drawn to construct the themes, identifying generic components and principal characteristics of sight-reading outcomes.

The current literature in the field of sight-reading can be classified into four themes according to the topic of interest. The first theme focuses on the consequences of sight reading competency, including musical achievement as a result of the ability to read music by sight. The second theme addresses the potential components involved in sight-reading ability, which include studies that have suggested techniques and tips for promoting sight-reading ability. The third theme focuses on the physical and psychological characteristics of sight-reading in both novice and expert musicians. These studies have presented valuable new findings regarding the speed, eye movement, clarity, neural functions, and musicality of the sight-reading performance outcomes. In addition, a small group of researchers have analyzed the phenomena and focused on describing the process of sight-reading. This latter group of research provides a theoretical basis for the phenomenon, rather than presenting empirical findings on the subject matter. These four themes in sight-reading research provide us with an integrated view of the information available related to sight-reading skills.

Musical Achievements as Results of the Ability to Read Music by Sight

Current research findings indicate that the ability to read music by sight influences other musical achievements. Sight-reading proficiency has also been shown to affect musical abilities such as error detection skill (Sheldon, 1998). Nuki (1984) found that sight-reading competency increased the ability to memorize piano performance pieces. Findings from two studies (Gilman, 2003; McPherson, 1995) support the notion that as musicians mature, the correlation between the sightplaying performance and rehearsed music performance increases. Gilman (2003) discovered that in the beginning stages of music training, sightplaying skill is not significantly correlated with the ability to perform rehearsed music. Results from McPherson's study (1995) showed a pattern of higher correlations between the five types of performance, including performing rehearsed music, sightplaying, playing from memory, playing by ear and improvising, as instrumentalists mature.

Other researchers compared the effectiveness of learning music through rote memory versus learning music from notation. Glenn (1999) revealed that in beginning string classes, both learning music by rote memory and learning music by reading notation created a positive effect on working memory capacity. In another study, Stwolinski (1998) made comparisons between the musical achievements from visual-centered learning versus aural-centered music learning. The results from this study suggested that listening to recordings rather than sightplaying music excerpts at the keyboard improved the player's ability to detect harmonic alterations within the pieces.

Sight-Reading Components

The components of the development of music reading skills have remained a major topic among music educators, perhaps based on the belief that the knowledge of what causes better sight-reading may enable music educators to draw implications for music literacy instruction. While some researchers attempted to investigate a single component (Jacobsen, 1942; Weaver, 1943; Zagorski, 1994, November), others were interested in multiple variables in the music reading process (McPherson, 1997; Rayner, 1997; Wolf, 1976). Furthermore, some components have been investigated more thoroughly than others due to researchers' interests and the potential contributions to music education. As a result, findings from accumulative studies within the same topic provide broader, sometimes controversial explanations from multiple perspectives, which are applied in different settings.

Throughout the history of music literacy research, trends among research topics—such as components of sight-reading ability—have emerged. At one point, the focus was to examine the basis of music learning. During the 1970's, music audiation was considered one of the prominent components in developing musicianship (Gordon, 1984). After 1980, the expansion of brain research increased the number of neurobiological and neuromusical studies. Moreover, studies about neural activation during sight-reading activities provided useful information regarding the physiological basis of music literacy (Hans, 1982; Hodges, 1996; Sergent, Zuck, Terriah, & McDonald, 1992; Virginia, Robert, & Feindel, 1999). Current literature has been focused on various variables as components in the sight-reading process (Demorest, 1998; Gromko, 2004; Roge, 1996)

Sight-singing and sightplaying performances are influenced by many components. Some components are more likely to come from readers' competency and readiness (Bernstein, 1981; Rubinstein, 1950), while other components are closely linked to the syntax and structure of the music itself (Shockley, 2001). It is important to note that individual musical readiness and capability tends to be the priority among music educators, especially when the goal of music instruction is to help all learners achieve their musical potential.

To perform given music pieces on an instrument by sight, a person's technical skill is as vital a component as cognitive ability. Technical acuity requires many sub-skills such as hand-eye coordination, independence of fingers, weight controls of the fingering, and agility count. Moreover, a perfect balance of the whole body as measured by relaxation and freedom of movement is required in many musical activities that demand coordination of parts of the body (Bernstein, 1981; Enoch, 1996; Uszler, Gordon & Mach, 1991).

Besides the importance of technical acuity when playing a musical instrument, music literacy skill plays yet another important role in sightplaying performance. An understanding of the concepts of pitch and melodic relationships tends to promote sight-reading competency. Furthermore, a knowledge of tonal patterns increases the ability to identify notes during the process of sight reading (McKnight, 1975). In addition, the individual's ability to inner-hear or audiate the sound with accurate intonations and pulse has been shown in many studies to be beneficial to sight-singing and sightplaying (Anderson, 1995; Sheldon, 1998; Wollner, & Halfpenny, 2003).

The longer a person has been trained in music education or been exposed to musical environments, the more specialized sightplaying skill can be expected. Also, the length and quality of exposure to music can gradually help develop a student's personal familiarity with musical patterns, types, styles, or genres. Familiarity with musical patterns and musical knowledge are crucial components in sight-reading development (Bamberger, 1996, 1999; Lehmann, 1993; Roe, 1933). Lowery (1940) emphasized that familiarity with musical patterns and eye-ear coordination in sightplaying performance help performers discriminate the quality of the performance in the expression of musical value and beauty. Furthermore, in sight-singing practice, Walker (1972) suggested that the length and frequency of involvement in formal musical performance significantly improves sight-singing performance.

Another component such as the mode of visual representation is embedded in the symbolic structure of the music itself (McKenzie, 1986). A musical piece that has a high level of complexity can impair the accuracy of sightplaying performances. The complexity of a musical piece may be perceived in both tonal and rhythmic modes. Moreover, atonality in a piece tends to pose an obstacle when a person reads music by sight (McKenzie, 1986). Self-paced reading of musicians was significantly delayed for music that contained diatonic violation (Gunther, Schmidt, et at. 2003). Asymetric rhythmic division or complicated rhythmic elements have also been shown to detract from reading ability (Gregory, 1972). To solve some of the notation-based problems, a color-coded notation system has been investigated to add a visual cue for normal readers (Rogers, 1991). Clifton (1997) found that the intervallic distance between notes affects the reader in that it takes the reader longer time to count each line or space. This "height effect" was detected in both expert and novice sightplayers; however this effect was more prevalent among poor sightplayers (Clifton, 1997). In piano sightplaying practice, research has shown that the effect of tonal and rhythmic structures as well as the effect of musical experience increase the quality of sightplaying outcomes (Walker, 1972). Lastly, difficulty of the fingerings has been shown to affect the quality of piano sightplaying performance (Sloboda, 1998).

The various goals of music educators have been illustrated equally by the variety of methods in music literacy teaching methods as well as several pedagogical methods. Many music literacy instructional techniques such as moveable-do, fixed-do, interval names, letter names, scale degree numbers, and neutral syllables have been used in sight-reading practice in order to improve music reading ability. Despite the large number of available music literacy techniques, music teachers face challenges in selecting appropriate methods for developing music literacy (Collins, 1979; Costanza & Russell, 1992; Davidson, Scripp, & Fletcher, 1995; Scott, 1995). Specifically, the selection challenges are due to the lack of theoretical paradigms. A theoretical paradigm can outline basic elements in music reading behavior, allowing educators to better understand the phenomenon and be able to select, adapt, and implement among the available literacy teaching methods.

Sight Reading Characteristics

Fluent music reading ability can be compared to fluent language reading ability. Just like a fluent language reader, fluent music sight-readers read quickly with purpose, using a variety of strategies to comprehend the context (Rubinstein, 1950; Tobin, 1957; Wolf, 1976). Also, fluent music sight-readers interact with the music, and are able to evaluate the music critically. Furthermore, when music sightplayers transfer their comprehension to sightplaying performance, the continuity, fluency, accuracy, artistic elements, and overall quality of the musical outcome become apparent.

Many studies have been conducted to investigate the characteristics of sightplaying performances. Accuracy and the artistic outcome of the performance are among the most important qualities of pianists (Sorel, 1968). In a study by Walters (1998), the accurate recollection and imitation of briefly presented chords showed a significant relationship to sightplaying competency. Betts and Cassidy (2000) observed right-hand against left-hand proficiency of 39 undergraduate non-keyboard music majors. Their research indicated that the right-hand's ability to accurately sightplay a melody decreased when a left-hand accompaniment was simultaneously performed. According to this study, left-hand accompaniment tended to interfere with the reading and sightplaying process.

Waters (1997) compared the characteristics of amateur and professional sightplaying performances. Besides accuracy and artistic elements of sightplaying performance, tempo was determined to be among the core qualities. Waters found that when compared to amateurs, expert pianists perceived notes or groups of notes more rapidly at a time. Also, the ability to play the corresponding note from the written notation to the keyboard was shown to be executed faster in expert pianists than in poor pianists (Clifton, 1986). The response rate of naming individual notes was also significantly faster in the superior players (Clifton, 1986; Waters, 1997).

When conducting a sight-reading test, specific standards and certain levels of musical outcomes have been set to assess students' ability to read music by sight. In addition, different types of measurements have been designed in order to assess both vocal and instrumental sight-reading ability. Examples of standard sight-reading tests for general music instruction include the Watkins-Farnum Instrumental Sight-Reading Scale (Watkins, and Farnum, 1954), the Iowa Musicianship Test (Hoover et al., 2003), and the Seashore Music Aptitude Test (Seashore, Lewis, & Saetveit, 1960). A limited number of sight-reading tests designed especially for particular instruments has been put into practice. In the piano sightplaying area, the Trinity college of London has developed a well-accepted standardized test for eleven steps in piano proficiency for each of the eleven grades—The Associated Board of the Royal School of Music's Graded Music Examination (1994). This test is revised every two years.

Process of Sight Reading

In order to choose the most appropriate pedagogical methods, research that focuses on the specific processes of sight-reading is needed. Only through a true and thorough understanding of the sight-reading process will the music teacher be able to choose the best tool to help his/her students reach their full musical potential. Due to the fact that reading music requires readiness in phonological understanding and visual-spatial reasoning ability similar to those in other types of symbolic reading, many researchers have made comparisons from music reading to other related areas including linguistics (Hahn, 1987; Hansen, Bernstorf & Stuber, 2004) and spatial-temporal tasks (Gromko & Poorman, 1998; Rauscher, Shaw, Levine, Wright, Dennis, & Newcomb, 1997). Thus, the link between music and literacy has been one of the prominent themes in music education research. Recently, the music-mathematics link has been actively disseminated and integrated in regular classroom instruction as well as in research studies (Rauscher, et al., 1997).

With regard to the issue of cognitive levels involved in the music reading process, Gilman (2003) proposed that reading at sight requires a moderate level of cognitive thinking. He proposed that even though reading by sight engages higher cognitive thinking than an error-detection task, playing by sight engages a lower cognitive level when compared to a transposition task.

Due to the overwhelming amount of data, there is a need to organize the interrelated research findings and cumulative data in the area of sight reading. A thorough explanation of the overall processes of the complexity of sight reading is often presented in the form of a model or taxonomy. Thus, creating a model is an appropriate means by which to organize a large amount of subtle details into one big picture. Three theoretical approaches, including Gordon's Stages of Music Literacy (2003), McPherson's Theoretical Model of Path Analysis (1997), and Mainwaring's Model of Relationship between Aural, Visual, and Action (1951), were selected to serve as a scaffold in order to assemble the model of sightplaying in this paper.

Gordon's Stages of Music Literacy

Gordon's work on *Stages of Music Literacy* (2003) explained the sequential skills acquired throughout music literacy development. Eight stages of music learning were divided according to the level of psychological involvement. The primary literacy levels involve perceptions or the senses. In Gordon's terms, the first five fundamental stages on the *perception level* consist of aural-oral perception, verbal association, partial synthesis, symbolic association, and composite synthesis. Musicians who achieve this fundamental level of music literacy are able to recognize familiar musical content, both aurally and visually. In the next stage of music literacy, the *conception level*, musicians are able to recognize unfamiliar musical content. These expert musicians express their creativity when they compose and improvise music. Gordon named the three stages in this cognition/conception level of music literacy: generalization, creativity-improvisation, and theoretical understanding.

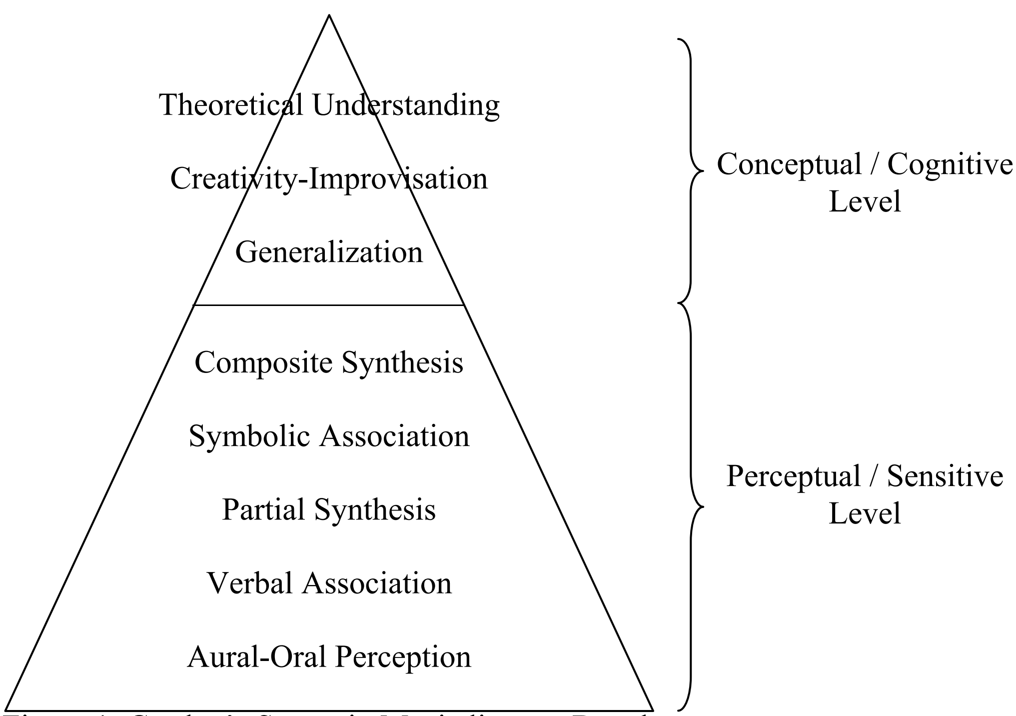


Figure 1: Gordon's Stages in Music literacy Development

McPherson's Theoretical Model of Path Analysis

McPherson's theoretical *model of path analysis* (McPherson, 1997) indicated that to play by ear, play from memory, improvise, perform, and sightplay are five distinct music performance skills. In his model, the length of study, quality of study, enriching activities, and early exposure are the four most important variables. McPherson proposed that the four variables have causal relationships in the five types of musical performance. McPherson's path analysis indicates that the skill of performing rehearsed music is most heavily influenced by the variables associated with length of study, as well as the player's ability to sightplay. In contrast, the skill of improvising was most strongly influenced by the capacity of musicians to play by ear. Moreover, results from his study showed a pattern of high correlations among the five types of performance as instrumentalists mature.

Considering the level of creativity involved in each type of performance, McPherson classified the five types of performance into two categories: *creative and re-creative performance*. Three out of the five types of performances, including sightplaying, playing from memory, and performing rehearsed music are categorized as *re-creative* performances, while the other two types, improvised performance and playing by ear, are categorized as *creative* performances.

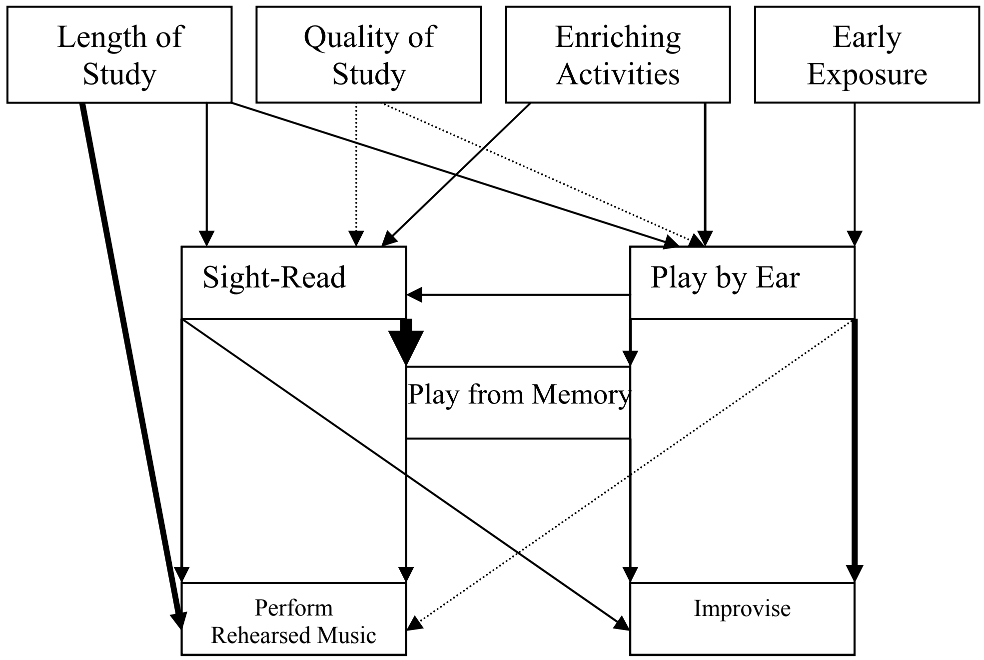


Figure 2: McPherson theoretical model. Thicker lines represent stronger influences

Mainwaring's Model of Relationship between Aural, Visual, and Action

Mainwaring (1951) suggested that the most musical way of teaching an instrument is to continually link sound with action. Reading notation should therefore come after the sound of the music has been established in the players' ears. It is an apparent theoretical belief that supports the approach of securing aural perception of musical sound to enhance visual perception of music notation. According to Mainwaring, the ideal relationship between aural, visual, and action during the process of reading music at sight should progress from aural perception to the act of performing the piece. He suggested that an effective sightplayer should internalize or hear the sound of a musical symbol before performing on the instrument. Thus, a typical music practice tends to focus on the act of performing on the instrument as an absolute result of reading music.

Ideally, the most musical way of producing music is to express the sound that corresponded to the three processes respectively: decoding the musical symbols, internally hearing the sound, and performing on an instrument. Mainwaring suggested that weaknesses in current literacy instruction are revealed when written music is performed without the performer's internal perception of written notation.

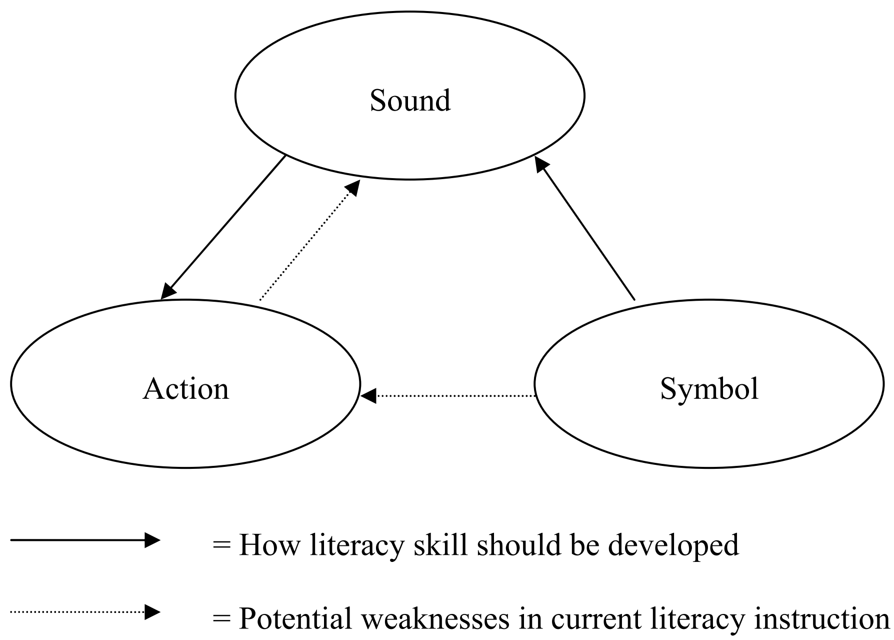


Figure 3: Model of literacy development (adapted by McPherson and Gabrielsson, 2002)

Due to the fact that there is a need for a theoretical paradigm to outline basic elements in music sight-reading and sightplaying for particular instruments, the purpose of this study is to construct a proposed model for piano sightplaying components. Related literature from the four themes presented earlier allows the integration of information to embrace widespread perspectives. Among the four themes, the two themes that had a prominent effect upon the emergence of the model were (1) the components involved in sight-reading ability and (2) the characteristics of sight-reading. The explanation of the model will include the comparison between the proposed model and current theories mentioned in this chapter.

METHOD OF STUDY

The goal of this study is to provide a theoretical model regarding sightplaying phenomena based upon investigation, analysis, and synthesis from a large amount of research findings, observation results, theoretical ideas, teaching methods, and perspectives from various fields of study including psychology of music, music education, psycho-musicology, and neurological science. Specifically, the focus of the study is on what affects an individual's ability to sightplay on an instrument capable of producing multiple pitches simultaneously, the piano.

Research Design: Theoretical Model Building

Theoretical model building is a method of acquiring knowledge through analysis and synthesis based upon both logical and creative thinking (Edwards, 1992). The philosophical background of this study leans more toward rationalism philosophy, where the mode of acquiring knowledge is through intuition, reasoning and logical relationship, as opposed to empirical philosophy (Yarbrough, 2000). High levels of cognitive thinking according to *Bloom's Taxonomy* (1956) are utilized throughout the model-building process. It includes making comparisons, drawing multi-directional relationships between schemes, and making a justification or evaluation upon findings and perspectives from diverse resources. In order to reinforce the quality and the credibility of the outcome, namely "theoretical model of components of piano sightplaying," it is the author's priority to control the credibility and validity in the process of cognitive thinking: analysis, synthesis, and evaluation.

