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Codification of Terminology and Procedure in Mental Practice with Applications to Piano Pedagogy

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CODIFICATION OF TERMINOLOGY AND PROCEDURE IN MENTAL PRACTICE WITH APPLICATIONS TO PIANO PEDAGOGY

by

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DEDICATION

For Clive, and everything he represents.

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ABSTRACT

Mental practice has been discussed among piano pedagogues from the nineteenth century until the present. Over time, many terms have been used to describe different kinds of mental practice. This variety can make it challenging for the independent teacher to consolidate the information and effectively apply mental practice to the private lesson. For this reason, a codification of the terms associated with mental practice is presented in this thesis. Terms are classified into four groups: Visualization (kinesthetic imagery and musical imagery), Aural (aural imagery and audiation), Psychological (mental wellness and guided imagery), and Hybrid (practice away from the piano and score study) techniques. These codified terms are then used to understand and organize mental practice studies and techniques occurring in other career fields, such as psychology, engineering, rehabilitation, medicine, business, sports, design, dance, and conducting. This resource provides direct applications from the findings of other fields to piano pedagogy, and will help inform further research so that studies can be conducted in more specialized and focused ways, leading to more piano-specific, transferable, and empirical conclusions.

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CHAPTER 1

INTRODUCTION

Mental practice has been a topic of discussion and examination by piano pedagogues from the nineteenth century to the present. Mental practice techniques, such as mentally hearing sound quality and mentally rehearsing away from the instrument, have been common practice in piano teaching since the 19th century. Early accounts include the concept of mental imaging of sound, and discourse in the 20th century includes studies on mental practice and the development of the concept of audiation by Edwin Gordon. Anton Schindler mentioned the following ideas of Ludwig van Beethoven (1770-1827):

> He set great store by the manner of striking the keys… the physical or material and the psychological of which Clementi made him aware. By its psychological import Clementi meant the fullness of the tone already conceived in the player's mind before the fingers strike the keys.[1]

Rosina Lhévinne, a renowned 20th century pedagogue, stated, "You imagine the sound you wish to produce, then you produce it."[2] Heinrich Neuhaus in his book, *The Art of Piano Playing*, discussed developing the inner ear through acting on tone production.[3] All three of these references, though at differing times in pedagogical history, express interest and importance in the idea of mentally hearing a sound before playing it on the

[1] Anton Schindler and Donald W. MacArdle, *Beethoven as I Knew Him* (Mineola, N.Y: Dover Publications, 1996), 98.
[2] Sarah Croom-Hatch, "Continuous Audiation for Piano Performance," *American Music Teacher* 42, no. 1 (1992): 14.
[3] Ibid.

instrument. In more recent references, Jennifer Mishra, in her article "A Century of Memorization Pedagogy," states that mental practice techniques such as hearing sound and mentally rehearsing away from the instrument have been around for many years, but that the idea of kinesthetic visualization became popular in the 1940s.[4]

The idea of mental practice is not limited to pianists. Philip A. Fine conducted a study that showed that 70% of a variety of classical musicians including instrumentalists, singers, and conductors indicated that mental practice was "very useful or even vital to them."[5] Stewart L. Ross produced a study about mental practice in regard to college trombonists that showed that a combination of physical and mental practice was as effective as physical practice alone.[6] A study by Abigail McHugh-Grifa focused on collegiate-level cellists and mental practice strategies they did or did not employ.[7] While this study was inconclusive in its original intent to differentiate the helpfulness of three different types of mental practice, McHugh-Grifa stated that the findings supported the overall efficacy of mental practice. Though there is variety in the specific kinds of mental practice used in these studies, they all conclude that mental practice is effective in some way.[8]

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[4] Jennifer Mishra, "A Century of Memorization Pedagogy," *Journal of Historical Research in Music Education*; Thousand Oaks 32, no. 1 (October 2010): 3–18.
[5] Philip A. Fine et al., "Performing Musicians' Understanding of the Terms 'Mental Practice' and 'Score Analysis,'" *Psychomusicology* 25, no. 1 (2015): 69–82.
[6] Stewart L. Ross, "The Effectiveness of Mental Practice in Improving the Performance of College Trombonists," *Journal of Research in Music Education* 33, no. 4 (1985): 221–30, https://doi.org/10.2307/3345249.
[7] Abigail McHugh-Grifa, "A Comparative Investigation of Mental Practice Strategies Used by Collegiate-Level Cello Students," *Contributions to Music Education*; Columbus 38, no. 1 (2011): 65–79.
[8] Linda Ross Happy and William E. Fredrickson, "The Effect of Mental Imaging Rehearsal on the Study of Black-Key Major Scales in a College Piano Class," *Missouri Journal of