Within the realm of constructivist philosophy the methodology of this study illustrates elements from a speculative theory-building methodology (Mertens, 1998;

Yarbrough, 2000). Speculative theory shares similarities with grounded theory in terms of its underlying constructive philosophy and construction-based theory (Parsons, 1951). However, the major difference between grounded theory and speculative theory lies in the fact that speculative theorists formulate their theory very systematically and usually abstractly, anchoring very little in actual research, whereas grounded theorists undergird their theoretical hypotheses with qualitative experimental data. Some researchers reject the speculative theory (Blumer, 1969; Glaser & Strauss, 1967) because of its lack of statistical credibility and practicality, whereas some researchers value speculative theory because it presents a logically articulated conceptual scheme (Parsons, 1951).

Due to the fact that many of the studies in the area of sight-reading, sight-singing, and sightplaying have been conducted through the empirical mode utilizing statistical measurements, the design of this type of study creates certain limitations regarding qualitative aspects. For instance, low power variables may not create statistical significance in quantitative experiments and therefore are omitted from the conclusion. In contrast, every small detail is as important as major elements in qualitative research. This follows the principle of "all voices must be heard" in the qualitative method of study. To better understand a complicated phenomenon such as sightplaying, all possible components must be synthesized even though some might not create a statistical significance when examined through an empirical lens. Instead of drawing objective conclusions similar to those of quantitative studies, this study is designed to examine rather subjective findings similar to those of qualitative studies. A generic explanation classifying all possible components involved in the sightplaying process will also maximize the practicality of this study's findings.

Despite the methodological characteristics—where building a theoretical model is an outcome of speculative hypotheses—a theoretical model provides a source of knowledge in a rich explanatory way throughout the entire model-constructing process. At the beginning of the model-constructing stage, the researcher tries to describe general elements, simplifies the complexity, integrates various concepts through a statement of relationships, and interprets incidents to explain why certain events occur and not others. At the completion of the model-building stage, the researcher presents the skeleton of the sightplaying process using an overarching explanatory scheme. At the application stage, the model provides valuable information that promotes readers' understanding toward sightplaying. At the same time, its implications provide a guideline to actions, which enable the readers to predict events as well as to solve problems. Even though this type of model provides more practicality than truth (Edwards, 1992), it allows simplification of the complex process of sightplaying. This model will be used as the underlying blueprint of the research effort.

To further explain why the methodology conducted in this study is valid, reliable, and contains high quality, each issue will be discussed separately. The research procedure and measurement conducted throughout this study has been designed to promote the qualitative value of the study. Therefore, the discussion about research quality issues will be accompanied by its parallel research procedures.

Dependability

In qualitative/constructivism research, change is expected and the researcher has a responsibility to track these changes and provide a documentable record of the process (Mertens, 1998). Dependability is a parallel aspect to reliability, where the change process can be inspected to attest to the quality and appropriateness of the inquiry process. During the model-constructing process of this study, the theoretical model was adapted, justified, and constantly revised. Reflective activities such as keeping a set of notes that recorded the analytic process allowed the author to confirm dependability.

Providing a generic layout of the components involved in sightplaying illustrates the dependability of the proposed model where it can be adapted to predict and explain any sightplaying process in any given instrumental setting.

Credibility

From an interpretive point of view, where the researcher plays an important role in analyzing and interpreting the data, credibility is necessary to confirm the research's validity (Mertens, 1998). Among all cognitive methods including making comparisons, drawing relationships, and describing elements, the researcher has to maintain the highest level of credibility. The following research procedures demonstrate the credibility of this study.

Assign Ranking to the Data Sources

To assign the relevance of each piece of information, many criteria have been set as guidelines including statistical significance, credibility of the proposal, supportive theories, and pedagogical effectiveness. Accordingly, statistical research, theoretical philosophies, and contemporary research findings will be prioritized over observations from case studies, opinions from practitioners, or dated research results.

Ranking or giving prominence or importance of each study is necessary because some resources provide more in-depth information than others. Statistical significance, sample size, degree of relevance, supportive thoughts, and theory-based comments are crucial to the process of ranking the resources. For instance, studies about sight-reading and sight-singing provide more generic information than studies about sightplaying.

Persistent Observation.

To avoid premature closure, the author observed over a sufficiently long period to identify salient issues. During the period of six months from August, 2003 to February, 2004, the researcher engaged in searching, informal experimenting, analyzing, drawing a proto-model (Edwards, 1992), developing a true model, and drawing conclusions.

The author constructed a theoretical model by utilizing similar modes of managing information to theory building in grounded theory methodology. Methods of giving descriptions and creating conceptual ordering were operated as fundamental processes in the theory-building paradigm. Conceptual ordering is a method whereby events and objects among various sources are organized and integrated into various concepts through statements of relationship (Mertens, 1998). The solid and logical conceptual schemes promote the credibility of the model in this study.

Progressive Subjectivity.

One of the strategies applied to confirm the credibility of this study was to consistently monitor the developmental process when constructing the model (Mertens, 1998; Patton, 2002). The author's journal provided a comprehensive document regarding the process of change from the beginning of the study until its end. Throughout the model-developing process, comments and suggestions were also provided from professional music educators who had experience in piano sightplaying performance. The supervision from these experts served as a method of monitoring and examining the subjectivity of the study. This research technique is parallel to reflective strategy, when grounded theorists reflect on their field notes, reports, thoughts, and feelings (Patton, 2002).

Confirmability

To prove that this study had a lucid objective toward building a theoretical model, the method of confirmability audit applied. Confirmability in a qualitative study is regarded as parallel to objectivity in the quantitative tradition (Lincoln & Guba, 1985). According to Strauss and Corbin (1998), confirmability audit is used to trace the data to their original sources and to confirm the process of synthesizing data using a chain of evidence to reach conclusions. In the present study, a complete set of analytic notes, showing the developmental process of constructing the model, confirmed the objectivity for each progressive stage to the final product of completing the true model. Each analytic note was kept in chronological order to confirm the process of synthesizing the data.

Data and Data Collecting Procedure

A majority of the study's references, 178 sources, are considered the body of research data. According to Glaser and Strauss (1967), the collection of archival material including documents, newspapers, and books is the equivalent of a collection of interviews or field notes. Books, articles, and research studies have been purposefully selected for this study to represent samples of reading material in the areas of sight-reading, sight-singing, and sightplaying.

The data-gathering procedures in this study are qualitative-based, therefore many terms and procedures from grounded theory were utilized, for instance triangulation, recursive, and emergence of regularities (Creswell, 2003; Guba & Lincoln, 1989; Mertens, 1998).

Triangulation

One of the key concepts in data gathering of the qualitative research is triangulation (Guba, et al, 1989). Triangulation requires the convergence of multiple data sources and methods from a variety of participants under a variety of conditions (Patton, 2002). Information from related fields of study plays an important role in this multi-perspective analysis. The following list is given to provide an example of diversity in data sources and methods using different criteria to define the categories.

The written material used as the data source for this study covers a large range including year of publication, type of publication, field of study, philosophical background, research metholodogy, and practical implication. A variety of writing from different fields of study includes linguistics, reading, science, music, education, special education, psychology, multicultural studies, and neurological science. Statistical research, ranging from descriptive statistics and regression analysis to analysis of variance, represents resources from the quantitative tradition. Findings from case studies and theoretical articles comprise materials from the qualitative research arena. Various types of publication materials were selected to form a complete set of research data that includes research studies, dissertations, pedagogical articles, books, and texts. Behavioral science materials and theoretical resources were equally examined to preserve their essences. Triangulation of data sources offers opportunities for deeper insight into the relationship between inquiry approach and sightplaying phenomenon (Patton, 2002).

Theoretical Sampling

Theoretical sampling was the data collection strategy used for this study, whereby the selection of incidents or resources was guided by the emerging theory. Unlike probability-based sampling, theoretical sampling is a selective data collection strategy. The author searched and chose research, pedagogical suggestions, thoughts, and theories according to their relevance to the topic and scope of concerns as well as their contribution to the theoretical formulation. The author constantly asked questions and interacted with the data that was gradually accumulated over time. When there were any questions, the author continued collecting data to help answer that question. Charmaz (2003) explained that as grounded theorists refine the categories and develop them as theoretical constructs, they normally go back to the field and collect delimited data to fill the conceptual gaps and holes. This type of selective sampling is known as a purposeful sampling (Mertens, 1998). According to Strauss and Corbin (1998), theoretical sampling refers to method of data gathering driven by concepts derived from the evolving theory and based on the concept of "making comparisons," the purpose of which is to go to places, people, or events that will maximize opportunities to discover variations among concepts and to identify categories in terms of their properties and dimension.

Recursive

Research findings from this study were generated and systematically built as successive pieces of data were gathered. This method of data interpretation and analysis is called recursive (Stainback & Stainback, 1988). In other words, the theoretical model of components in sightplaying gradually emerged from the data. By applying the recursive concept, data collecting in this study was an ongoing process. The process of data collecting occurred at the same time as the construction of the theoretical model. As the emergence set the direction, the author gathered more information to support, contradict, or make comparisons to the theoretical model.

At the beginning stage of this study, a handful of literature in the area of sight-reading, sight-singing, and sightplaying was collected in order to create conceptual schemes, procedural models, and directional relationships among variables. As the themes of components and sub-components of sightplaying emerged, the author searched for additional references in the areas that needed more explanations and clarification. Even though some guiding research questions were formulated at the beginning of the process, additional categories or themes were allowed to emerge from the data.

Emergence of Regularities

Lincoln and Guba (1985) recommended that data analysis and data collection cease with the emergence of regularities; that is, when no new information emerges with additional data analysis. In the present study, the author stopped collecting more evidence when new information could not be used to draw further findings. It became the author's decision to cease data collection and data sampling when the new information did not contribute to any changes or yield any additional informative details to the model being developed.

Data Analysis

It is the goal of this study to make a reference from previous research findings in order to draw patterns or themes that occur in the process of sightplaying. Philosophical beliefs, analytic schemes, and analytic strategies are crucial elements in the course of data analysis. Each element will be discussed as follows.

Philosophical Belief

Both imperialistic philosophy and rationalism influenced data analysis in this study's activities (Yarbrough, 2000). The imperialist mind believes that the value and meaning of music are driven from the person involved in the musical activities (Yarbrough, 2000). Therefore, human experience, as a result of human perceptions through the five senses, is the source of knowledge for the imperialist. In contrast, rationalism focuses more on the beauty inherent within the music itself, rather than a person as a listener, composer, or performer (Yarbrough, 2000). Therefore, musical syntax, structure, and other characteristics play important roles in sightplaying phenomena. To understand an individual's sightplaying skill, both individual and environmental components should be taken into consideration. Being rational allows the musician to recognize the essence of musical elements as a component in the process of sightplaying. At the same time, being imperialistic enables the musician to acknowledge, appreciate, and carefully observe human musical ability.

Another consequence of applying both schools of thought is exhibited in the use and selection of resources as data for the research. Physical acoustics and psychological acoustics are closely related fields in that both subjects examine sound. However, psychological acoustics deals with the phenomenon of hearing music from a psychological and aesthetic point of view, whereas physical acoustics focuses on the science of sound activities (Yarbrough, 2000). One field focuses on human sensation and perception while the other concentrates on the actual existence of musical sound by mathematical measurement of the sound wave. Literature from both areas will be utilized in this study in order to provide perspectives from both the empirical and rational points of view.

Being rational also allows the musician to implement logical calculations and comparisons from all possible resources between cause and effect in the process of sightplaying. Consequently, the author has proposed that sightplaying is a result of both innate and acquired components.

Analytical Scheme

Path Analysis

Due to the fact that the relationships between the variables involved in sightplaying performance can be multi-directional, path analysis was determined to be an effective analytic strategy of this study. Instead of linear regression analysis where the process is drawn in a single direction, path analysis focuses on multi-directional relationships. Causal relationship, or influence between variables, is one of the most essential qualities in the path analysis process. The theoretical model presented as the final outcome of this study illustrates the interrelationship between each variable as well as demonstrating multi-directional musical development. Accordingly, path analysis process was considered as one of the analytical schemes used in this study.

Inductive Analysis

Immersion in the details and specifics of the data to discover important patterns, themes, and interrelationships illustrates inductive analysis strategy (Patton, 2002). To analyze the data inductively, the author collected specific information from a variety of sources and drew upon personal knowledge and experience in order to form conclusions. This method of cognitive thinking allowed processing of the information from smaller units in order to generate a larger general concept. Variables that have an effect in sightplaying performance were synthesized and carefully analyzed before they were classified into themes and categories that constituted the proposed model.

Method of comparison

A method of comparison was employed in order to build and refine categories, define conceptual similarities, find negative evidence, and discover patterns. It was suggested by Lincoln and Guba (1985) that a constant comparative method of analysis should be applied, making comparisons and asking questions about the data consistency. Comparisons have been made between disciplines such as language reading and math reading. Agreements, alignment, coexistence, and similar outcomes from previous studies were brought to a solid conclusion, whereas disagreement and contradiction from different studies provided an in-depth explanation about the phenomenon under different conditions. If there were occasions when sources were not in agreement, they were made explicit in the report.

Analytic Strategies

Open Coding

Open coding is the initial analytic process though which concepts are identified and their properties and dimensions are discovered in data (Strauss et. al, 1998). During the open coding process, data are broken down into discrete parts, closely examined, compared for similarities and differences, then grouped and categorized. At this beginning stage, the author utilized *Microsoft Excel, XP version,* a spreadsheet software to help classify and categorize the resources into general categories or strands.

At the beginning of coding process in this study, the author identified all variables that were shown in literature to be involved in a person's sightplaying ability. According to Strauss et al (1998) the variables' properties were carefully investigated before the author classified them into each strand. All terms and concepts that represented the same concept were grouped into the same strand representing a single idea (Straus et al, 1998). As a result, 23 strands were found as the basis that built up the foundation of the model. (By referring to the model on page 42, 23 stands are separately listed in each rectangle with thin border line.)

Axial Coding

The second analytical process involved axial coding, establishing relationships between subcategories. Straus and Corbin (1989) stated that the term "axial" is used because the type of coding occurs around the axis of a category, linking categories at the level of properties and dimension.

After identifying the smallest set of meaningful units in open coding, the next step was to sort and sift through each set to identify relationships between variables, patterns, and themes, as well as to draw distinctions and common sequences between sub-groups. At this beginning stage, the author utilized *File Maker Pro Version 7.0,* a database software to help sort and code each citation into categories that applied. Some citations provided resourceful information for more than one idea, therefore a database software allowed the author to label and assign an unlimited number of codes to increase precision in the axial coding process.

The database software program allowed the data to be kept, sorted, and categorized. Each research finding was entered and stored, readily retrievable to make a cross reference from one topic to others. It was possible to complete sorting and coding either manually or by computer. A specific word could be selected from each record's abstract storage to perform a computerized search. Each datum of this study was also manually coded, with the records classified into multiple sub-categories that applied to the relevance of the content area to the themes. This manual search allowed the author to be more specific and to be motivated by a theorist-centered approach rather than data-centered. The computerized search option supplied a complete set of records supporting the focused theme. The manual search, as a result of previous axial coding, increased the precision of the search.

To make the classification become more appearance to readers, and to reinforce the organization of the model, the author applied axial coding when grouping 23 strands into nine major classifications. (By referring to the model on page 42, the nine classifications are illustrated in rectangles with a bold border line as the second level of classification.)

Selective Coding

Selective coding is a process of integrating and refining the theory (Mertens, 1998; Patton, 2002). When the major categories are integrated to form a larger theoretical scheme, the research findings finally take the form of a theory. In the present study, the four major components of sightplaying were drawn from multiple sub-categories: physical coordination, psychological awareness, musical potential, and musical exposure and experiences. These four components serve the paradigm in a different manner. The first two components—Coordination and Awareness (CA)—tend to contribute to a person's immediate response to a sightplaying performance, whereas the latter two components—Potential and Exposure (PE)—tend to serve as a basis of individual's aptitude in sightplaying competence. In other words, Coordination and Awareness are the "forefront" elements enabling a person to handle sightplaying tasks, while Potential and Exposure serve as "backup" resources to a person's sightplaying competence.

At this final stage, the author utilized a flow chart to illustrate the relationships among the four components and sub-categories. Patterns of the relationships and the role of each element in the sightplaying process were demonstrated in type of a flow chart representing the theoretical model. The proposed model is an analytic or symbolic model, where the diagram or flowchart graphic represents the ingredients and the flow of the process. The author proposed that the model serves as a universal blueprint of the sightplaying process, enabling music educators to understand the phenomenon in a "big picture" sort of way and, therefore, effectively adjust research implications to fit their unique situations. (By referring to the model on page 42, the four components are illustrated in rectangles with double border lines, listed in the second row of the model.)

Although the flow chart illustrating the relationships among the four components and their sub-categories actually depicts the results of this study, it will be presented, before the data analysis, in this chapter. Due to the extensive amount of information gathered to support each concept, the flow chart is provided as an advance organizer so readers can have a better expectation of what is to come and better understanding regarding each sub-category when navigating through the specific content in the following four chapters (see Figure 4 page 42).

The next four chapters represent the body of the research. Each of the four chapters provides a summary of the analysis of current literature on each sightplaying component: physical coordination, musical awareness, musical potential, and music experience. There are no hierarchical relationships among the components. However, the order of the presentation of the four components establishes an acronym for the four categories:

CAPE, which stands for physical Coordination, musical Awareness, musical Potential, and music Experiences.

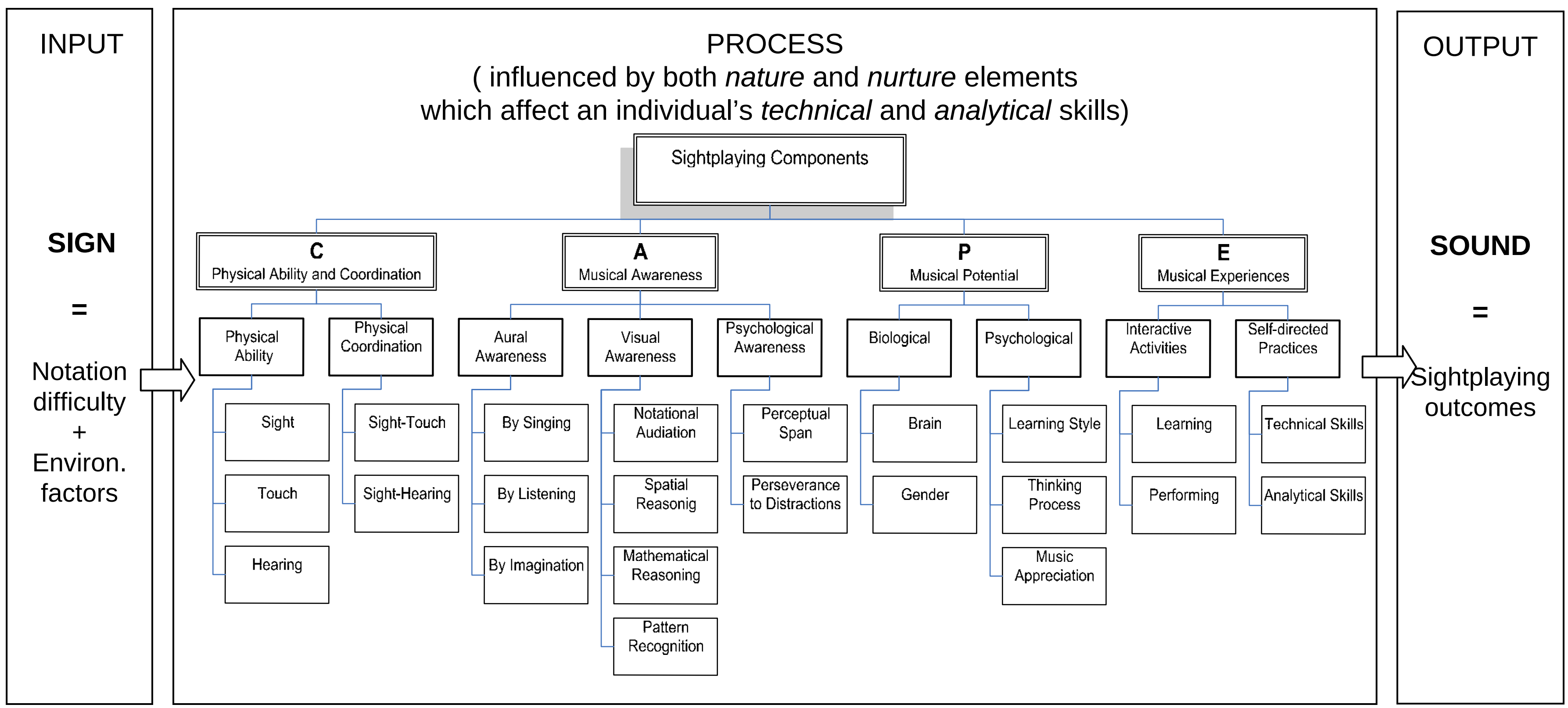
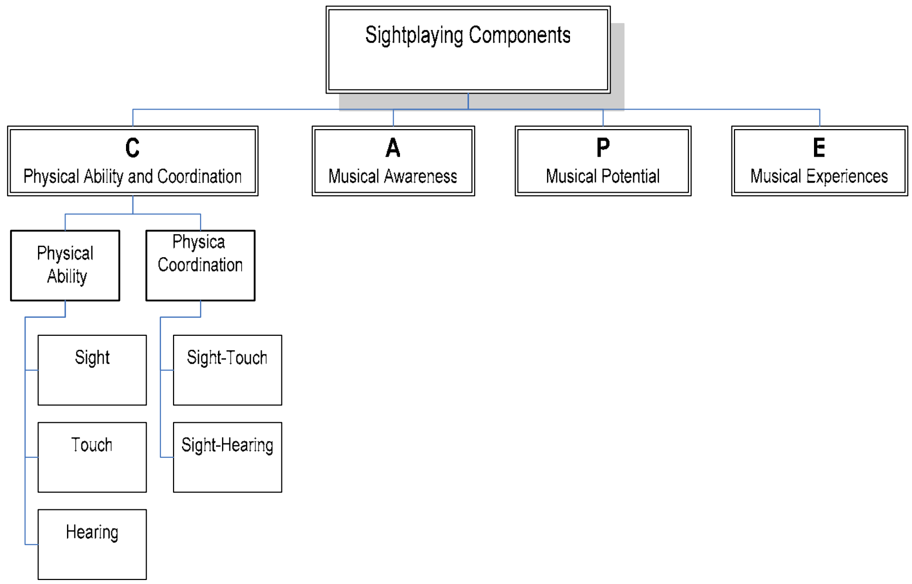


Figure 4: Theoretical Model of Piano Sightplaying Components

COMPONENT 1: PHYSICAL ABILITY AND COORDINATION



Among the four proposed components, the first component concerned with piano sightplaying performance deals with physical ability and coordination. Insightful sensational perception and kinesthetic coordination serve as a primary connection in the translation of music notation to performance. Three of the five sensory faculties, hearing, sight, and touch, are the major pathways underlying sightplaying development. When a person sightplays the music, hearing the sound being played, seeing and reading the notation, pressing the keys on the keyboard, and controlling the pedals all occur simultaneously. Therefore, these faculties in sensational perception need to operate independently as well as in synchronization with the others when it comes to performing at sight.

Reading unlearned music and simultaneously playing that music on an instrument requires physical sensitivity as well as coordination between the two activities (Bernstein, 1981). In other words, sightplaying performance is a consequence of the performer's ability to isolate each physical perception when perceiving the stimuli from various modes as well as coordinate physical motions effectively to perform on the keyboard. Proper refinement of these innate physical and sensory abilities by means of training and experiences will cause them to develop into effective music skills (McPherson, 1994).

The focus of this chapter is the very rudimentary function of music making, namely sensory perceptions and motor skills operated by the player's level of physical and habitual reaction. Many sensory perception abilities that have been developed to engage mental awareness and cognitive thinking will be discussed in the following chapters. Knowledge from theoretical, pedagogical, and statistical literature forms the basis of this chapter.

Physical Ability

The Sense of Sight

Reading music by sight requires the eyes to move quickly to gather as much information as possible before transferring this information into the production of sound. The amount of reading information acquired is dependent upon the movement of the eyes from one point to another (saccadic movement) and the size of seeing window (fixation) (Pollatsek, 1993). The quality of the information being gathered may depend upon other faculties such as music knowledge, experience, and cognitive ability (McPherson, Bailey, & Sinclair, 1997; Sloboda, 1984; Waters, 1997; Wolf, 1976). In this chapter, where basic physical response is our concern, the quantity of the information gathered by human eyes is the focus. Chapter Five will address the quality of the information being read and the processing of the information.

The Movement of the Eyes: Saccadic

Saccade or saccadic eye movement happens when the eyes move from one point to another (Fischer & Biscaldi, 1999; Pollatsek, Rayner, Fisher, & Reichle, 1999). Even though no information is being processed during each saccade, it is necessary to understand the speed, the pattern, or the direction of saccadic eye movement when it comes to reading learned music as opposed to unlearned music in the sightplaying setting.

Saccadic speed. Human saccadic speed refers to how fast the eyes move from one object to another. When people read or view any static display, their eyes shift location quite frequently in different directions (Fischer, 1999). The eyes also do not move continuously throughout the page, instead they move in a series of rapid movements from one point to another. This saccadic movement lasts between 15-50 milliseconds after each static motion to the object (Pollasek et al, 1993). Even though no useful information is extracted during this saccadic eye movement, improving saccadic eye movement can increase the overall reading speed of an individual. Despite the fact that saccadic reaction speed differs for each individual, research has indicated that saccadic speed can be enhanced by daily practice (Fischer, Boch, & Ramsperger, 1984)

An attempt to train amblyopia (the eye condition, noted by reduced vision, commonly known as lazy eye) has been made in various approaches such as the creation of a computerized screen that projects words or pictures at a very rapid speed, or using flash cards, so that an individual can train his/her eyes to move more rapidly to increase their saccadic action (Jacobsen, 1942). This technique proved beneficial to language reading, but there has been no proof of any benefit to music reading. Moreover, findings from Jacobson's (1942) study in the similar topic of training the eyes to move fast opposed the earlier claim. He studied eye movement in reading vocal and instrumental music and suggested that training of eye movements alone cannot lead to efficient reading of music scores.

Consequently, pedagogical suggestions for the improvement of saccadic action had been proposed. Zagorski and Tan (1994) made a pedagogical suggestion of using the "pulse of the music" as an anchor for eye movement while reading ahead for patterns of note values, intervals, keyboard topography, and fingerings. Some educators suggested using the technique of "scanning the page" rather than looking at each note individually when teaching students to sightplay (Boitos, 1998). This approach implies the necessity of moving the eyes rapidly in order to quickly grasp the musical information on the printed page. Familiarity with text has been shown to have a positive influence on the saccadic speed when results from the study revealed that young children and skilled readers tended to have a slow saccadic eye movement when they read difficult text (Stark, Giveen, & Terdiman, 1991).

Other components can adversely affect a person's saccadic ability such as generic blueprint, neurological pathway, or simply the familiarity of the text or the music being read. For a person with amblyopia as well as a person with dyslexia, saccadic ability is diminished by generic limitation (Pavlidis, 1981). Pavlidis (1981) claimed that slow saccadic reaction time, or unusual eye movement time, is one of the components affecting reading difficulty in dyslexic individuals.

Saccadic pattern. Saccadic pattern refers to the relationship or the ratio between saccadic periods and fixation period. Normally within a period of one second, the eyes shift alternately between fixation and saccade, 100-250 milliseconds per fixation and 20-

40 milliseconds per saccade (Fischer et al, 1993). In other words, under normal circumstances, for 90 percent of the reading time the eyes are in fixation and the other 10 percent the eyes move from one point to another. Unusual eye movement patterns such as “reverse staircase” or regressive eye movement can be observed in persons with dyslexia (Rubino & Minden, 1973). Reverse staircase or regressive eye movement is when the eye moves back to material that has already been read (Reyner & Pollatsek, 1997)

The lexical components, including difficulty level and the complexity of the written material, can cause the fixation period to last longer and cause the saccadic jump to be shorter. In a situation when difficult text was given to both unskilled and skilled readers, both showed deficiency in eye movement (Stark et al, 1991). Research conducted in 2002 documented that readers of Chinese had a longer perceptual span when reading the Chinese language as compared to English, due to the fact that Chinese characters contain more information and therefore require a longer processing time (Liu et al, 2002). Other components that may cause this shifting in saccadic patterns range from reading deficiencies that are influenced by age and cognitive readiness, to neurological perception (Inhoff, 1986).

Saccade directions. Because much of language reading is from left to right, the majority of saccade direction is one direction (Pollatsek, Raney, LaGasse, & Rayner, 1993). A reverse direction, merely 25 percent of reading time, known as regression, can be seen when the reader makes a large right-to-left return sweep saccade when they go from the end of one line to the beginning of the next. However, in music reading, multi-directional saccade is necessary because the eyes need to be able to move both vertically to process all notes in the harmonic intervals and horizontally to focus on the melodic notes in succession. Results of research by Weaver (1943), who recorded eye movements in keyboard performances of 15 trained musicians during sightplaying of short musical selections representing harmonic, melodic, and accompanied-melody types of tonal arrangements, supported the necessity of multi-directional saccade in music reading. In his study, musicians tended to have a regular alternation of almost vertical movements of the eyes from one half of the staff to the other half, and frequent horizontal movements on the treble staff with relatively few saccadic shifts between the treble staff and the bass staff. He also documented that treble parts of chords were usually read before bass parts.

The Seeing Window: Fixation

Fixation—the act of pointing the eyes to a location in space— is the act of execution of the visual stimulus by making sense of what is seen (Pollatsek et al, 1993). Fixation occurs between each saccade, where the eyes stay relatively still to extract information from the seeing window. In language reading, fixation time can vary from about 80-250 milliseconds per fixation depending on the parameters of visual stimulation and the behavioral task-dependent conditions (Pollatsek et al, 1999). Just as speed is as important as endurance for athletes, efficient saccadic action relies on effective fixation (Pollatsek et al, 1999). In music reading, while saccadic eye movement is the speed of moving from one musical picture to the next, fixation is the ability to see and grasp the meaning from a picture assembled from various musical symbols at one time (Pollatsek et al, 1999).

The size of fixation. The study of the human eye's fixation involves how much of the visual representation an individual perceives at one time. Both language and music literacy research have paid attention to the size of the fixation, known as the "moving window" (Rayner & Pollatsek, 1997; Truitt, Clifton, Pollatsek, & Rayner, 1997), when an individual reads words and notation. In language reading, researchers used the number of words or the number of character spaces to the left and right of fixation as a measurement for the size of fixation; for example one-word window, two-word window, or 14-letter window (Pollatsek et al, 1999). The researchers used a special screen designed to detect where the reader was fixating.

In music sightplaying research (Jacobsen, 1942; Weaver, 1943), the researchers used a moving window tool, where a machine presented a limited amount of information for each moving window for one fixation. An observer then detected whether the sightplaying performance proceeded without errors. Limited numbers of saccadic reaction and fixation in music reading were recorded. Regarding the amount of notes per each fixation, known as the size of the moving window, the research showed a difference between novice and expert readers' proficiency in vocal and instrumental readings. Immature readers had an average recognition score of .41 notes per pause, while mature readers' value was 2.5 notes per pause (Jacobsen, 1942). Findings from another study (Weaver, 1943) agreed with the previous study's results regarding mature readers. By investigating the moving window of 15 trained keyboard musicians, Weaver found that the average number of notes executed per reading pause varied between one and two notes at a time during sightplaying of short musical selections representing harmonic, melodic, and accompanied-melody types of tonal arrangements.

Sorel (1968) investigated whether the size and duration of the moving window would affect sightplaying performance, named "controlled exposure technique." Participants were allowed to see only a short amount of notation at a time and were asked to sightplay the given notation. By controlling and limiting the amount of exposure of the music, Sorel found a significant improvement in sightplaying performance. This approach showed that the controlled exposure technique reduced sightplaying note and meter errors among college piano students as well as increased their ability to play with expression. In addition, student attitudes toward the approach were favorable.

The duration of the fixation. The most commonly used measure of fixation duration is gaze duration, which is the total time spent fixating on a word (Pollatsek et al, 1993). Regarding the duration of the fixation, results from Jacobsen's study (1942) favored mature readers by stating that while immature music readers required equal time between recognition of words and notation, mature music readers spent only two-thirds of their time with notation reading as compared to word reading. Findings from Weaver's study (1943) gave a precise duration of each fixation for trained musicians. The average duration of trained musicians' music reading pauses varied between 0.27 and 0.53 seconds. In language reading, Posner et al (1992) found that the eyes remained fixed on a given word for about 0.25 seconds. Results from both studies demonstrate that the duration of fixation in music and language reading are similar in length.

Authors of more current psychological studies in language reading also have concluded that the length of time spent during the fixation on words reflects linguistic properties of those words, including high frequency words and the length of the word (Inhoff, 1986). Results from research in music reading (Cliffton, 1986) indicated that good text readers seemed to gain benefits from repetitive musical structure when reading music. Piano teaching methods for young children have applied the concept of improving the quality of the fixation by focusing on the spatial distance between melodic and harmonic interval notes (Palmer, Manus, & Lethco, 1981, 1988; Vogt & Bates, 2001). These methods reinforce fast recognition of intervallic distance: seconds, thirds, fourths, etc. However, some pedagogues (Gordon, 2004; Hayge, 2000) have suggested familiarizing students with tonal and rhythmic patterns containing more than two notes in one pattern. These patterns are the frequently used patterns seen in various types of compositions. Young students need to be able to recognize the sound and the written notation of those frequent patterns, such as major and minor melodic patterns containing scale degrees one, three, and five. The later group of teaching methods concentrated more on aural relationships rather than visual relationships between the notes. Hayge and Sillick (1997) proposed that each melodic or rhythmic pattern in music is the smallest meaningful piece of information in music reading, similar to a word in language reading.

Current literature has indicated that the eyes naturally look at one point per one fixation, which explains why small intervals are easier to read. Notes are read in relation to other notes. Clifton (1986) found that under brief presentation conditions (150 milliseconds), small intervals are more accurately read than large intervals. The "height effect" tends to be one challenging factor when reading music. Poor sightplayers showed a larger height effect, taking longer to count each line or space on the staff. Clifton (1986) suggested that adequate sightplaying depends on how the musician reads notes in relation to other notes, probably by computing intervals between them. Piano pedagogues and research findings suggested that students need to learn notes in both clefs equally well in order to master the sightplaying skills (Harrel, 1996; Jacobsen, 1942). In order to develop this facility, when teaching sightplaying, teachers should provide students with pieces that contain simple bass patterns.

Pedagogical suggestions of moving the eyes quickly on the page and reading the music in a big chunk should be considered with the understanding of human saccadic and fixation characteristics. However, Pollatsek (1999) suggested that the number of letters or music notes fixated upon by human eyes may not trigger the same amount of information with respect to cognitive processing by the human brain. This explains why mere rapid speed of eye movement may not contribute to the overall quality of sightplaying performance.

Summary for the sense of sight

When it comes to reading music, the trained eyes seem to be compatible with the written notation in both the speed in saccadic movement and the size of fixation. Mature readers read music faster and tend to see more than a single note at a time. In contrast, novice readers read more slowly and tend to see each separate note at a time. Within the same amount of time given, skilled readers may be able to sightplay an entire musical phrase because they may recognize some familiar melodic patterns and spend less time identifying each single notes. Unskilled readers, on the other hand, may be able to sightplay the first few notes of the phrase and need to spend more time identifying each note.

Similar to language reading, the lexical property, namely the simplicity of the written notation, and the frequent use of the notation can positively affect how the eye can effectively fixate and saccade between one point to another. However, reading music is different from language reading in the way that it involves multiple saccadic directions. Music written for piano is often written on more than one staff requiring vertical as well as horizontal reading.

The Sense of Touch

Due to the versatility and capability of the keyboard, a pianist normally performs multiple notes simultaneously, unlike performers on most other instruments. It is crucial for the pianists' fine motor skills to function both independently as well as cooperatively with perception skills. Independent kinesthetic or tactile skills, including gross and fine motor skills, enable the performer to navigate on the entire range of the keyboard with less or sometimes entirely without visual monitoring (Lehman et al., 2002).

The ability to navigate through the series of black and white keys on the keyboard fluently, with minimal visual monitoring, is a crucial element in piano sightplaying performance because the eyes need to spend as much time as possible on the written page to decode the written notation within stringent time constraints (Richman, 1986). Knowing the location of each specific key without looking down the keyboard and understanding the relationships among the keys can increase speed and accuracy when decoding written notation to sound. Moreover, keen decisions on selection of fingering combinations contribute to the musicality and the articulation of the sightplaying performance.

Sense of Keyboard Geography

The ability to play efficiently the keys corresponding to the notation is needed when performing music at sight. Good sightplayers are able to navigate through the keyboard at a faster speed than less skilled pianists. Research has shown that good sightplayers were faster than poor sightplayers on a music-matching task for both physical matching of notes and matching of letter names with notes (Clifton, 1986). When good sightplayers were asked to match the note names with the keys on the piano, they responded quickly with high accuracy.

Looking back and forth between the score and keyboard while sightplaying is an indication of a lack of competency in keyboard topography. Harrel (1996) suggested that in order to develop a keen tactile sense of the keyboard all piano students should avoid looking down at the keyboard unless it is absolutely necessary. This will prevent an interruption of the flow of the music when looking up to find the place.

Visual monitoring while performing can range from the most independent keyboard topographic awareness to the least independent. Richman (1986) emphasized that the pianist should develop both a sense of referential touch, identifying a note by looking at the keyboard, and sense of absolute touch, identifying a note without looking at the keyboard. A sense of referential touch is vital, especially when it comes to sightplaying performance with complicated music. Moreover, Lannert (1945) suggested that knowledge of keyboard topography was one among other factors that discriminated the good from the poor readers. Banton's (1995) study illustrated that the degree to which visual feedback was relied on depended on the performers' familiarity with the sight-reading situation. The more familiar the performer with sightplaying avtivity, the less visual feedback was needed.

The relationship between the space on the score and the space on the keyboard should be understood and practiced. Patterns in music are not only the relationships between notes, but the space between them. Good sight readers realize that there is a correlation between the spacing in a musical score and the spacing on the keyboard (Harrel, 1996). Teachers need to stress the importance of sightplaying on a continual basis. Computer programs and flash cards are effective ways to teach students to identify notes. Covering students' fingers was suggested as preparation for keyboard topography awareness by preventing the eyes from looking directly at the keyboard (Clark, 1992). The goal is to have students become more independent and trust their kinesthetic ability secured by minimal visual support.

The practice of navigating on top of the keyboard silently—*shadowing*—has proven to be an advantage in music reading. Kostka (2000) suggested that this technique improved undergraduate music major students' rhythmic and melodic accuracy. Shadowing also proved to decrease performers' hesitation when sightplaying on the piano. Kostka stated that shadowing increased performers' pitch perception and raised their awareness of keyboard topography. Students who prepared with both error-detection and shadowing techniques achieved modest sightplaying improvements. Results also showed that rhythmic accuracy was the category with highest improvement, followed by note accuracy and level of hesitations.

Consistency in Fingering Patterns

The planning and execution of complex finger movements is a subtask of sightplaying skill that requires cognition (Gilman, 2003). Once the performer attains the competency of navigating the keys corresponding to the notation, finger choice is an important component that impacts the fluency of the performance. Twisted fingering may cause performance disruption, while well-planned and smoothly connected fingering positively affects the quality of the performance, reinforcing the musicality and emotional expression of the piece being performed. Poor choice of fingering can be a considerable hindrance to fluent sightplaying performance (Tobin, 1957).

Good sightplaying keyboardists are able to apply basic principles of fingering to the notation being read. For instance, they would recognize a two-octave-arpeggio pattern on the printed page and would apply a basic finger pattern of an alternate group of three successive fingers (from the thumb, to index finger, and to the middle finger) with a group of four successive fingers (from the thumb, to index finger, to the middle finger, and to ring finger) to achieve the smooth connection between each pitch in this two-octave-arpeggio pattern. A study conducted by Sloboda, Clarke, Parncutt, and Raekallio (1998) showed that good piano sightplayers performed not only with higher accuracy, but also with consistency in fingering patterns. Sixteen pianists from three expertise levels sightplayed the right-hand score of seven studies by Czerny with no finger numbers indicated. Performance accuracy and fingering consistency were both positively correlated with expertise level. It is worth noting that even though consistency in fingering pattern results in a better sightplaying performance, it represents only a limited understanding of how the reader comprehends musical notation (Sloboda et al, 1998).

High levels of cognitive thinking and aural perception should be involved when sightplaying because reading music at sight is an intellectual process rather than merely an act of transferring visual stimuli to sound (Mainwaring, 1951; Tobin, 1957). Tobin (1957) suggested that although characteristics of good fingering in general depend on the convenience of the finger moves, the pianist's consideration of the outline of the musical passage should be involved.

Summary for the sense of touch

Sense of keyboard geography and consistency in fingering patterns are the key elements in the sense of touch related with piano sightplaying. Effective sense of keyboard geography allows readers to keep their eyes on the music and continue reading notes in advance of the notes being performed. Many teaching tools such as the use of flash cards or computer screen and shadowing can enhance a sense of keyboard geography by highlighting the relationships between the keyboard and the printed notation. Consistent fingering patterns also benefit a player's sightplaying speed and accuracy.

The Sense of Hearing

Sense of hearing serves a pianist when he or she performs music by reading at sight as an auditory feedback to measure the performed pitches to match the written notation. Skilled pianists simultaneously listen to the sound of the notes as they are performing to monitor the accuracy of the notes being performed as well as to enhance expressive musical performance.

Auditory Feedback as an Aid to Monitor Accuracy

Although auditory feedback as an aid to monitor accuracy may have less of an effect on sightplaying performance because no possibility of error correction exists (Lehmann, 2002), it allows the performer to hear and adjust his or her sound quality to follow the written notation. Lehman (2002) stated that auditory feedback serves as a cue for creating expectations about the next note, leading to a musical performance. It also allows the pianist to note mistakes for future corrections. From the performance point of view, Rubinstein (1950) suggested that a proficient sightplaying musician has to be able to keep at least the most basic musical elements, which are notes and their time value, because they are the most important in any performance.

One study investigating 15 pianists showed that sightplaying without hearing the sound of the music being performed produced similar results to sightplaying when hearing the music (Banton, 1995). Results also indicated that the withdrawal of auditory feedback produced a less negative effect in performance accuracy compared to the withdrawal of visual feedback. Although results from this study may lead to the assumption that that withdrawal of aural feedback creates less affects than withdrawal of visual feedback during sightplaying performance, it cannot be concluded that auditory feedback is less important than visual feedback for performers of all ages and expertise levels. This is because the results from this study were based on trained musicians. No study has been conducted with beginning music readers to investigate how crucial aural feedback can affect young beginner's sightplaying performance.

Auditory Feedback as an Aid to Enhance Expressive Musical Performance

Because of the nature of the piano, a pianist has to be concerned with the tone and articulation of the sound but not with its intonation. While sightplaying, pianists must actively perceive the sound at least in two levels, however. The primary level of sound components deals with acoustical properties, including the accuracy toward articulation, dynamics, and tempo. The secondary level of musical sound component deals with musical expressive elements. These include hearing the phrase structure, cadence, and chord progression. To be able to perceive these elements, one needs to have compatible musical knowledge and experiences (Mainwaring, 1941).

Familiarity with the sound of different musical patterns that had been performed before may facilitate expression of performers' musicality though their performance. Lowery (1940) proposed that sight-reading is facilitated by familiarity with musical patterns and by highly developed eye-ear coordination. Mere eye-hand coordination results in a performance devoid of musical value. Rubinstein (1950) stated that phrasing and shading of the music are among the eight musical factors necessary to proficient sightplaying. However, some flexibility may be allowed for when it comes to performance of a piece never seen before (Clark, 1998).

Summary for the sense of hearing

Auditory feedback as both an aid to monitor accuracy and an aid to enhance expressive musical performance plays a vital role in sightplaying performance. Without these two auditory functions, sightplaying performance will merely become an act of decoding musical notation without the essence of musical expression. More studies in this field could lead to a precise prediction of the relationships between aural feedback and the accuracy of sightplaying performance.

Physical Coordination

Coordination between an individual's perception and motor skills, based primarily on physical reaction and innate capability, is the focus of this section of the chapter. In contrast, coordination between the senses and motor skills that involve psychological or intellectual abilities will be discussed in the following chapters. Sightplaying by definition involves coordination mostly between the eyes (reading) and the hands (playing), therefore ear-hand coordination will not be discussed.

Eyes- Hand Span (Sight-Touch)

Reading ahead of the measure being performed has been recommended for piano sighplaying by experts and research studies (Lannert, 1945; Rayner, & Pollatsek, 1997; Rubinstein, 1950; Zagorski, & Tan, 1994). However, it is necessary to understand humans' innate capability of this specific skill. Current literature in the area of eye-hand coordination utilized a measurement to observe the phenomenon by diverse measurements including investigating how far the visual execution was ahead of the hands performing the music (Rayner, 1997) or compared eye movement data and keypress data to investigate the discrepancy between the point of the eye fixation and the point of the music being performed (Gilman, & Underwood, 2003; Truitt et al, 1997).

To better understand the eye-hand span phenomenon, fixation characteristics should be briefly described. Waters' (1997) study showed that better sightplayers require shorter and fewer fixations to encode reading material because they are able to grasp more information in one fixation. Fewer fixations explain two characteristics of skilled sightplayers. First, proficient sightplayers tend to have longer jumps around the reading material because they know what to look for. Second, better sightplayers' fixations were more expanded across the line and phrase boundaries, instead of on individual notes (Goolsby, 1994).

Regarding how far the visual system is ahead of the hands, findings from many research studies have proven that the size of eye-hand span of skilled piano sightplayers is larger than that of less skilled piano sightplayers (Gilman & Underwood, 2003; Goolsby, 1994; Rayner & Pollatsek, 1997; Truitt et al, 1997). Even though these findings revealed discrepancies among the number of beats constituting eye-hand span, all studies agreed that musicians' eyes move ahead of their hands. Truitt et al. (1997) found that the eyes of trained pianists move approximately a little more than one beat ahead, whereas Rayner (1997) reported eye movement from two to five beats in advance. Rayner illustrated that for less skilled pianists, the average eye-hand span was only about half a beat, indicating that the fixation point was less than one beat ahead of the hands. Weaver (1943) concluded in his study with 15 trained keyboardists that the discrepancy between eye movement and hand movement, where hands tend to follow eyes, was variable but never exceeded a separation of eight successive notes or chords between the eye and hand. Goolsby (1994) examined the characteristics of eye movements during sightplaying and how far the visual system was ahead of the hands. Skilled musicians typically extracted information up to about five beats ahead of the hands when they were sight-singing. These findings are parallel to previous ones regarding the fixation characteristics of proficient pianists. We can conclude that due to the fact that the eyes of good pianist sightplayers move quickly and grasp a big chunk of information, the eye-hand span phenomenon is superior to that of less skilled pianist sightplayers.

Constraints that might cause the eye-hand span to shift from the normal capability can come either from within the written notation, or be embedded in the performer's physical and psychological readiness. Tempo, level of difficulty of the piece, structure of the piece, and harmonization are notational-related components. These components were manipulated and adjusted in research design settings and therefore should be carefully managed in the instructional setting. Proper control over notational-related components should contribute to a high quality sightplaying outcome. However, some components are performer-related and need to be considered when studying sightplaying phenomena. These components include an individual's anxiety level, personal preparation speed, and cognitive involvement. These components may be beyond the control of the instructor; however, they should be taken into consideration when analyzing individual sightplaying competency.

Similar to text reading, each music reader is accustomed to his or her individual reading speed. Establishing a specific tempo for sightplaying performance has shown to affect accuracy of sightplaying outcomes. In a study by Souter (2002), the eye movement of nine highly skilled keyboardists were measured as they sightplayed two similar hymns in counterbalanced order at strictly controlled tempi. Results showed that the keyboardists reduced both the number and duration of fixations in order to be compatible with the faster tempo (120 Meazel Metronome (M.M = 120) versus 60 Meazel Metronome (M.M. = 60)). This confirmed that eye movement in music reading is an intricate mechanism for adapting to tempo.

Eye- Ear Coordination (Sight-Hearing)

Eye-ear coordination is the basic ability to perceive musical elements from the sound being produced on the keyboard. Skilled sightplayers should be able to discriminate differences in pitch, rhythm, tempo, harmony, and dynamics, therefore determining whether what they are playing corresponds to the written notation. This fundamental coordination between eye and ear enables a person to achieve the more complex levels of eye-ear synchronization such as inner-hearing ability or audiation (Gordon, 2004). Tobin (1957) proposed that there is a difference between seeing and recognizing; and recognizing is a necessity for good and accurate reading. He further explained that recognizing can only happen when one reads music that is similar to what has been seen before.

Visual pattern recognition without intellectual awareness may help facilitate the decision on fingering choice and increase the speed of the performance on the keyboard, but may not provide enough facilitation to optimize effective sightplaying performance

(Clark, 1998). This is because aural perception without intellectual awareness may help increase performance accuracy, but it may not be credited with the musicality and aesthetic value of the performance.

Beginner piano method books and guide for piano teachers (Noona & Noona, 1999; Palmer et al, 1983; Shockley, 2001; Vogt, & Bates, 2001) emphasize the importance of comprehending note patterns when reading music. These patterns include both short patterns such as harmonic and melodic intervals and longer patterns such as arpeggios and scales. These patterns serve as tools to help the eyes quickly decode spatial relationships between notes. At the same time, possessing the ability to accurately recognize note patterns enables the reader to insure that the tonality of the notes being performed corresponds with the printed notes.

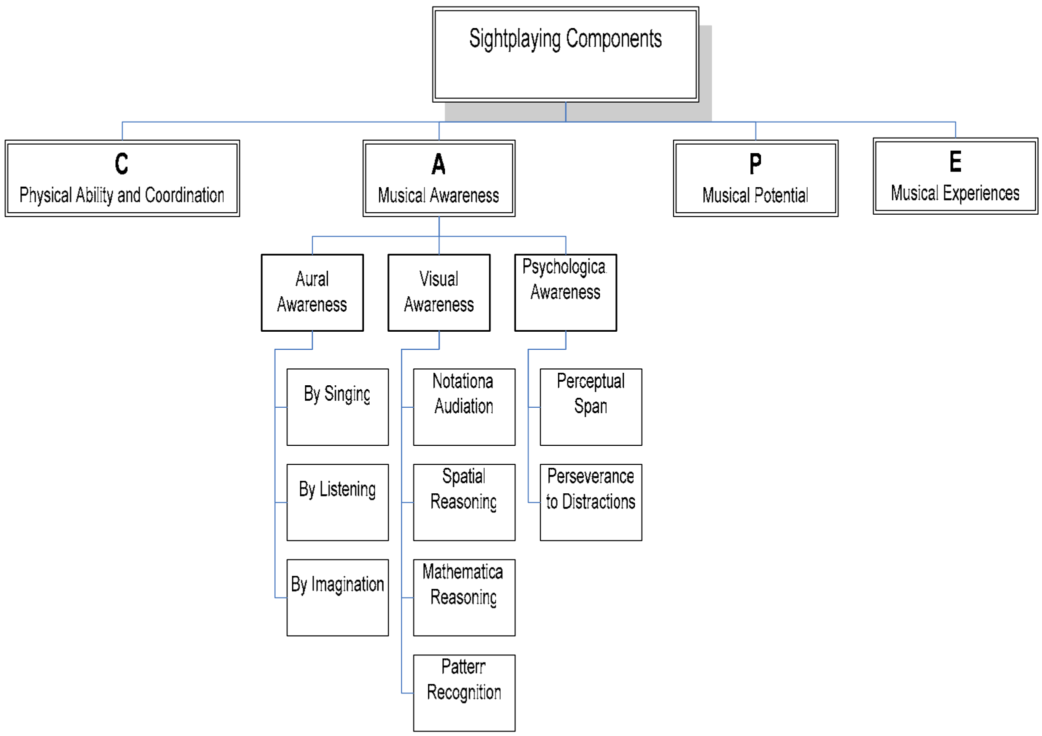
An adequate amount of meaningful sight-reading experiences and sufficient musical knowledge helps the ears make secure connections between the sound and visual representation. Merely decoding the musical notation to the corresponding keys on the piano is a note spelling activity rather than a sightplaying activity. Feierabend (1997) stated that the ability to identify letter names such as F, A, C, E, or D-sharp when looking at notes on a staff and to press corresponding keys on an instrument should not be confused with true music literacy. Strong spelling skills may or may not promote overall musical literacy development if the spelling technique is merely focused on the visual and spatial relationships between the written notes and the keys on the keyboard instead of understanding the relationships between each sound. One of the goals in teaching instrumental music literacy is to enable children to express their music through their instrument rather than using the instrument to hear music. This notion is well-supported by many educators (Feierabend, 1997; Kodály, 1974; Mainwaring, 1941, 1951). Mainwaring (1941, 1951) believed that effective music literacy skill is an ability to see the musical notation and being able to hear the notation inwardly before reproducing it on an instrument. Kodály (1974) stressed that music teachers should not allow students to go near an instrument until they can read music or sing correctly. He emphasized that children should be able to "sing on their instrument."

Summary

During the process of reading music at sight, musicians need to be able to transfer the message decoded from visual presentation to kinesthetic movement, including many aspects of fine motor skill movements, to sound. At the same time the sightplayers have to readily perceive aural feedback from the sound they are performing. These two scenarios happen almost simultaneously when a person performs music at sight.

The content of this chapter identified physical components of sightplaying competence. Current literature including findings from research studies and pedagogical suggestions helped the author draw a general conclusion that both an individual's physical ability and his/her physical coordination contributes to the overall outcome of sightplaying performance. Independence among the senses of sight, of touch, and sense of hearing are as important as the coordination between sight and the other two senses. Some aspects of physical ability and coordination may be more apparent than others. However, the author fulfilled the main purpose of this paper, which is to generalize the complexity of the sightplaying phenomena by classifying all possible components concerned with physical ability and coordination that may contribute to the outcome of keyboard sightplaying performance.

COMPONENT 2: MUSICAL AWARENESS



The second component contributing to music sightplaying deals with an awareness of the musical mind that enables the reader to raise his or her level of attention to the written stimuli. When the eyes, ears, and hands are ready to read music at sight, the next step is to make certain that the mind is alert to the musical stimuli and ready to comprehend the music at a conceptual level (Gordon, 2003). Sensory perception and kinesthetic coordination serve as fundamental material in building the ability to read music at sight; psychological and conceptual components serve as a strong architectural plan, strengthening the construction (Gordon, 1999).

Musical awareness components are characterized by high levels of mental, cognitive, and psychological engagement when interacting with the musical stimuli. Without psychological and conceptual awareness, transferring the written symbols to sound represents only an ability to match the presented notes to fingers. Perception and cognition are inextricably intertwined in the process of music reading, not discrete qualities (Bamberger, 1999).

At this level of establishing musical awareness, the goal is to make the “ears see” the music and the “eyes hear” the sound. Establishing this is not merely a matter of developing eye-ear coordination. Instead, this task depends on many components beyond physical coordination. In this chapter, these will be classified into three areas: aural awareness, visual awareness, and cognitive awareness.

Aural awareness: Audiation

Aural awareness as discussed in this chapter is classified in the conceptual stage rather than the perceptual stage (Gordon, 1999). Instead of aural sensory perception, aural awareness implies degrees of reading comprehension and mental conception as the underlying properties. This aural skill plays an important role in music making and comprehending written notation. Music comprehension can be demonstrated as an ability to mentally hear and/or match the pitch. The concept of aural awareness by means of hearing the tonal and rhythmic essence in music is always the focus in music literacy education, even though the terminology varies from one method or theory to another. These terminologies include “music audiation” (Gordon, 1971), Kodaly’s “inner-hearing ability” (Choksy, 1988), or “music imaging” (Anderson, 1995). Vocal pitch-matching ability is distinct from pitch-discrimination ability and these two facilities have shown no effect from one to another (Geringer, 1983). Geringer found that even though pitch discrimination and vocal pitch matching scores of fourth graders were significantly higher than those of preschool children, there were no significant relationships between pitch-discrimination ability and vocal pitch-matching ability in both fourth graders and preschoolers.

It is this strong aural skill that serves as a foundation for music comprehension in both aural and written modes. Stowolinski and Faulconer (1988) found that by improving aural ability to recognize the tonality of the piece, one can easily detect errant harmony when hearing the performance. Research findings (Atterbury, 1993) indicated that children with high musical aptitudes as measured by Gordon's (1986) Primary Measures of Music Audiation (PMMA) had a significant advancement in literacy development over children with lower musical aptitudes. Imaginative inner-hearing, involving the ability to hear pitch and rhythmic passages without needing to hear the actual sound, significantly improved the ability to read music by sight (Anderson, 1995). After eight months of training rhythmic reading through the discovery of correct tempo, rote and emulation concepts, music imaging (similar to audiation), and developing mental presets, students significantly raised their average score on the Arizona State Sight-Reading Testing Instrument. Anderson stated that the ability to internally vocalize the sound while performing by sight contributed to the intonation and precision of the outcomes.

In addition, audiation ability has been shown to outperform other components in affecting literacy development. Atterbury (1993) found no significant effect from teaching modes—instruction with or without piano accompaniment—on kindergartners' ability to sing in tune, but found that children with high musical aptitudes as measured by the

PMMA had significantly better ability to sing in tune. Jarjisian (1983) discovered that both high tonal aptitude test scores on the PMMA and a combined method focusing on diatonic and pentatonic pitch pattern instruction contributed to children's significant achievement in controlling the tonality in rote-singing.

Tests and Instructional Methods to Detect Aural Awareness

PMMA is a standardized test of vocal/aural accuracy conception (Gordon, 1986). Children take the test by listening to pairs of tonal or rhythmic patterns and then determining whether those pairs are same or different. This test requires no reading skill, which makes it suitable for children as young as Kindergarten level.

Regarding the need to detect students' conceptual ability in aural music using multi-perspective arrays, many researchers have utilized various instruments to effectively reflect the targeted variables. Some instruments have emphasized the vocal reproduction of the music by the listener (Atterbury, 1993; Jarjisian, 1983), while others focused on other modes of reproduction such as written response (Bamberger, 1999; Upitis, 1992).

Many instructional instruments focus on visual or bodily response to the music. The author believes that teachers might be better off assessing children's understanding of music through their own representations rather than asking them to interpret musical symbols by singing or talking. This is because young children have difficulty expressing themselves verbally about music (Flowers, 1993; McMahon, 1986; Scott-Kassner, 1992). Researchers found that music learning is similar to language learning, where receptive skills precede expressive skills (Sims, 1990, 1990/1991, 1991, 1995; Taggert, 1994). As a result, there is evidence of instructional strategies and measurements which include the use of the figural-metric paradigm or the figure-ground relationship to evaluate students' representations of rhythm/pitch as a response in listening activities (Gordon, 1986; Upitis, 1992). Invented representations of music content are considered useful for teachers to assess young children's conceptual abilities toward music presented in an aural mode (Upitis, 1992).

Listeners' written responses during listening activities can be classified into two response categories: higher cognitive and lower cognitive. When children's bodily responses to music are involved with higher levels of cognitive thinking, children are intellectually exercising their comprehension and application skills. Activities such as purposefully playing an instrument, singing, talking and describing, answering application questions, or making a decision on how long to listen to music exhibit the listener's conceptual awareness and cognitive thinking. In contrast, when children's bodily response to music is involved with a lower level of cognitive thinking, they merely exercise their basic understanding and discrimination skills. For instance, a listener's detection of changes in musical structure such as pitch, rhythm, and/or harmony, their indication of preferences for one style over another, or clapping, tapping, moving parts or the whole body to the corresponding tempo indicate only discrimination skill, not comprehension skill.

Teaching Tools Promoting Aural Awareness

Many researchers have tried to search out the causes of musical aptitude. In this chapter only those factors that were purposefully or intentionally established to stimulate conceptual thinking and awareness will be discussed. These factors include singing activities, practicing imaginative audiation, listening activities, and attention. Other factors that were beyond the control of the music researcher, such as gender, age, and socioeconomic status will be discussed in chapter seven.

Use of the Singing Voice

The singing voice is a primary instrument for all (Kodaly, 1974). A person should be accustomed to their own singing voice before they attempt to play an instrument. In other words, musicians control the sound of the instrument to reflect the sound they have in mind (Gordon, 2004). Enoch (1997) recommended that even at the early stage of learning to play the piano, the student must be taught to listen to the sounds he is making. Rutkowski (1996) found small relationships between use of the singing voice and developmental music aptitude in kindergarteners' group instruction. For older students, Robinson (1996) found that singing helps students develop aural skills, learn sightplaying, and make connections between the basic elements of music theory and the practical application.

Neutral syllable. Neutral syllables can be any simple pronunciation or nonsense words used to facilitate articulation of the specific essence of the musical sound: pitch or rhythm, without any rules or grammar. The use of neutral syllables (such as "bum", "da", or "do") as a tool to reinforce tonality in the early singing voice has shown to be effective (Goetze, 1985; Gordon, 2004). Another study indicated that singing songs with or without words enhanced the audiation of young children with low developmental musical aptitudes (Levinowitz, 1987). The use of neutral syllables encourages listeners' genuine aural perceptions and conceptions about melodic or rhythmic elements in sound. Using neutral syllables prevents any errors affected by more complicated factors. After a person becomes accustomed to neutral syllables, a more systematic syllable can be introduced to foster his/her aural conceptual skills. Kodàly syllables, metric counting, and unit counting are example of systematic syllable systems. They will be further discussed in the next chapter due to their educational features (Heyge, 1997; Kodaly, 1971; Mainwaring, 1941).

In both language and music literacy, there has been a focus on sound before symbol. Since music is an oral-based form of presentation, many pedagogical methods focus on reinforcing listening abilities in young children. Attaching language or assigning nonsense syllables to label the sound (Kodàly, 1971; Schockley, 2001) enables young learners to effectively register beat and pitch patterns and reinforce these into their long-term memory. Labeling is practical for learning music literacy because it is a concrete means by which to identify, refer to, organize, and communicate about an abstract entity: the sound in music.

For listening perception to progress from memorizing syllabic names to the application of the names as a tool to support sight-reading, musically-trained auditory perception is a crucial foundation. Therefore, at the early stage of music literacy development, young students are encouraged to utilize some kind of labeling system to articulate the sound, and to establish and secure common melodic and rhythmic patterns in their minds (Gordon, 2004). If this method of labeling, namely attaching syllables to sound, is properly and carefully instilled, these young learners will be able to read music with deeper understanding. Melodic labeling or tonal syllable systems include solfège fixed-do, solfège moveable-do, non-solfège numbers, and non-solfège letter names, whereas rhythmic labeling includes the metric counting system, unit counting system, and other systems.

However, these labeling systems vary in their applications and feasibility. In terms of feasibility, some melodic labeling systems may require more aural perception than others. When teaching music literacy, it is crucial to lay a good foundation of aural perception before introducing symbols. Some educators believe it is important to familiarize the learner with the sound, using so-called neutral syllables, before introducing any type of syntax-based syllable system (Gordon, 2004). Neutral syllables are applied to capture and represent the most important element in the sound. When capturing tonal elements, a single word is used for every pitch in a pattern, but each word is sung in tune to represent specific pitches in a tonal pattern. When capturing rhythmic elements, a single word is also used for every rhythm, but each word is precisely articulated in the correct time. Gordon (2004) stressed that children gain benefits when teachers secure neutral syllables before introducing any type of labeling. He emphasized that a well-developed perception of sound should be mastered before attaching syllables to sound, when teaching young children. He further explained that the reason so many teachers and students find syllables so difficult to grasp may stem from "sound and syllables" being taught together instead of keeping "sound before syllables" as the customary practice. Heyge and Sillick (1997) agreed with Gordon that at the beginning stage of music literacy, suitable rhythmic and tonal language to musical patterns should be used to reinforce aural-oral perception as well as introducing verbal association related to musical elements. Comments from Feierabend (1997) corresponded with this notion of sound before syllable. He stated that manipulation of symbols does not necessarily evoke musical thinking, whereas manipulation of sounds pursues musical thinking. Music is not the symbols found on the printed page, but the sounds that reach the ear (Feierabend, 1997).

Music educators may find other syllable systems that illustrate connections between each pitch in the tonal sequence in the form of letter sequence or number sequence to reinforce children' music literacy. Brown (2003) proposed that solfège systems are aural-based and require more class time for children to grasp the concepts, whereas non-solfège systems including letters and numbers are common so that most children already know them from a very young age.

Use of Meaningful Listening Activities

Music education literature supports the notion that listening activities fostering musical vocabulary should begin in the early childhood years (Flowers, 1993; Pearson, 1996; Scott-Kassner,1992; Sims, 1991). Gordon (1999) specified that listening preparation should be done before a child is eighteen months old and not later than three years of age—the same time period in which verbal language background is acquired.

Invented notation. The ability to articulate what is being heard is important to the foundation of music literacy (Kodaly, 1974). Young children need to be able to express themselves through a practical written form when responding to music. Invented notation is one example of a practical method for children to communicate what they hear in a written form (Upitis, 1992). It is beneficial to the beginning process of music literacy because it allows young listeners to exercise their cognitive thinking in the form of pattern recognition as well as discrimination abilities. Listening activities become more meaningful to each individual listener because he/she is permitted to conceptualize the music based on personal preference and understanding. With proper musical nourishment, these techniques can encourage young listeners to develop pattern recognition ability and other skills.

Use of Individual Attention and Imagination

Personality and innate capability affect the level of individual awareness and attentiveness to music stimuli. Each individual differs in their level of intuitive awareness. Some have a high level of attentiveness and curiosity, while others need motivation. Sims and Nolker (2002) discovered that the factor that affects how long young children chose to listen to music resulted from individual personal character, not the type of music. How interesting the stimulus is to the listener may motivate their initial attention. Familiarity of the type of music and cognitive ability of the listener play an important role in self motivation (Zagorski, 1994).

A good example of using attention level to utilize maximum aural and oral capability can be illustrated by Goetze's (1989) study. Findings showed that children of various ages, including kindergartners, first graders, and third graders, sang more accurately when singing individually than in a group (Goetze, 1989). Individual singing required higher awareness of the mental conception of sound, while at the same time promoting the control of sound production.

Novice readers may practice articulating and cognitively thinking about a musical piece to visualize the piece in a more concrete manner or to foster visual perception by implementing a mental image strategy called "think aloud" (Maxwell, 2002). In his study, the experimental group, consisting of 26 choir members, used "think aloud" strategy and was instructed by the researcher to pay attention to pitch, duration, timbre, and intensity of the piece. This strategy had shown significant positive effects in the overall quality of the sight-singing performance of the experimental group over the control group.

Summary

Aural awareness is an important component that contributes to an overall outcome of sightplaying competency. People who are capable of recognizing musical elements in sounds tend to be successful in sightplaying activities. Without the ability to recognize musical elements portrayed in sounds, it is difficult to understand or recognize musical elements portrayed in written notation. Training and meaningful experiences have proven to be beneficial to the development of aural awareness skills (Goetze,1985; Gordon, 2004; Robinson,1996). Accordingly, many teaching tools have been applied to promote aural awareness through singing, listening, and activities that engage students' attention.

Visual Awareness: Decoding ability

After a person achieves the musical aural conceptual abilities mentioned above, this skill can be further transferred to incorporate with visual perception and visual conception. The ability to inwardly hear written music, visual-spatial reasoning ability, mathematic reasoning ability, and perception of notes in group as a pattern play important roles in influencing effective visual awareness.

Notational Audiation

After an individual is capable of hearing music inwardly without its being present acoustically, the ability to inwardly hear written music can be acquired (Gordon, 1999). Terms to describe these activities ware initially developed by Edwin Gordon in 1971. He stated that the imaginative hearing of musical sound without the presence of notation was called *audiation*, whereas imaginative hearing of musical sound as a result of reading the notation was called *notational audiation***.** When people are engaged in notational audiation, they hear the musical sound and give syntactical meaning to what they see in music notation before they perform it, before someone else performs it, or as they write it (Gordon, 1971). Mainwaring (1941, 1951) suggested that the most efficient and effective means of developing a young player's overall musicianship is for the player to see the musical notation and hear the notation inwardly before reproducing it on an instrument. In other words, when literacy development progresses from sound to symbol, it illustrates the effectiveness of music literacy development.

Notational audiation has been a concern of music educators for decades (Gordon, 1999). It is normally considered as the sole necessary factor of sight-reading, sight-singing, and sightplaying. In the process of sight-reading, neither singing nor instrumental skills are needed. Sight-reading without performance can be considered the fundamental form of notational audiation proficiency. Once sight-reading ability is coordinated with singing skills, it yields effective sight-singing; once sight-reading performance is coordinated with instrumental skills, it produces an effective sightplaying performance (Gordon, 1999).

Spatial Reasoning Ability

Besides the conceptual knowledge of musical sounds as portrayed in written notation, the ability to conceive and understand spatial elements of written notation is crucial in music reading. When decoding musical signs, one needs to transfer the meaning of pitch and rhythm presented in notation. Spatial-reasoning ability facilitates a person's understanding of spatial relationships between and among notes on the staves and their relationships to sound (Rauscher, 1997).

Some visual elements of written notation can cause confusion for readers. In other words, the efficiency of decoding competency depends partly upon the physical property of the written score itself. Wide spaces, large intervals, and ledger line notes may cause decoding difficulties, especially for novice readers (Lannert, 1945). Even though the ability to read ledger line notes was not significant in discriminating good from poor readers, data from research (Lannert, 1945) showed a small deterioration in music reading ability caused by the complications in visibility pertaining to presentation of the notation. Jacobsen (1942) found that, in instrumental readings for both novice and expert readers, most errors were associated with the bass clef and ledger lines.

Research studies have shown that music training has an effect on one's spatial-reasoning ability in research studies. These type of studies examined individual spatial reasoning ability by investigating the area of electrical brain activity while participants engaged in a spatial-reasoning task (Flohr, 1999; Rauscher, Shaw, Levine, Wright, Dennis, & Newcomb, 1997). Results from research in this area have shown causal links from music training and private piano lessons to young children's visual-spatial ability (Flohr, 1999; Rauscher et al., 1997).

Research conducted by Gillman (2002) focused on the visual presentation and spatial quality of intervals. The results indicated that similar spatial distance can create a "false alarm" to human eyes—even for professional musicians. From this research, we understand that the ability to detect similarities among patterns is an important aspect in reading and decoding written music. Due to the fact that detecting similarity requires less attention than detecting dissimilarity, sightplayers were more accurate at judging "same" intervals when pairs were visually similar and least accurate at judging "same" intervals when pairs were spatially dissimilar (Gillman, Underwood, & Morehen, 2002). Conversely, sightplayers were more accurate at judging "different" intervals when pairs were spatially dissimilar and least accurate at judging "different" intervals when pairs were visually similar. This interaction between actual similarity and visual similarity was greater for poor sightplayers compared to good sightplayers. Forty pianists were required to indicate whether two consecutively presented intervals were the “same” or “different.” These pairs of intervals were either visually similar, visually dissimilar, or spatially dissimilar (Gilman et al. 2002).

Mathematical Reasoning Ability

When decoding musical signs, one needs to comprehend the meaning of rhythm and pitch presented in written notation. When spatial-reasoning ability facilitates a person’s understanding of spatial relationships and pitch production, mathematical understanding about fractions fosters a person’s understanding of rhythm and note values. Elliott (1982) categorized many types of sightplaying errors and found 70 percent to be rhythm errors. A thorough understanding about the length of notes and their relation to the beat facilitates overall sightplaying performance.

The teaching concept of “sound before sign” is beneficial to improving rhythmic aural perception (Feierabend, 1997; Kodaly, 1974; Mainwaring, 1951). An effective teaching method for rhythm perception should begin from an aural experience with rhythmic patterns, later making connections to written notation, just as we learn to read language (Kodaly, 1974). However, under some circumstances, a person must be able to calculate an unforeseen rhythmic pattern that then requires some level of mathematic ability to divide and subdivide beats within a measure.

Perception of Notes in a Group as a Pattern

Good sightplayers have an ability to rapidly perceive a group of notes at a time (Harrel, 1996). Their rapid eye movement is not merely the result of trained eyes, but a consequence of intellectual and cognitive ability regarding musical form and structure. They understand how to make the written notation convey continuous meaning and make connections to the next piece of information. When the eyes see groups of notes, a whole line can be taken in with several stops instead of pausing for each note (Harrel, 1996). The ability to perceive notes quickly was examined in an experimental research study (Water, et al 1997). Eye movement recordings were taken as musicians performed a sightplaying task. These data demonstrated that full-time music students were able to perform the comparisons with fewer number of glances—and shorter glances between the patterns—compared to non-music majors. Results from these studies showed that skilled sightplaying is associated with an ability to rapidly perceive notes or groups of notes in a score.

In another study, scanning for the familiar patterns illustrated the level of perceptual alertness (Wolf, 1976). The ability to detect musical patterns has been shown to promote reading speed and comprehension (Grutzmacher, 1987; Lowery, 1940; McKnight, 1975; Wolf, 1976). Zagorski and Tan (1994) suggested that piano students can learn to sightplay more fluently by using the pulse of the music as an anchor for eye movement while reading ahead for patterns of note values, intervals, keyboard topography, and fingerings. A movement from a Handel sonata was used to illustrate the principle of scanning for familiar patterns. Sightplaying was analyzed as it related to pattern recognition ability. Zagorski and Tan (1994) suggested the close relationship between musical sight-reading and the reading of conventional text. This schematic model of interlocking information-processing systems explains the differences between skilled and unskilled sightplayers.

Teaching Tools Promoting Visual Awareness

Use of Meaningful Reading Activities

Meaningful reading activities stimulate the flow of the reading process from a perceptual to a conceptual level. Readers become cognitively involved when reading activities are meaningful to them (Shockley, 2001). *Mapping Music* (Shockley, 2001) is a teaching tool to help encourage piano students to read music with a high attention level in order to find the patterns or meaning in the written notation. It has been said to improve ability to perform both by sight and rehearsed performance. Shockley (2001) studied the effectiveness of this tool with her private piano students of varying ages and ability levels and found it an effective method to improve their music literacy. With this method, students read music away from the keyboard. They then try to search for musical patterns by applying their knowledge to what they see on the printed page. In this level of visual awareness, mapping music is based upon the visual and spatial representations of the notes in short patterns rather than the “big picture” related to the form and structure of the piece. To increase eye movement, students may read notes in context, in blocks or groups, recognize intervals and chords, explore visual imagery, and read ahead. Marking and studying the score, defining terms, and color-coding material can be applied to increase students’ visual awareness.

Some reading aids or techniques may help increase children's reading speed, but may not stimulate the flow of the reading process from a perceptual to a conceptual level. For example, learning activities that focus on identifying names and matching a corresponding key on the keyboard with a written note could reinforce reading speed, but not necessarily promote conceptual thinking. Using a different color for each pitch could be classified as such when results from Rogers' (1991) study demonstrated that although many fifth and sixth graders favored color-coded notation as it was easier to read and play, their sightplaying performance and memory task did not improve after they had been under color-coded instruction for 12 weeks.

Summary

Visual awareness is an important component in sightplaying competency because it allows individual music readers to make musical connections between sight and sound in their minds before they use an instrument to convey that music they perceive. Without this ability, sightplaying activity merely represents one's ability to decode printed notation into sound through corresponding keys on the keyboard. A review of current literature in this field found that notational audiation ability and ability to see notes in patterns benefit sightplaying performance. Abundant research studies and pedagogical articles can be used to support the idea that there are positive effects from these two sets of musical abilities to sightplaying competence. Fewer research studies have been conducted to investigate the relationships between other intellectual abilities. However, a few researchers have focused on the relationships between spatial and mathematical reasoning ability and sightplaying performance.

Psychological Awareness

In this study, psychological awareness refers to an attentive state of mind engaged when a person reads music. When reading music at sight, the reader's mental consciousness plays an important role in controlling how much of the written music can be processed at a time and at what level the information is intellectually involved. Not only the fluency of the sightplaying outcome, but also the musical expressive sound of the music being conveyed are the result of mental alertness. Current research in the area of sight-reading and sightplaying provides a better understanding regarding psychological awareness when a person attempts to read music at sight. For the purpose of this study, psychological components affecting sightplaying performance will be classified into two major categories: perceptual span and working memory.

Perceptual Span

The speed and amount of written music a person grasps in one fixation when he/she reads music demonstrates the level of each individual's psychological involvement. One of the expected qualities in mental alertness is known as perceptual span. To be an efficient sight-reader, one must be able to read more than one note at a time, rather than reading note by note. Researchers in the area of perceptual span normally observe the size of a person's fixation to investigate the actual amount of written notation the brain actively processes at a time. Some studies have used the length of the fixation window, while others focused on the speed of each fixation when trying to explain readers' perceptual span.

Perceptual span is a measure of the amount of information extracted around the fixation point. Only a handful of research studies in the music reading area have been conducted regarding perceptual span. Moreover, due to the uniqueness of the design and limitations of each study (Bean, 1938; Jacobsen, 1941; Weaver, 1943), the results regarding the size of perceptual span in musicians and non-musicians are inconclusive. Sloboda (1984) claimed that the perceptual span of the unskilled sightplayer is about three to four notes, but for the skilled sightplayer it is six to seven notes. However, Truitt (1997) disagreed with the earlier study and claimed that pianists do not need to see more than the whole measure in order to perform without errors. He claimed that a two-beat window condition promoted longer playing time when compared to four-beat, six-beat, and no windows.

Previous techniques of sightplaying range from dividing the number of notes per line by the number of eye fixations a musician made on one line, to observing how long a person can continue playing after the removal of the printed notation (Sloboda, 1984). Recent studies have implemented the *eye-contingent moving window* technique (Truitt et al, 1997) to examine music readers' perceptual spans. The *moving window* technique is used to determine how far the reader's perceptual processing is ahead of the fixation point. A certain size of moving window; namely two-beat, four-beat, six-beat, or no window, is applied to investigate the relationships between the size of the moving window and the continuity of the sightplaying outcome.

The purpose of this study is not to draw a conclusion about how many notes or how long a normal perceptual span is. The most important thing is to acknowledge the presence of perceptual span and its contribution to note reading. The issue of how many notes need to be executed ahead of one's fixation point is not as important as knowing that one must be able to process written notation more than one note at a time. Studies have shown that musicians make sense of information from the perimeter of the focal point, called the parafovea (Gilman, 2003). Inconclusive results from various research imply that there are many circumstances and limitations that could impact sightplaying performance. Those circumstances range from the required tempo of performance and the availability of written music, to the size of the moving window.

Pedagogical suggestions always focus on the notion of reading the music ahead of what being played. The eyes should move forward to notice details in advance of the execution of the music. One needs to organize his/her thinking in such as way that the music will flow rapidly and unhampered (Hardy, 1998).

Characteristics of Perceptual Span

Perceptual span is adjustable. In order to read and comprehend the written text, a person automatically adjusts his/her perceptual span according to the complexity of the material. In language reading, Reyner (1986) found that when fourth graders read age-appropriate material, their perceptual span size was virtually the same as adults, whereas when they read material that was too difficult for them, their perceptual span became much shorter, little more than a word. A similar phenomenon can be found in music reading. Regarding music notation reading, Sloboda (1984) found that eye-hand span is not a fixed measure even in one individual. Instead it grows or shrinks according to the musical structure or musical phrase. If the phrase is longer than the normal fixation, the fixation expands to cover all of the notes. Likewise, if the phrase is shorter than the normal fixation, the fixation shrinks to fit the structure.

In language reading, the level of difficulty of the text affects the size of the perceptual span. More difficult text requires more focused attention. The development of the perceptual span seems to be related to the difficulty of processing the fixated word (Rayner et al, 1997), allowing one's attention to be spread further into the periphery of vision. The region from which readers extract useful information is measured by finding the smallest moving window, enabling a person to read at their own pace.

Recognition of patterns improves the perceptual span. Recognition of the patterns in music can be very beneficial in developing sightplaying because quick identification of intervallic or chordal patterns—frequently structured in musical passages—increases fluency in the reading process (Bernstein, 1981). In research on word reading, Kinnison and Clifton (1995) found that the presence of frequently-used words or familiar words increased a person's reading speed—called a "preview benefit." The study showed preview benefit of the target word when the preceding words were high frequency, and no benefit from preview of the target word when the preceding word was low frequency.

The implications of using familiar note patterns to increase perceptual span has been a major concern in sight-reading research. Familiarity with melodic and rhythmic patterns needs to be encouraged as early as possible in order to better secure the connection between sight and sound. Gordon (1997) emphasized that with informal guidance, children will develop audiation skills that will serve as readiness to learn music in the future. This is an example of the dual encoding instructional technique, where different modes of perception have been utilized to foster one's understanding about a subject. Despite the fact that recognition of visual patterns without the ability to make connections between printed notes and sound is viewed as a less superior proficiency compared with notational audiation when reading music, it has proven to assist readers when sightplaying music.

Perseverance to Distractions

The level of attention during a sightplaying performance can be determined by many variables. Some originate from the written notation, while others may relate to the environment of the performance. To manipulate multi-tasking activities such as reading music at sight while performing on an instrument, one needs to be able to disregard distractions. Many obstacles may threaten one's perceptual awareness to the target information by shifting mental attention to unimportant details or the wrong message. Because music reading is an intellectual task where the reader cognitively applies their prior knowledge to the reading text, the attention level to stay on task can vary when there are interferences. While less experienced readers tend to be bothered by environmental interference such as outside noise, room environment, or sightplaying subtasks such as controlling foot pedals or following a soloist, experienced readers tend to be distracted by musical interference such as violations of normal music structure and atonal melodic lines (McKenzie & Vaneerd, et al., 1986).

Aural and Attentional Interference

Interference can cause problems with any type of cognitive task. One recent study (Thomas, 1996) demonstrated the effect of intellectual distractions to working memory on several mathematical problem-solving tasks. The distraction referred to the task that involves retaining digits in memory while engaged in other activities. One example could be when young students have trouble recalling the result of a mathematic computation if they are distracted by another set of computations. Thus, the simple task of mathematic computation can be problematic to young children if they are interrupted by another task that requires them to retain information in their working memory.

In music, noise seems to distract attention in musical thinking and musical performance. A direct aural distraction factor was investigated in a study by Wollner (2003) which found the negative consequences of aural interference during students' sight-singing activities. Music major participants found inner hearing to be significantly more difficult when they sight-sang the melody while being exposed to distracting music. Distracted inner hearing led to significantly lower rating results for overall quality.

A similar phenomenon can be found in a sightplaying task. Betts and Cassidy (2000) reported that 39 non-keyboard music majors' attention to the left hand during a harmonization task resulted in a less accurate right-hand performance. Results demonstrated that attention on the left-hand passage did interfere with the right-hand performance. In contrast, when participants performed with only one hand at a time, the right-hand performance was superior to the left-hand performance in many areas including accuracy and consistency.

Sightplaying Subtasks

Sightplaying is a complex task comprised of many subtasks. These subtasks, when not fully matured or developed, can become obstacles or distraction to the whole process of sightplaying. Subtasks at difficult levels of intellectual understanding and complicated physical execution are required. When performing at sight, the reader has to overcome and employ all of the subtasks regardless of their difficulty level.

Normally when researchers investigate sightplaying phenomena, they tend to limit as many variables—sightplaying subtasks— as possible in order to increase the precision of the study's design. By limiting the number of variables, it is difficult to inspect the causal interrelationship among all possible subtasks and variables. For instance, to fit the manageable design of the study, Truitt and his colleagues (1997) had to adapt the original printed music for use by only one hand to contain only quarter notes/rests and half notes/rests. Music educators need to be conscious about possible subtasks that could hinder sightplaying outcomes in normal settings. These subtasks include articulations, balance and control, pedaling, fingering, and body control (Bernstein, 1981).

Sightplaying is an important tool that applies in music learning, composing, and arranging. Under differing conditions, sightplaying activities require differing levels of cognitive thinking and interpretation of written notation. Gilman (2003) referred to different types of sightplaying activities by their involvement with cognitive thinking, so called "cognitive load." According to her study, the medium cognitive load in sightplaying took place when pianists sightplayed the music as it was written, whereas the high cognitive load took place when pianists were required to perform the music one tone lower than the notation. Various types of cognitive thinking can be involved during specific sightplaying activities, such as transposition, error detection, decisions regarding the style of performance, and many others.

The complexity of sightplaying's subtasks create technically difficult barriers for researchers in this field. Consequently, connections and transfers from various studies in the field need to be drawn to help determine general characteristics of sightplaying phenomena.

Diatonic Violation

Violation of the expected tonal structure tends to be an obstacle in sightplaying performances for more experienced pianists. An experiment was carried out to determine whether sightplaying diatonic violations in a musical score released similar brain activation patterns, shown via ERBP (Event-Related Brain Potential) components as when hearing such violations in auditory mode (Gunter, et al 2003). In this behavioral study, musicians were visually presented with 120 scores of familiar musical pieces, half of which contained a diatonic violation. The music was presented in a measure-by-measure manner. Self-paced reading was significantly delayed for measures containing a violation, indicating that sightplaying a violation requires additional effort. Since diatonic violations require more attention when reading music, the eyes move more slowly.

Atonal Melodic Line

Atonal melodic line is another component that adversely affects expert sight readers. Results from a study by McKenzie (1986) showed that an atonal condition in a sightplaying piece affected rhythmic accuracy. The authors investigated the effects of tonal structure on rhythm in piano performances by observing the performance of five skilled pianists while they sightplayed short segments of music under different tonal conditions. Results indicated significant differences between the tonal and atonal conditions for the rhythm in performance. The atonal condition may have created a distraction or confusion during the sightplaying performance. In this situation, where the melodic line was atonal, no certain expectation regarding the tonal structure could be drawn in the process of reading at sight. As a result, the task became more complicated.

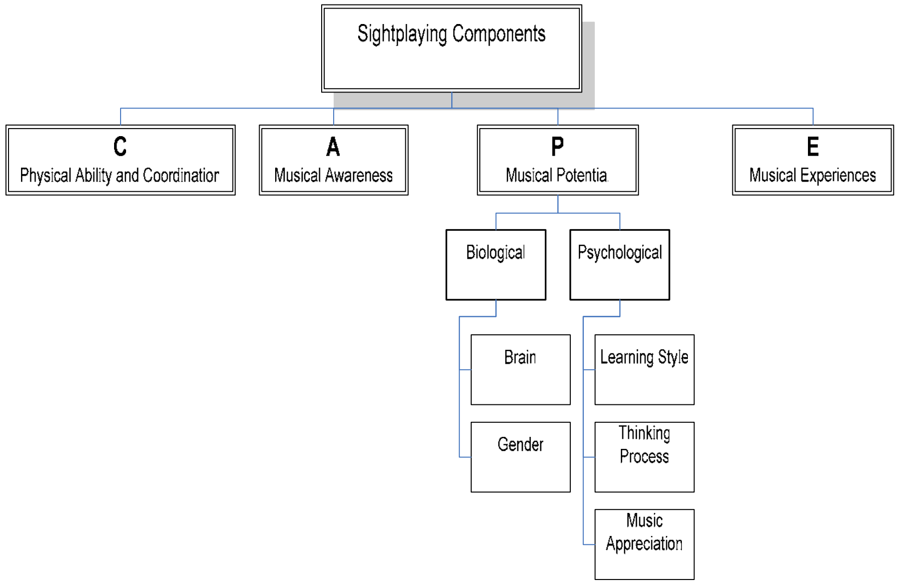
Elements related to aural, visual, and psychological awareness mentioned in this chapter play a vital role in the music reader’s comprehension of the written notation. Some components in these categories can be more easily improved, manipulated, or controlld than others. Teaching methods can be properly adjusted to stimulate students’ musical awareness in all areas: aurally, visually, and psychologically. In the next chapter, sightplaying factors that are more difficult to change or alter will be discussed. Those factors are classified as sightplaying potential.

Summary

Psychological awareness is another important intrinsic ability that benefits a person's sightplaying competency because it involves the readers' mind and mental process when they read and play music. Musical nuances that are captured in sightplayers' mental processes while reading the music are transferred to musical sounds to portray musical elements. In other words, how the body and fingers function in sightplaying activities correspond to what musical information is being processed in the readers' mind (Gordon, 2003). It is our teaching goal to foster students' mental awareness while they perform music at sight. Current research leads to the conclusion that an appropriate perceptual span that matches the music reading task is beneficial and can be improved when students recognize frequently occuring patterns. At the same time, good sightplayers have to be able to disregard possible distractions that may come from the musical context, environment, or various performance subtleties (Gunter et al., 2003).

Musical awareness includes aural, visual, and psychological perceptions. Since the author's philosophy follows the notion of "sound before symbol," these three components of musical awareness were proposed in a purposeful order. Aural awareness allows a person to recognize musical elements portrayed in sounds. This ability should then enable a person to read music and understand musical elements portrayed in written notation. Visual awareness comes when readers make musical connections between sight and sound in their minds before they use an instrument to convey that music. Finally, psychological awareness involves the readers' mind and mental processes when they read and play music. This would allow the performer to transfer what is being read through the sound of the instrument with a possibility of expressing individual musical personalities.

COMPONENT 3: MUSICAL POTENTIAL



Musical potential refers to assets that identify each individual's predisposition for music learning and development. These are generally considered to be difficult to manipulate, arrange, adjust, or remediate. Unlike physical coordination or musical awareness, where learning environments can foster positive development, musical potential components are more subtle and tend to exist as a stabilized asset. These include biological potential and psychological potential (Gordon, 1999). Due to the stability of these potentials, it is important to accept these assets in order to adapt instruction rather than to assume that one general teaching method would fit all learners. General music classroom instruction is appropriate for general music concept learning. However, when it comes to teaching sightplaying, which is a complicated skill requiring a high level of proficiency in music reading and instrumental performing, learner-centered instruction is essential.

Biological Factors

Biological characteristics serve as an influential part of the foundation for literacy development. Two characteristics shown to have involuntary affects on music reading and music perception are brain physiology and gender. The following section explains how the brain works when making music and how gender differences affect memory and spatial ability.

The Brain

Since kinesthetic coordination and psychological awareness alone may not be accountable for the quality of an individual's musical memory, cognition, and performance, it is important to understand the function of the brain and how it affects each individual's sightplaying capability.

Anatomy of the Brain

The human brain is divided into three major parts: the cerebral cortex, brain stem, and cerebellum. However, it is important to understand that the brain functions as a whole by interrelating its component parts. The cerebral cortex consists of four parts: frontal lobe (most anterior, right under the forehead), parietal lobe (near the back and top of the head), occipital lobe (most posterior, at the back of the head), and temporal lobe (side of head above ears). The temporal lobe plays an important role in visual and aural perception. The parietal brain activations are claimed to be visuo-motor transcoding pathways.

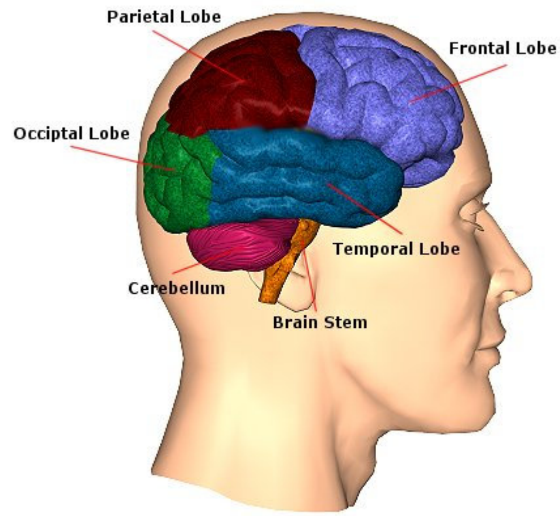


Figure 5 : Anatomy of the brain

source: http://www.neuroskills.com/index.shtml?main=/tbi/bfrontal.shtml

Sightplaying Tasks and the Brain

Sightplaying requires both reading and performing ability. Many brain research studies have been conducted with the aim of trying to understand the process of music reading, especially after July 1989, when President George Bush Sr. signed House Joint Resolution (HJR) 174, identifying that the House and Senate resolved to designate the decade beginning January 1, 1990, as the "Decade of the Brain" (Hoffmann, 2002). The findings from neuromusical research provided a wide perspective toward musical behaviors and sightplaying phenomena. There are two major pieces of information that will be discussed in this section. The first part is about the similarities in brain activation between language reading and music reading. The second part is about the hemisphere of brain activation during sightplaying tasks.

Certain neural pathways within the brain are built and reinforced when a person learns certain tasks. These pathways are composed of electrochemical messages between each neuron in the brain (Sergent, 1992). While neural pathways in linguistic or mathematical tasks can be traced as patterns, musical perception is more complicated. Previous studies have found useful information regarding music reading and the brain. First, it was found that areas of brain activation during music reading tasks demonstrate the same pattern of brain cells as brain activation during word reading tasks (Sergent, 1992). Sight-reading tasks activate the cortical area that is distinct from, but close to, the areas underlying similar verbal operations. Positron emission tomography (PET) and magnetic resonance imaging (MRI) were used to examine the neural organization of musical sightplaying and keyboard performance in ten professional pianists. Another group of researchers (Schon, et al, 2002) found similarities to previous research results, which indicated that the three music reading tasks: standard Western notation, notation with words, and notation with numbers, revealed a similar pattern of activated brain areas in professional pianists. However, the result provided additional knowledge that among other areas of the brain, unique forms of brain activation in the parietal area were related to different types of notation. The brain areas involved in music reading were investigated by functional magnetic resolution imaging (fMRI). Direct contrasts between the music notation and verbal or numerical notation tasks also revealed specific major areas of activation in the right occipito-temporal junction, superior parietal lobe, and the intraparietal sulcus. *(Sulci (singular, Sulcus): Grooves within the convolutions of cerebral cortex, the deepest of which are sometimes called fissures.)*

This finding leads to the discussion of the second issue in this section, historically a somewhat controversial issue, regarding left-right hemisphere and sightplaying cognition. Earlier studies have suggested that music tasks tend to stimulate many neural activations in the right hemisphere of the brain (Milner, 1968). However, recent neurological studies have clarified and provided a more complete explanation regarding music and the brain. The modern interpretation is that music tasks require activation of both hemispheres of the brain. Some researchers (Sergent, 1993; Hodges, 2000) confirmed that musical operations involved more complexity in brain function than other cognitive tasks. Musical processing is spread throughout the brain, ranging from front/back, top/bottom, to left/right (Parsons, et al 1998). Moreover, selectively changing the focus of attention radically alters brain activation patterns (Platel, et al 1997). Regarding music listening tasks, Petche (1988) found that while the left hemisphere was primarily activated for verbal processing, bilateral brain involvement was shown. Hodges (2000) suggested that instead of allowing naïve interpretations of research data to fuel the misconception that musical knowledge involves only the right side of the brain, one should consider subject, stimulus, and task variables within each music task. These variables intrinsically dominated different types of brain activities.

When music reading tasks require both memory tasks and analytical tasks, Hoffman (2002) found that both hemispheres of the brain are activated. He proposed that the two temporal lobes seem to work differently when conductors sight-read music; the left temporal lobe may be more involved in perceptual tasks relating to visual music reading, while the right temporal lobe is more involved with music processing and memory retrieval through connections to the left frontal area. It was recorded that music was initially perceived from the left temporal lobe and then processed in the right temporal lobe.

Musical Effects from Brain Impairment

Brain impairment, either from prenatal effects or accident, has been shown to impair music potential. If particular areas of the brain are injured, the respective function of brain cells in that area will most likely be impaired. Many studies have recorded the damage or the loss of musical potential or musical abilities caused by different types of brain injuries. In this paper, traumatic brain injury, dyslexia, and aphasia will be discussed as a result of my review through available research.

Traumatic brain injury. Because the temporal lobe is heavily responsible for visual and aural perception, damage in the temporal lobe area can deteriorate many visual and aural abilities. Kolb and Wishaw (1990) identified eight principal symptoms of temporal lobe damage. Among those eight symptoms, those that are closely related to music playing and reading are 1) disturbance of auditory sensation and perception, 2) disturbance of selective attention of auditory and visual input, 3) disorders of visual perception, and 4) impaired long-term memory. All four of these symptoms can negatively affect reading music at sight.

The temporal lobe can be divided into a left and right side. When both temporal lobes are damaged, selective attention to visual or auditory input can occur (Milner, 1962). Milner (1962) conducted a medical study that illustrated the specific music tasks that involved brain activation in the right temporal lobe area. Patients who had a large part of the right temporal lobe removed had lower scores than before the loss on four of the six subtests of the Seashore Measures of Musical Talents, including tonal memory, timbre, loudness, and time subtests (Milner, 1962). It is worth noting that rhythmic memory was still intact despite the loss of the right temporal lobe. Recent researchers have conducted similar research. A less extensive right temporal lobectomy did not cause impairment in any of the six subtests, based on the results from a study conducted by a group of neurosurgical researchers (Koike, Shimizu, Suzuki, Ishijima, & Sugishita, 1996).

Dyslexia. According to the International Dyslexia Association's Committee of Members in November, 1994, "Dyslexia is a neurologically-based, often familial, disorder which interferes with the acquisition and processing of language." Varying in degrees of severity, it is manifested by difficulties in receptive and expressive language, including phonological processing in reading, writing, spelling, handwriting, and sometimes in arithmetic. Dyslexia is not a result of lack of motivation, sensory impairment, inadequate instructional or environmental opportunities, or other limiting conditions, but may occur together with these conditions. From this definition, people who have dyslexic difficulties may well be confronted with many obstacles in the process of sightplaying. Atterbury (1985) discovered that children with learning disabilities made more mistakes when they clapped different rhythmic patterns compared to normal students. This research finding suggests that children with learning disabilities may not be able to learn music as easily as their peers.

A dyslexic child has difficulty transferring information from what is heard to what is seen and vice versa (Hubicki, 1994). Specific reading problems associated with dyslexia include difficulties in pronouncing new words, distinguishing similarities and differences in words and music, and discriminating differences in letter sounds. To better increase discrimination among music notes, color-coded notation was suggested to be helpful for musicians with dyslexic difficulties (Hubicki, 1994). Findings from a study conducted by Jaarsma, Ruijssenaars, and Broeck (1998) revealed that dyslexic children needed more time to learn musical notation than did children without dyslexia. Dyslexic children also made more mistakes when reading musical notation. The same group of researchers also found that instead of confusing two notes that are next to each other (i.e. G-A), children with dyslexia tend to get confused between successive line notes or successive space notes (i.e. F-A), namely—transposition errors of the interval of the third. This finding may demonstrate how the visual-spatial aspect plays a role in music reading and comprehension.

A*phasia.* Aphasia is a partial or total loss of the ability to articulate ideas or comprehend spoken or written language, resulting from damage to the brain caused by injury or disease (The American Heritage Dictionary, 2002). The aphasic patient shows a specfic impairment in naming musical notes and letters in the context of instrumental reading of notes. The ability to orally name notes (which are given the letter names A-G in English) and to play notes from a spoken note name was severely impaired. By contrast, instrumental sight reading and matching of written letters and single notes were both well preserved. This complex pattern of impairments can be explained in terms of a specific deficit in the letter name system (Bevan, 2003).

Summary

In summary, the following concerns should be considered when trying to understand the function of the brain in relation to music sightplaying. Regarding the functionality of the brain based upon its cerebral cortex parts, music reading and hearing tasks involve neurons in the temporal lobe area, whereas motorphysical tasks activate neurons in the parietal lobe. Regarding the pattern of brain activation, music-related tasks may not be as straightforward as other cognitive tasks, especially with respect to hemisphere specialization. It is important to recognize brain function as a whole with interrelated component parts.

It is, therefore, most accurate to conclude that music involves not only the right side of the brain, but both hemispheres. Although left and right hemispheres of the brain process information in different ways affecting each individual to process information using his/her dominant side, as teachers, we realize that students need to engage both sides of the brain in a balanced manner in order to enhance effective thinking and learning.

Gender Effects

Gender differences establish biological consequences which may have an impact on music potential. These differences may be subtle, and findings from related fields of study have provided useful information toward developing an understanding of possible effects.

Female Brain versus Male Brain

Even though the average male brain is slightly larger than the average female brain, the female brain is slightly larger proportionally when compared with body size (Sylwester, 2004). It is known that females tend to have a more dominant left hemisphere, and males a more dominant right hemisphere (Sylwester, 2004). The left hemisphere of the brain is responsible for verbal cognition and rhythmic perception, whereas the right hemisphere is responsible for non-verbal cognition and melodic perception. This raises the question yet unanswered; would female students learn best when music instruction is rhythmic-centered and male students learn best in a melodic-centered environment?

In addition, the membrane that connects the left and right hemispheres, called the corpus callosum, is slightly larger in females. Female tended to have higher interhemispheric coherence values compared to males (Rabinowicz, et al. 2000). Petche, Lindner, Rappelsberger, and Gruber (1988) found gender differences in both the power of brain activation and the area of brain activation in music listening. A later study conducted by Steinmetz, Staiger, Schlaug, Huang, and Jancke (1995) found a coherence difference affect attributed to gender.

Gender and Memory

Memory plays an important role in sightplaying development. The recognition of musical patterns simplifies complicated musical patterns and increases efficiency when reading music at sight. Memory involves recalling a general concept and also the factual knowledge that underlies the concept. Females seem to perform slightly better on factual recall and males on conceptual recall (Sylwester, 2004). In music reading scenarios, for example, female students might tend to rely on factual knowledge by recognizing specific notes and fingering patterns from when playing an F major chord to a C seventh chord in arpeggio style. Male students might tend to rely on conceptual knowledge by identifying the harmonic structure of the chord progression, in this case tonic to dominant seventh.

Gender and Spatial Ability

Spatial navigation of the eyes from one spot to another spot on the reading material seems to be important in music reading. Findings from research revealed that gender has an impact on one’s spatial navigation. Sandstrom (1998) found that women pay more attention to landmarks while men tend to take cues from geometrical relationships in a spatial navigation task. Would the difference in the two spatial cognitive approaches affect how males and females read music? Would a spatial relationship (between the notes) approach be more appropriate for male students, while looking at the big picture of the piece be more appropriate for female students?

Summary

These characteristics based upon gender differences—brain function, memory, and spatial ability—should not be applied to stereotype any individual according to gender. The emphasis should be on the recognition of individual differences, which might have a tendency to be based upon gender differences. Since biological components including the structure of the brain and gender characteristics tend to be stable, it is important for teachers to accept this preset asset and adapt their instruction strategies to fit all learners.

Psychological Components

It is important to acknowledge the significance of individual-related components on sightplaying. Differences in learning styles, thinking patterns, points of view, and attention span affect how each individual perceives music. In this section, mode of learning preference, music thinking stereotypes, and music appreciation will be discussed as individual-related components which may affect sight-playing success.

Individual Learning Mode

Each individual has his/her preference of learning mode or learning style, whether visual, aural, tactile, or kinesthetic (Rainey, & Kolb, 1995; Sims & Sims, 1995). When it comes to music reading at sight, a person needs to rely upon a visual mode for reading music notation. Ideally, music educators hope that readers will hear the sound of the printed notes in their mind before performing on the instrument, requiring internal perception of the written notation (Kodály, 1974). However, many readers may not engage in aural stimulus as their primary mode of preference when reading music by sight. Perhaps spatial recognition is becoming more meaningful to those who prefer a visual-mode of reading music.

As a music educator, adaptation is needed when teaching each individual. *Dual encoding* has proven to be psychologically beneficial. Therefore, the connection and interrelationship between visual and aural modes is valuable in the development of music literacy.

Personal Thinking Process

Reading music is not merely an act of literally decoding the note. It involves understanding and comprehending the musical message. Each individual has his/her own individual style when it comes to making sense of the music.

Comprehending a Big Picture in Music Pieces

Besides the fact that males seem to depend more on geometric cues and females seem to depend more on landmarks when it comes to navigation strategies (Sandstrom, 1998) each individual has his/her own preference when comprehending written materials. Using the geometric strategy, one may focus on the relationships of points, lines, and angles in written notation. However, with the landmark strategy, one may focus on the prominent features of the musical phrases in the piece. Results from a study conducted by Bamberger (1999) concurred that each individual is different when trying to comprehend the big picture of music pieces. The researcher found that children applied one of two methods of meaning construction, either pathmaking or mapmaking. Pathmakers would learn more similarly to those who are geometric thinkers, where attention to the relationships among the small parts is prominent. Mapmakers would learn and think more similarly to those who are landmark thinkers, where each distinct significant element stands out to outline the smaller parts.

Frances Clark was a piano pedagogue who influenced the concept of using notation landmarks when reading music from the grand staff. To secure reading, she suggested focusing on the five landmark notes, which she identified as the two Fs on the bass staff, middle C, and the two Gs on the treble staff (Clark, 1998).

Comprehending Details in Music Pieces

Bamberger (1999) studied how individuals referred to measuring durations using their own strategy. Data were derived from children's drawings of simple rhythmic figures. There were two types of strategies children used for making sense of simple rhythmic figures: figural drawing related to gestures versus metric drawing. Findings showed that individuals tended to favor one or the other of the strategies. Using metric drawing better represented rhythmic relationships among the notes, while figural drawing may have represented overall emotional response as result of rhythmic stimulus.

Personal Music Appreciation/Attention

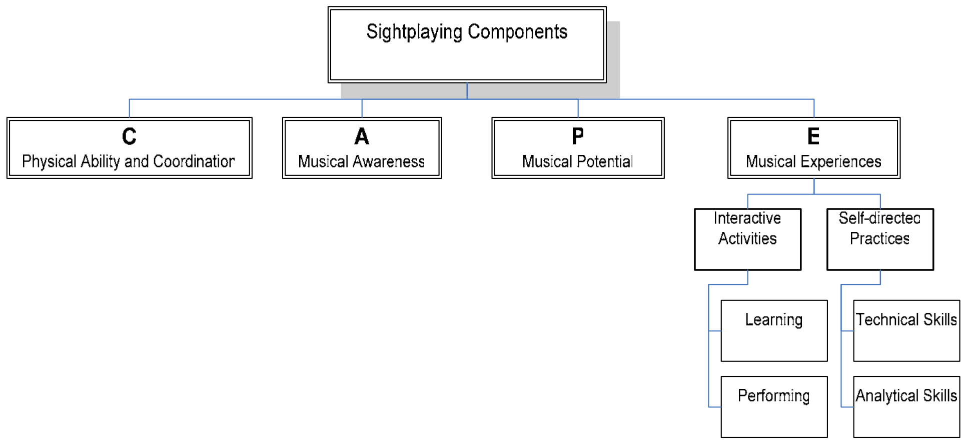
Personal music appreciation is a result of both nature and nurture aspects. It is assured that education and meaningful musical experiences play a vital role in increasing music appreciation. However, there is some research evidence that shows the importance of individual personality in music appreciation. Sims and Nolker (2002) conducted a study with kindergarteners between the age of four and six. The children listened to four selections for as long as they chose at a listening center during a free-choice activity time within their classroom. Results showed that when young children freely participate in music listening, individual personality is a significant factor affecting how long each child chose to listen to different musical excerpts. It was concluded that listening behavior is affected by an individual's personality rather than characteristics of the musical stimuli. An implication that might be drawn from this study is that since personality has a significant affect to individual attentive listening behavior, individual level of attentiveness may have an affect on other musical tasks, as well.

Individual personality contributes to the capacity for literacy development, which may structure musical potential in sightplaying development. According to *The American Heritage Dictionary* (2000), personality is "a pattern of collective character, behavioral, temperamental, emotional, and mental traits of a person." Personality is formed respective to individual growth, personal belief system, and value.

Summary

We have seen how musical potential with respect to biological and psychological characteristics serves as the third component in the proposed model of sightplaying development. Biological and psychological assets may promote music learning or may obstruct music development. It is the music teacher's responsibility to implement instruction that will stimulate what resources each person has previously acquired. There are countless unique ways and approaches to improve musical achievement from an individual's potential resources. Appropriate musical influence should nurture the biological and psychological potential.

COMPONENT 4: MUSIC EXPERIENCES



The last component deals with personal abilities gained through music experiences including both instructional experiences and personal music experiences. In this paper, formal/informal instruction, early/late musical exposure, and general/instrumental lessons are all classified as musical experiences that reinforce music reading and performing. This music experience component plays a vital role, directly influencing the development of one's keyboard sightplaying ability from the early stage of literacy development to the advanced stage of keyboard sightplaying proficiency (Grutzmacher, 1987; Nuki, 1984, Price & Blanton et al., 1998). Music experiences also have a major effect on the other three components in this proposed model: physical coordination, musical awareness, and music potential, due to the fact that the brain has plasticity, physical coordination can be trained, and the awareness of music can be fostered.

For the purpose of this study, the terms *interactive musical experiences* and *personal sightplaying experiences* were proposed as the two major categories in order to classify the types of music participation that require the sightplayers to interact with others and music experiences that involve more sightplaying practice. The author believes that while interactive experiences facilitate musicians to gain readiness for sightplaying performance, personal sightplaying experiences promote skills the pianists need in order to accelerate to the most proficient level of sightplaying performance.

Interactive Music Experiences

As mentioned above, the author believes that interactive musical experiences, which engage music reading actively, facilitate musicians' acquisition of readiness, confidence, and enjoyment when reading by sight. Interactive musical experiences also allow beginning music readers to communicate with others via the written language of music. This way the practicality and usefulness of written notation becomes apparent to young readers in a meaningful way. This utilitarian purpose for written music should foster young readers' affection and personal value for music reading.

Interactive musical experiences include both formal music learning activities and informal music participation. In other words, interactive activities can occur inside or outside of music classes. Most children learn how to read music when they engage in formal music education (Feierabend, 1997). Young readers should have opportunities to interact musically with peers through the use of written notation. Informal music participation tends to occur as a consequence of each person's musical environment. Both formal and informal musical experiences play important roles in nurturing children' music literacy skills.

Formal Music Instruction

"Reading and notating music" (MENC, 1994) is one of nine content standards for music education put forth by MENC: The National Association for Music Education. Music teachers are individually responsible for implementing and manipulating the task of teaching reading music at sight. Many research studies have shown that formal music education has had positive effects on sight-reading and sightplaying ability (Grutzmacher, 1987; Nuki, 1984; Price & Blanton et al., 1998).

In the following section, four important aspects of teaching music literacy will be discussed. These aspects have been applied from contemporary music teaching methods, writings by music educator philosophers, as well as research studies. These four aspects have been selected by the author to discuss in this section based upon their substantial contribution to knowledge in the field of music literacy, particularly relevant to the construction of the sightplaying components model.

Music is Aural-Based

A major literacy implication to this theory is to realize that introducing notation before the students are ready may delay their literacy development (Montessori, 1964). This theory is supported by many teaching methods that focus on aural perception before visual perception or sound before sign such as Suzuki, Orff, Kodaly, Gordon, and Montessori methods. McKnight (1975) found that tonal perception of music patterns is more effective in developing sightplaying and auditory-visual discrimination skills than learning the pitch by letter name and fingering. A study conducted by Grutzmacher (1987) showed that the understanding of tonal concept had a significant effect on melodic sight-reading improvement in *Iowa Tests of Musical Literacy* compared to competence in instrumental technical skill.

Pattern Prominence in Music Reading

The smallest chunk of musical information that makes sense is a pattern, not a single note. Gordon (2004) stated that the terms “words” and “patterns” function synonymously in language reading and music reading, respectively. Gordon suggested that patterns should be built from different classifications: *melodic* modes, *harmonic* modes, *foundation chords,* and different *meters.* Flash cards may be used to improve recognition of a pattern (Jacobsen, 1942). Many sight-reading methods have suggested reading ahead or reading patterns. An implication to music literacy is that music reading is not merely note spelling (Feierabend, 1997; Shockley, 2001). Speller readers tend to read music phonetically, naming note by note, instead of looking at the big picture, which is an overall structure of the piece (Udtaisuk, 2002).

Music Reading Involves Analytical Thinking

Analytical task is important when reading music. Some pedagogical suggestions and studies have been designed by following this concept. A language reading comprehension strategy that aims to increase familiarity and cognitive awareness has been used in music settings. This method, called the SQ3R method, includes surveying, asking questions, reading, reciting, and reviewing the reading material, and has been shown to motivate sightplaying ability (Reid, 1995). Music mapping is another literacy reinforcement method (Shockley, 2001) that can increase musical pattern awareness from the reader’s point of view. Mapping the music has been claimed by Shockley (2001) to accelerate the music learning and secure memory. These two example methods allow the readers to engage their individual imagination and cognitive thinking skills.

Importance of Movements in Music Reading

When teaching music literacy to young learners, body movements have been shown to reinforce beat and rhythm perception effectively. Bodily movement includes both gross and fine motor movement ranging from walking and hopping, to tapping and patschen (Orff, 1978). Body movement (Montessori, 1964; Orff, 1978) and echoing the rhythmic patterns (Heyge & Sillick, 1997; Levinowitz, 1998) also increased awareness of subdivisions of the beat. To improve students' acquisition of rhythmic skills, Lenowitz suggested that individual echoing of rhythm patterns may be beneficial to students' sight-reading performance.

Body movements also have shown to be effective techniques for teaching older children how to sight-read music. Foot tapping and counting out loud were found to increase rhythmic sight-reading competencies for string students (Salzberg & Wang, 1989). That study also reveals important information regarding the difference between proper sight-reading teaching techniques for less experienced and for advanced string students. Salzberg and Wang (1989) investigated four types of sight-reading teaching techniques, called prompt conditions. These include counting out loud, foot tapping, counting and tapping simultaneously, and no prompt. Results from the study demonstrated that counting out loud was the most effective prompt for less experienced performers, whereas both counting and tapping techniques showed equal effectiveness for advanced students (Salzberg & Wang, 1989).

Informal Music Participation

Informal music participation tends to occur as a consequence of each person's personal music appreciation and voluntary involvement with music. School-aged children gain informal reading experiences mostly through extra-curricular activities or other music participation spent during their leisure time at home. Parents play an important role in a child's informal music experiences. Parental support has been shown to contribute to a person's success as a musical performer (Moore, Burland, & Davidson, 2003). Results from one study (Custodero & Johnson-Green, 2003) revealed that parents who are involved in formal music experiences play and sing with their child more often than the parents who are not involved in formal music experiences.

Informal music participation can range from a less intense level of music reading involved to an intense level of music reading, from individual to ensemble performance mode, from rehearsed pieces to never-before-seen pieces. For instance, less intense level of music reading refers to when music notation can be used as a guideline for memory retrieval of familiar pieces in group performance, whereas intense level of music reading refers to when notation is provided to a performer when accompanying new pieces.

For the purpose of this study, informal music participation activities are classified into two general types of performance: accompanying activities and solo performance. The classification was based upon the review of literature, which supports the idea that these two types of activities have apparent causal relationships to sightplaying competence.

Accompanying

Few research studies have been conducted to find relationships between accompanying experience and sightplaying competencies. Although accompanying experience has demonstrated significant benefits to sightplaying competency. Lehman and Ericsson's (1993) study illustrated that pianists with solo performance specialization performed poorer than accompanists on sightplaying activities when required to perform under a specific tempo. However, the researcher found that expert pianists performed equally well with accompanist pianists when they were allowed to perform at their own pace.

When tempo is maintained in a musical manner instead of controlled by a metronome, the performers' appreciation affects lifelong learning outcomes. When tempo keeping is done for the sake of confinement or limitation, increased anxiety level can occur as a drawback. In a less tempo-restricted activities where the steady beat is controlled by somewhat more flexible balance between each instrument that plays in an ensemble, young sightplayers may feel less threatened when they sightplay. Lyke (1996), a piano pedagogue, suggested using various ensemble performances such as piano four-hand, two-piano, and piano accompanying (to instrument or voice) to improve sightplaying skills.

When practicing sightplaying, it was suggested not to stop, but omit or edit a note when the score is too difficult to decode within limited time (Lyke, 1996). Frequent practicing may help decrease stopping, uneven tempo, or correcting errors, but a practice environment that might prevent those symptoms from happening would be accompanying. Accompanying performance or practice automatically controls many unwanted sightplaying behaviors because the performance must go on and everybody has to manage his/her own problem-solving musical outcomes.

Results from another study by Lehmann and Ericsson (1996) corresponded to their earlier research findings in 1993, which emphasized on the positive causal effects from accompanying experience to sightplaying competency. Accumulated amount of time spent in accompanying-related activities and the amount of accompanying repertoire accounted for the significant unique variance in sightplaying and accompanying performance (Lehmann & Ericsson, 1996).

Solo Performance

Research findings have shown that experiences in solo performance tend to have a positive effect in sightplaying ability. Wolf (1976) found an association between sightplaying performance and general instrumental performance. Other research conducted by McPherson (1994) showed that in the beginning stages of training, sightreading skill is not significantly correlated with the ability to perform a repertoire of rehearsed music for a comprehensive performance examination as assessed on the AMEB (Australian Music Examinations Board) examination. However, as instrumentalists matured, correlations between these two aspects of performance seemed to strengthen markedly.

Summary

Interactive music experiences, including both formal education and informal participation, play an important role in both increasing one's reading appreciation and developing one's sightplaying competency. This social interaction aspect of interactive music activities could encourage music readers to gain social satisfaction and personal self-esteem, which may positively affect one's personal value and appreciation in music reading. Costa-Giomi (2004) found that piano instruction had a positive effect on children's self-esteem. Results from another study (Moore et al., 2003) showed that successful adults were those who took part in more concert activities in childhood, did more improvisation, and who had mothers at home in their early years. These findings support the author's supposition that interactive music making benefits an individual's musical competence.

Sightplaying Practice

It is the author's belief that personal sightplaying practice facilitates pianists to individually accelerate their skills to the most proficient level of sightplaying performance. During the players' personal sightplaying experiences, they manage to spend their time engaging in reading and performing to match their personal specific needs, interests, or expectations. This type of experience refers to individual practicing time, private lessons, self-taught learning, and self-discovering occasions. Due to the fact that sightplaying requires a complicated set of skills and proficiencies that is distinct from other music performance skills (Lehman et al, 1993; McPherson, 2002), in order to become good at sightplaying performance a person needs to practice those skills frequently and effectively. Personal sightplaying experiences allow the musician to focus on particular technical and analytical skills that are essential for developing his/her sightplaying ability.

As proposed earlier in this chapter, sightplaying skills are built upon essential sets of technical and analytical skills. This concept was influenced by Gardner's *Intelligence Reframed: Multiple intelligence* (1980). Gardner suggested that there are sub-intelligences or intellectual cores existing inside each of eight intelligences, including musical intelligences. Sightplaying intelligence would be properly identified as a sub-intelligence or intellectual core existing within musical intelligence. Studies conducted by Lehmann (Lehmann et al., 1993; Lehmann et al., 1996) also suggested that specialized sightplaying sub-skills can be identified in expert pianists.

The details regarding each specific element in the set of reading skills, or so-called intellectual cores, are still ambiguous in current literature. Traditionally, it was suggested that by reading more music, one would become a better reader. Developing good reading skills comes mostly with acquiring experience doing just that (Lyke, 1996). Sloboda (1978) suggested that persistence and practice make good readers.

For the purpose of this paper, the following analysis was developed to further identify the intellectual cores of sightplaying intelligence. These intellectual cores can be divided into technical-related and analytical-related cores. The tactile or technical cores refer to accuracy of performance, agility, tempo control, balance, fingering, and tactile sense of touch. The analytical cores refer to the reader's analytical thoughts toward the reading material. These two cores align well with Richman's (1986) innovative program for keyboard sightplaying, in which *keyboard orientation* is parallel to technical cores and *visual perception* is parallel to analytical cores. These two cores, however, are slightly different but still related to the sightplaying sub-skills proposed by Lehman and Ericsson (1996). According to their theory, improvisation, recall, and kinesthetic ability are the sub-skills of sightplaying. The author proposes that Lehman and Ericsson's kinesthetic sub-skill is equivalent to tactile or technical cores in this proposed model, whereas Lehman and Ericsson's improvisation and recall sub-skills are equivalent to analytical cores in my model.

The analysis in the following section was based upon current literature that derives from two sources of knowledge. The first source, which numbers higher, came from pedagogical approaches and suggestions regarding piano sightplaying. The second source, which numbers only a handful, came from research studies mostly conducted to investigate expert pianists as the participants.

Technical-Related Cores

A few research studies have been conducted to investigate direct relationships between technical proficiency and the ability to sightplay. This is because almost all of the studies in this area had been conducted with expert pianists who were normally assumed to achieve a high level of technical proficiency. However, from pedagogical documents, it is obvious that many keyboard technical skills are extremely important to sightplaying ability. These technical skills include sense of fingering, proper balance between fingers, and the ability to play scales and arpeggios in both major and minor modes with good quality and speed (Bernstein, 1981; Lyke, 1996; Rubinstein, 1950).

Tactile Sense of Touch

Among other technical skills, tactile sense of keyboard layout tends to provide a prominent asset to sightplaying. Many pedagogues (Bernstein, 1981; Lyke, 1996) emphasize avoiding looking down at the keyboard when sightplaying so the eyes can stay on the page the majority of the time to prevent interruption in the flow of music. This suggestion was also influenced by the fact that ability to feel the geography on the keyboard is very important.

By means of practicing, the pianist has mastered both physical coordination and geographic perception of the keyboard. From a neurological standpoint, research has shown that the area of the motor cortex controlling the fingers increased in response to piano exercises, both actual and imagined (Pascual-Leone, Dang, Cohen, Brasil-Neto, Cammarota & Hallett, 1995). Authors of another study found that the auditory cortex, which responds to piano tones, was 25 percent larger among experienced musicians (Pantev, Oostenveld, Engelien, Ross, Roberts, & Hoke, 1998). There are growing indications that those who study music, particularly beginning at an early age, show neurological differences compared to those who have not had such training (Schlaug, Jaencke, Huang, & Steinmetz, 1995). Faita and Besson (1994) demonstrated that musically trained subjects had stronger and faster brain responses to musical tasks than untrained subjects.

It is very important for good sightplayers to be able to identify a note on the keyboard without looking at the keyboard. According to Richman's (1986) innovative sightplaying program, the pianist should practice both a referential sense of touch and an absolute sense of touch. Referential sense of touch refers to the ability to identify the keys by feeling, meaning the reader can silently walk his fingers on the keyboard without looking at it when trying to find the pitch. Absolute sense of touch refers to the physiological memory of where the keys are in relation to the performer's body. This skill is often needed in case the passage requires a long jump or multiple pitches at a time.

Analytical-Related cores

An analysis of the relationships between notes or patterns was reported to be beneficial to sightplaying (Gunter et al., 2003). During this process, the reader applied associative information as well as theoretical and structural facts pertaining to the written notation to form secure memory and comprehension. The ability to plan in advance and expect the upcoming musical message differentiates between novice and master performers (Bernstein, 1981). Bernstein (1981) once self-investigated his own sightplaying strategy and explained that he found himself anticipating what was to come, for example, repetitions of motifs, rhythms, and harmonic progression.

One behavior study (Drake & Palmer, 2000) investigated the acquisition of music performance skills over eleven practice trials in novice and expert pianists differing in age, training, and sightplaying ability. Drake found that the more rapidly a person could understand, decode, execute, or problem-solve notational difficulty, the more efficient the preparation of his/her performance. A strong positive relationship between the mastery of temporal constraints and planning abilities within performance was found. Drake and Palmer suggested that these two cognitive indicators, thinking and planning, are closely related and may arise from segmentation processes during sightplaying performances. It is worth noting that the ability to grasp musical structure through extensive training in harmony and compositional elements were components in memorization as well as in sightplaying (Nuki, 1984).

The following intellectual cores are classified as abilities that derive from the analytical influences when a musician reads music at sight.

Ability to Read Ahead

Reading ahead of the music being performed is a well-accepted pedagogical suggestion (Bernstein, 1981; Lyke, 1996). Findings from research studies supported this implication by showing that expert pianists have a tendency to have an eye-hand span that is larger than that of other people (Gilman & Underwood, 2003; Jacobsen, 1942; Rayner & Pollatsek, 1997; Truitt, Clifton, Pollatsek & Rayner, 1997). The reading-ahead phenomenon is, however, a result of an advanced analytical ability and superior music comprehension skills when experts read music. This specialized skill represents a synchronization of multiple tasks including playing the first measure, scanning the next measure with one's peripheral vision, applying theoretical knowledge to secure memory, comprehending the music, and moving the fingers to find the keys without looking at the keyboard.

With efficient reading speed and analytical competence, these expert readers tend to be able to predict successive notes or patterns. Accurately predicting successive music allows the reader to expand his/her reading window as well as move eyes faster in each reading window (Truitt et al., 1997). Generally speaking, a phenomenon of reading ahead is a behavioral consequence of a well-developed physiological readiness of the larger eye-hand span mentioned in chapter four. This ability is a common characteristic in expert pianists.

Ability to Memorize and Recall Written Music

Unlike reading-ahead behavior, where the speed of analytical ability influences the behavior, memorizing and recalling music behaviors are driven by the quality of a person's analytical involvement when reading music. While memorization of a written music pattern involves one's short-term memory, recalling familiar music patterns involves one's long-term memory.

When the analytical stage is engaged at a short-term memory level, the reader needs to quickly read the material and store the musical essence into his short-term memory, and retrieve that information once it is actually being played. This complicated set of cognitive/analytical functions is almost instinctively handled by expert pianists.

This is because mature readers can quickly analyze complex musical situations and reduce them to simplest elements while they read at sight (Bernstein, 1981).

Familiarity seems to be one of the effective tools for increasing a person's pattern recognition when it comes to recalling music. Wolf (1976) identified that the ability to recognize patterns in music makes a distinctive quality between expert pianists and regular readers in sightplaying tasks. A musician's familiarity with forms and patterns in music was an important component in increasing accuracy when a person responded to written notation after one hour of waiting time (Roe, 1933). To gain familiarity toward different types of music, a good reader exposes himself to new written material on a regular basis rather than reading the same material over and over (Lyke, 1981).

From a neurological stand point, familiar music or routines activate neurons in the left hemisphere, while novel music or challenging tasks activate neurons in the right hemisphere (Hoffman, 2002). The corpus callosum, the muscle linked between the two hemispheres, was thicker in musicians than that of the one of non-musicians, especially when the musicians had begun their training before the age of six (Schlaug et al, 1995).

Ability to Correct Errors

Proofreader behaviors can be found within many expert players' sightplaying performance (Sloboda, 1978). This phenomenon was described as the reader unintentionally correcting the notes to match their expectation. This could represent a consequence of analytical thinking toward music notation. In some cases, a proofreader's theoretical assumption may influence him/her to substitute the printed note on the score with another note that follows his/her musical knowledge and experiences.

The phenomenon of "proofreaders' error" (i.e., the tendency for incorrectly spelled words to be overlooked when the misspelling is slight) is shown to occur in expert musicians (Sloboda, 1978). This proofreader phenomenon occurs in both experts and novice pianists. It happens when the readers recognize salient features of the musical piece and fill in the rest with rapid inference (Jacobsen, 1942). Even though proofreader behavior represents a high level of cognitive/analytical thinking, this behavior could provide benefits in correcting and editing a score, but negatively affect the accuracy aspect of a sightplaying performance.

An ability to correct errors is present in improvised performance. Lehman and Ericsson (1996) categorized improvisation as a sub-skill of sight-reading. However, improvised performance involves more creative analytical thinking and problem-solving abilities than restricted analytical thinking when compared to sightplaying performance. Therefore, I am not classifying the ability to improvise music as an intellectual core of sightplaying intelligence. Moreover, improvised performance requires a distinct set of intellectual cores that are more diverse than parallel to the sightplaying intellectual core.

In conclusion, personal sightplaying experiences play an important role in nurturing pianists' technical and analytical skills specifically devoted to keyboard sightplaying. Technical cores are responsible for physical skills and agility to effectively convey music from written mode to sound. This includes sense of fingering, proper balance between fingers, and the ability to play scales and arpeggios in both major and minor modes with good quality and speed (Bernstein, 1981; Lyke, 1996; Rubinstein, 1950). Analytical cores involve pianists' ability to read-ahead, memorize music patterns, recall relevant music form, and correct errors.

Summary

Both interactive music experiences and specific sightplaying experiences (sightplaying intelligence) are crucial components in the development of sightplaying ability. Interactive music experiences influence an individual's psychological appreciation and general reading readiness through both keyboard-oriented and nonkeyboard-oriented music participation. Sightplaying experiences foster an individual's specific sightplaying sub-skills through keyboard-oriented practices. General music classroom instruction, private lessons, accompanying experiences, and many hours of individual practice all contribute to the perfection and expertise in sightplaying performance on such a versatile instrument as the piano (Costa-Giomi, 2004). Research has shown that once the musician becomes musically mature, a pattern of higher correlations among the five types of performance is evidenced, which means that the abilities to perform rehearsed music, sightplay, play from memory, play by ear, and improvise tend to correlate when individuals are continuously exposed to meaningful music experiences (McPherson, 1995).

DISCUSSION AND IMPLICATIONS

The content of this chapter can be divided into two sections. The first section of this chapter contains the discussion of the results from this study's investigation, which is presented through a proposed sightplaying model. The model provides a general blueprint of the phenomenon implying causal relationships as well as correlations among the four components. Related issues regarding sightplaying phenomena will be discussed in this section as well. The second section of this chapter contains research implications for researchers and educators.

Discussion: The Four Sightplaying Components

As proposed earlier, the acronym for the four components is CAPE: physical Coordination, musical Awareness, musical Potential, and musical Experience. Each component represents many vital elements affecting sightplaying competency. These elements were classified into 32 strands under each of the four components. When observed carefully, these four components serve the paradigm in a different manner. The first two components—Coordination and Awareness (CA)—contribute to a person's immediate response to a sightplaying task, whereas the later two components—Potential and Exposure (PE)—serve as a basis of personal aptitude in sightplaying competence. In other words, Coordination and Awareness are the "forefront" elements enabling a person to handle sightplaying tasks, while Potential and Experiences serve as "backup" resources to a person's sightplaying competence. Generally speaking, physical coordination and musical awareness serve as the resources for the immediate outcome, while musical potential and musical exposure serve as the basic elements that scaffold the total competence.

The proposed model of piano sightplaying components classified four major components according to their relevance to sightplaying outcomes and development. Each of the four components can be broken down into specific variables. All of the variables discussed in this study have either been identified by experts or investigated by researchers from various fields of studies.

Current literature embodied the data source for this study, reflecting different perspectives and concentrations about each variable of the four components. Results from research studies provided concrete conclusions regarding the effectiveness or the validity of these variables supported by statistical testing. Pedagogical articles and teaching philosophies from experts have offered authentic suggestions and practices.

Both types of resources allowed the author to synthesize the proposed model with multiple perspectives. As a result, the model represents a simplified explanation of the complex process of sightplaying on the piano specifically with the major components involved in the process.

Physical coordination refers to physical ability as well as physical coordination between eyes, ears, and hands that results in physical sensory motor skills ranging from gross motor skills to fine motor skills. In other words, this group of physical coordination-related components can be referred to as components related to bodily movement in gross and fine motor skills (Gilman, 2003; Harrel, 1996; Kostka, 2000) as well as principal sensory motor skills related to reading and performing (Clark, 1992; Jacobsen, 1942; Weaver, 1943). Accomplishment in this area allows the reader to perform with a compatible level of accuracy and agility to the given sightplaying repertoire.

Musical awareness raises the vital role of perception in music reading and playing. Ideally, music readers need to be able to aurally perceive the sound of the printed notation before it is being performed (Gordon, 1965; 1971; Kodály, 1974, Mainwaring, 1941). In other words, when the body is ready to perform the music at sight, it is time to be certain that the mind is focused on the music as well. This type of awareness influences the artistry and musicality of the sightplaying outcome. To be responsive to musical stimuli, one's ears, eyes, and mind need to be sensitive and ready to be fully receptive to the music. These components can be acquired through instructional influences (Feierabend, 1997; Goetze, 1985; Gordon, 2004; Heyge & Sillick, 1997; Levinowitz, 1987) as well as those influences resulting from individual personality and music sensitivity of the player (Sims & Nolker, 2002).

Musical potential includes most of the elements that are beyond the player's control or are given to us by nature. Some of these potential components can benefit music reading, whereas others may not create any major effects. Genetic, neural, and mental components exist as a stabilized asset. Sometimes this asset causes predisposition in music learning and development in each individual. Gifted and talented individuals benefit from what they are given by nature, whereas individuals with certain disabilities may be challenged when it comes to reading music (Atterbury, 1985; Milner, 1962). These elements from nature can vitally affect musical competence. Researchers have discovered a common area of brain activation during reading and performing tasks; however, the degree of activation is unique from one person to another (Sergent, Terriah, & McDonald, 1992). Genetics indicated a significant correlation to musical pitch recognition in a twin study (Drayna, Manichaikul, Lange, Snieder, & Spector, 2001).

When one tries to comprehend musical written materials, research shows that an individual's personal thinking process influenced the individual's reading ability (Bamberger,1999; Sandstrom, 1998)

The musical experience includes the entire range of music experiences from the early years of development through the later years of learning. Musical experiences refer to both formal and informal music participation and music education. The proposed model separates music experiences into two categories: interactive musical experiences and specific sightplaying experiences. It is the specific sightplaying experiences that play an important role in developing sub-skills needed in sightplaying activities (Lehman et al, 1993; McPherson, 2002). Both technical skill and analytical sub-skills are uniquely developed based upon individual preference and styles of learning, practicing, and performing. It is beyond the scope of this study to discuss this issue, however there is evidence that expert performers tend to approach and master sightplaying techniques with distinct styles and directions (Bernstein, 1981; Richman, 1985). As opposed to specific sightplaying experiences, which allow the pianists to practice and improve piano sightplaying sub-skills, interactive musical experiences as classified into formal music education and informal music participation benefit both novice and expert readers' affection, appreciation, and competence in general sightplaying activities (Grutzmacher, 1987; Nuki, 1984, Price & Blanton et al., 1998). Accompanying is an example of informal interactive musical experience that benefits pianists' sightplaying ability. Lehman and Ericsson's (1993) study found that pianists with performance specialization performed more poorly than accompanists on sightplaying tasks. When a person participates in group performances his/her reading is enhanced in musically meaningful ways. For instance, tempo is more controlled in a group performance, which consequently forces the eyes to read forward.

It is worth noting that among the four components, musical experience plays a distinct role in interacting with and stimulating the other components. Piano instruction directly stimulates a sense of keyboard geography (Harrel, 1996). At the same time, it increases an individual's aural awareness such as detection of harmonic alteration in music (Destwolinski, Faulconer, & Schwarzkopf, 1988), and error detection ability (Sheldon, 1998). There is evidence that musical experience enhances musicians' brains. A larger area of auditory cortical representation was found in expert pianists (Pantev, Oostenveld, Engelien, Ross, Roberts, & Hoke, 1998).

In the following paragraphs, sightplaying phenomena will be discussed according to the three themes to provide a better clarification of the proposed model as well as to make connections to current literature in the field. These themes include the issue of the origins of the four components (nature and nurture), the issue of physical versus analytical skills embedded in the four components, and the procedural aspect of sightplaying activities. Figure 4 (page 42) provides a visual illustration of the interrelationships between these three themes and the four components of sightplaying performance. Generally speaking, sightplaying performance can be viewed as an outcome of the reader's analytical thinking and technical ability, where the meaning of musical signs is transferred into sound. Nature and nurture are included in this model because they have been shown to have an impact on the quality of each of the four components.

Origin of the Four Components: Nature versus Nurture

Even though the model cannot provide information about the extent to which nature and nurture play roles in the equation of sightplaying ability, it is worth noting that both nature and nurture impact each of the four components in the model. The four components in the proposed model can be explained in terms of the fundamental roots of each component. For example, to develop physical coordination, both nature (intuitive) and nurture (environmental) variables play an important role. Not only do genetics and maturity solely underpin the physical ability of an individual, but also the practice that supports the development of physical skills. It is essential to recognize these two sources that are embedded in each component in order to better understand the phenomenon. The ability to recognize innate/intuitive and environmentally-based variables enables music educators to appropriately and effectively select the proper nurturing approach and guidance for each player.

Regarding the second component, musical awareness, the innate ability of audiation or perfect pitch (nature) can benefit from early music stimulus, guidance, and age-appropriate music exposure (nurture). The combination of nature and nurture contributes to a person's overall musical awareness. The concept of music aptitude (Gordon, 1965; 1971; 1997; 1999) aligns well with music potential, the third component, in which both innate components and early music exposure are crucially important. Early music exposure during the first years of the developmental process reinforces a child's potential for music learning (Feierabend, 1997; Heyge et al, 1997; Montessori, 1964).

Technical versus Analytical Skills Embedded in the four Components

Sightplaying is a complex process of making music, where the reader has to be competent in the two related aspects—technical performance skill and reading comprehension skill. The finer a pianist comprehends the sightplaying music, the higher quality sightplaying outcome results (Lehmann & Ericsson, 1993; 1996). The more fluent technical skills the pianist has mastered, the more accurate the performance will be (Bernstein, 1981; Lyke, 1996; Rubinstein, 1950). These two qualities need to be developed simultaneously when one attempts to improve his/her sightplaying skills.

Each of the four components proposed in this model contributes to both analytical (reading) and technical (performing) aspects in one's sightplaying ability. Some components incline more toward one aspect than another. For instance, competence in physical coordination benefits performing skills to a higher degree than reading comprehension, whereas high achievement in musical awareness promotes more reading comprehension than performing skills. Musical potential and music experiences contribute to both the analytical and technical aspects of sightplaying competence. One's musical potential tends to correspond with variables involuntarily given and formed by nature, whereas one's music experiences correspond with a person's volunteer effort and practice. Accordingly, musical potential and musical experience can impact both reading and performing ability to a large extent. For instance, one's learning disabilities may impact one's reading and analytical abilities to a lesser or greater extent. Similarly, one's perseverance and effort in sightplaying learning and practicing could promote one's acceleration in sightplaying.

Procedural Aspect in Sightplaying: An Instructional Approach

Sightplaying ability is normally evaluated via sightplaying performance. It is important to know that a person's true ability to sightplay may not present in a sightplaying performance due to an effect from environmental factors. There are many denominators in a sightplaying performance environment that could affect the sightplayer's sightplaying performance. From a procedural aspect of sightplaying performance, this music making process can be divided into three main stages: input, process, and output. Considering the sightplayer as an information processor, he/she efficiently transfers standard written notation (input), through the process of gathering and integrating his/her knowledge and understanding in order to reproduce the sound (output) that represents the score as accurately, fluently, and artistically as possible.

Each person's sightplaying performance can fluctuate dramatically under different sightplaying circumstances. This is because environmental factors can influence the quality and characteristics of the input in the process of sightplaying, making the activity become more challenging to the performer. In a sightplaying assessment scenario, the difficulty of the piece and length of preparation time are the environmental factors that could negatively affect the immediate outcome. In sightplaying accompaniment, expectation from the audience, performing tempo, and formality of the performance could account for additional challenges. Environmental factors can create psychological and emotional challenges to the performers. Accordingly, these environmental denominators need to be taken into consideration when it comes to assessing sightplaying ability.

Some individuals may be more compatible with challenging situations than others. However, when it comes to teaching and developing a sightplaying performance, it is important to be concerned with these other situational variables in addition to the four components.

Implications

The proposed model organizes basic components in the process of sightplaying. It illustrates both hierarchical and parallel relationships among the four major components and their subordinate elements. The four major components—CAPE—are the theme categories underpinning the elements of sightplaying skill. The model enables researchers and practitioners to systematically investigate and understand the relationships among all possible variables in the paradigm of sightplaying. Each variable plays a vital role in the development of sightplaying competence. High achievement in sightplaying skill development is the consequence of well-developed and well-attained subordinate sightplaying components proposed in the model.

One of the important implications of the model is to recognize that the inter-relationships among the four components are subtly embedded. Each of the subordinate components not only contributes to the overall perfection of sightplaying competence, but also affects the other subordinate components. For instance, a strong sense of intonation benefits overall sightplaying performance. At the same time, it can positively influence other elements such as aural awareness and sense of keyboard geography. Positive affects from one component to the others can be beneficial to the process of sightplaying development. At the same time, negative affects can also create obstacles to the process. For instance, a lack of attentive listening could negatively affect an individual’s aural awareness as well as his/her sightplaying ability.

Another important implication of the model is to recognize that each component in the model, although functioning interdependently, is independent and requires a unique set of readiness. For instance, the ability to read complicated music is independent from instrumental performance ability. This explains why a music theorist can understand the harmonic structure of a difficult piece, but may have difficulty performing the music on a particular instrument.

The proposed model share similarities with Gordon's *Stages of Music Literacy* (2003), McPherson's theoretical *Model of Path Analysis* (1997), and Mainwaring's *Model of Relationships between Aural, Visual, and Action* (1951), where the focus is on the explanation of the music reading process. However, these three theories focus on music reading and music playing, whereas the proposed model depicts specific details regarding sightplaying specifically on the piano. Gordon's *Stages of Music Literacy* (2003) classifies hierarchical stages of music literacy development. McPherson's theoretical *Model of Path Analysis* (1997) illustrates how different factors have an influence in music reading and music playing. Mainwaring's *Model of Relationships between Aural, Visual, and Action* (1951) demonstrates an ideal pathway of how aural and visual perception should be incorporated to increase musicality when reading music. Among these three theories, the proposed theory is most closely related to McPherson's model by means of focusing on variables that affect music reading and playing.

However, there are distinct differences between McPherson's and my models. First, while McPherson was concerned with the five types of music playing, ranging from notation-based to aural-based, I paid specific attention to notation-based music playing, so-called sightplaying. Second, different research philosophies underpinned each model.

While McPherson based his model on statistical correlation, my model provides a general picture of sightplaying phenomena based on reviews of both research and pedagogical literature. When used with caution, this model can be very useful to provide an overview for researchers and educators.

Implications for Researchers

The speculative theory-building methodology selected for this study has proven to be effective and compatible to the production of this study. The theoretical model proposed in this study provides a well-organized illustration about this complex phenomenon. Each component in the model conveys a separate piece of information distinct from the other components. When systematically combined together, this blueprint of piano sightplaying clarifies fundamental relationships among the components and their subordinate components.

Because the proposed sightplaying blueprint is based mostly upon theoretical analyses and assumptions, it can be reframed with perspectives from other research methodologies to explain more in-depth about the relationships among the components. Statistical measurements or interviews with expert pianists are examples of applicable quantitative and qualitative methodologies that could supply comprehensive information. Future research could either provide a supplement to this model or infuse diverse aspects. Future studies may investigate the relationships between variables or a comparison of the effectiveness among variables. A precise correlation value between each variable could be investigated with statistical measurements such as correlations among different components suggested in the model. Statistical measurements might also reveal hierarchical patterns among the subordinate components. Various kinds of assessments and research designs could help verify if each one of the four components of CAPE is a significant factor contributing to sightplaying outcomes or sightplaying ability.

As a researcher recognizing the inter-relationships among multiple components, one needs to have a multi-perspective approach when designing, choosing the methodology of the study, and making conclusions about his/her research concerning this phenomenon. The influence among components may be present regardless of research controls, and should not be neglected or underestimated despite any significant statistical correlation, or the absence thereof.

The author also found that there are many variables related with the sightplaying process that have not been thoroughly studied. Since there is so little knowledge about so many variables, this may be one of the reasons why some experts' opinions about certain practices, and pedagogues' suggestions, are used by practitioners with ambiguous standards or inadequate explanations. Experts' or pedagogues' opinions on how to improve sightplaying ability, although potentially useful, should be reframed with scientific or psychological explanations. Results from scientific measurements should help suggest more effective practices and allow more accurate predictions. Experimentation can also provide more legitimate evidence that some practices create more advantage to overall sightplaying development than others.

Implications for Educators

Music educators and keyboard instructors can benefit from the proposed model, especially as they are the ones who often play a major role in educating or diagnosing sightplaying skills in each student. It is the educator's responsibility to evaluate the situation and systematically diagnose each individual student's ability. The model allows teachers to identify students' abilities as well as weaknesses within a sightplaying paradigm. One way to improve competence in a sightplayer is to make certain that there is balanced development among the four areas of sightplaying components—CAPE: Coordination, Awareness, Potential, and Exposure.

The main concept implied from the model is that there are multiple components involved in the process of sightplaying competency. The development of this particular skill or the diagnosis of the phenomena has to be done carefully with a multiple-perspective approach. As a music educator, one should be aware that proficiency from one area is a tool to promote achievement in the other areas. Numerous sightplaying components, suggested by this model, should allow the educator to creatively combine and freely manipulate each variable with a variety of possibilities.

Developing each prerequisite skill separately is beneficial at a beginning level, where engaging multiple facets in one task could make the sightplaying practice become more worthwhile. A sightplaying exercise that stimulates technical readiness, reading, and comprehension (incorporating Coordination and Awareness) should accelerate a student's progress more effectively than an exercise that is solely focused on the fingering pattern (Coordination). Reinforcing an act of "reading ahead" may not provide the most profit to sightplaying development if the practice is solely focused on physical movement of the eyes (Coordination), but not involved with intellectual thinking (Awareness).

Many teaching techniques and suggestions for developing sightplaying competency have been passed down through generations of piano teachers. Some suggestions are simply prototype behaviors modeled by expert pianists and accepted by pedagogues. Others are pedagogical suggestions that allow teachers to maximize a student's sightplaying performance accuracy. These two types of suggestions play different roles in developing sightplaying skill. The former allows novice sightplayers to learn and imitate how proficient sightplayers successfully engage in this task. The latter pedagogical implications stimulate and reinforce the student's achievement in a constructive environment. These suggestions include selecting sight-reading pieces that are not as difficult or as complicated as the regular practicing pieces, so called "one level lower than the student's performance level" (Harrel, 1996). Harrel (1996) suggested that the teacher should allow students to perform with a slow tempo and give students adequate preparation time. Adequate preparation time should allow students to notice melodic, harmonic, or rhythmic patterns as well as increase student's recognition of the meaning of the written music when sightplaying. During the Trinity college's sightplaying examination, for example, the students are encouraged to spend a brief moment to comprehend the music and move their fingers quietly over the keyboard, called "shadowing," during their preparation time. This preparation time is considered an essential element that promotes the quality of students' sightplaying outcome.

When sightplaying teaching techniques and suggestions are introduced with a lack of fundamental understanding toward sightplaying components, they are merely ideal music behaviors that are unapproachable from the student's level of understanding and ability. Knowing that musical awareness requires many components including aural, visual and intellectual awareness, the teacher would constantly develop the student's musical awareness via all possible media. Without inclusive engagement in musical awareness, "reading music in patterns" could become merely an ideal behavior, unrelated to students' ability, if the students do not understand the particular pattern in relationship to the other transposed patterns. An effective way to apply pedagogical suggestions is to analyze into which of the four categories a particular suggestion or technique falls. A single practice or exercise that can simultaneously engage more than one component of sightplaying skill should promote a better and longer-lasting result.

An effective way to capture a student's attention when reading and teaching them the value of music reading is to make it enjoyable. Especially at the beginning stage of learning, instead of focusing on perfection and accuracy of the reading, reading frequently on a regular basis should be more beneficial. This will encourage students to love to read for the sake of reading, not because they are forced to do so. However, practicing sight-reading exercises alone on an everyday basis may not be the most effective way with many beginning learners. Due to the fact that reading never-before-seen music on an instrument—sightplaying—requires more effort and physical control than reading familiar music, music instructors need to construct this task more effectively to prevent frustration. Duet or ensemble performances are examples of appropriate activities that allow music reading—sometimes familiar music and sometimes unfamiliar music—to be engaged in musically meaningful ways. At the same time, reading music in group performances serves a functional purpose of requiring a teamwork effort. Reading music this way should result in a more pleasant environment than reading music with the metronome.

Among the four components, music experiences—including interactive experiences and specific sightplaying experiences—seem to be the strongest components underlying sightplaying intelligence and its sub-skills. Specific sightplaying experiences tend to play a vital role in motivating a person to master his/her highest level of achievement. During specific sightplaying practice, the pianist can evaluate his/her style, competences, weaknesses—metacognition—and can make individual adjustments that suit his/her competence level. This “personal touch” could be a vital tool, serving as a catalyst for acceleration of individual ability.

Sightplaying occurs in different circumstances including learning, practicing, competition, testing, and performing. In each circumstance, environmental components play a vital role in affecting the sightplayers’ performance. In a more threatening and challenging environment, a sightplayer may have to perform under pressure and anxiety in order to fulfill different aspects of expectation of the listeners. Although this issue is beyond the scope of this study, music educators need to be concerned with this when it comes to evaluating or examining students’ sightplaying competency.

Conclusion

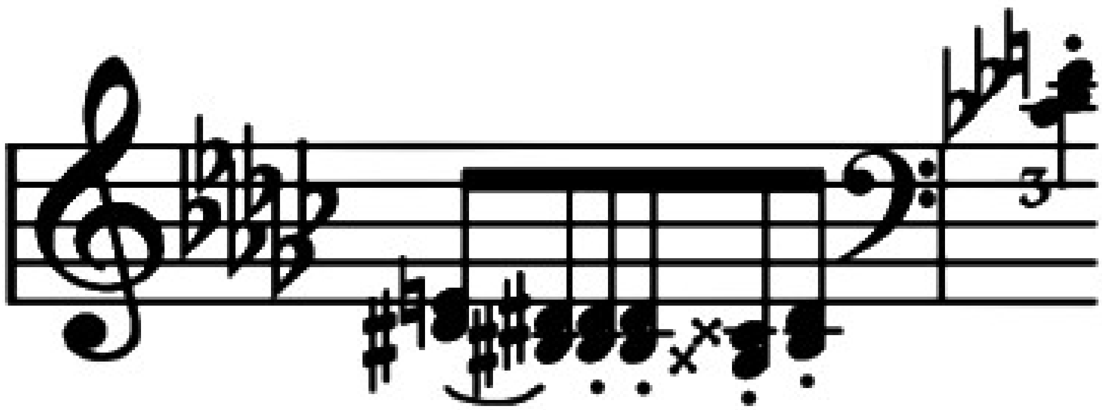
The proposed model is aimed at clarifying the salient details in the process of sightplaying. Regarding the four components, physical coordination and musical awareness serve as the resources for the immediate outcome, while musical potential and musical exposure serve as the basic elements that scaffold the total competence. Variation among levels or differences in the strength of the components cannot be predicted or implied at this point, however, the model is valuable because it allows us to see a complete picture of how the process is achieved and the possible components involved in the process of sightplaying development as well as sightplaying performance.

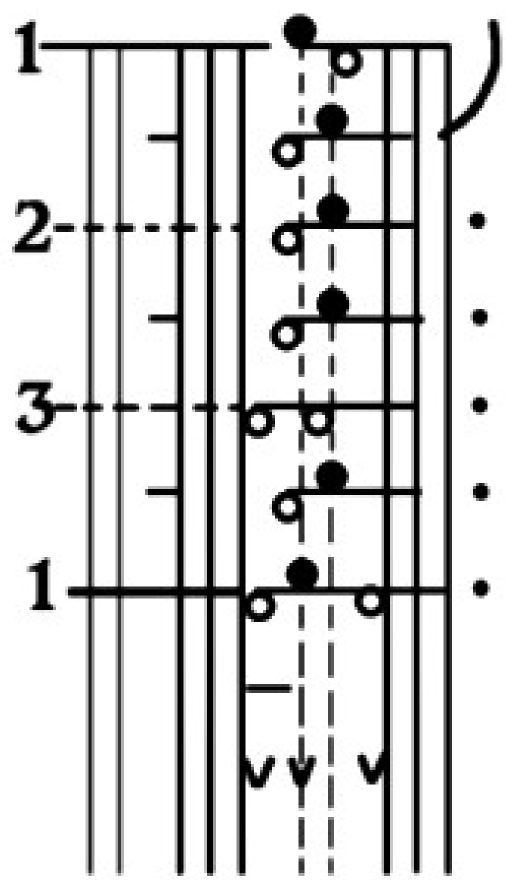
This proposed model should be able to explain sightplaying on instruments in addition to piano as well as sight-singing. While each instrument and singing requires different technical skills, with appropriate adaptations, this model is versatile enough to apply to different performing media.

As a result of an extended review of literature, the author proposed a generalized picture about the possible components shown to be involved in the process of sightplaying development as well as sightplaying performance. With a qualitative philosophy as the research methodology and multiple perspectives in mind, the author believes that the model describing the four sightplaying components, CAPE: physical Coordination, musical Awareness, musical Potential, and musical Experiences, is useful as an instructional and experimental guideline for investigating and understanding a unique sightplaying ability in each individual as well as sightplaying performance in different circumstances. When using this model, music educators and researchers need to be aware that variations among levels or differences in the strengths of the component have not been predicted by this model. Any generalizations and implications need to be drawn with appropriate caution.

Appendix A

Standard Western Notation compared to Klavarskribbo Notation





Source: http://www.klavarskribo.nl/oud/english

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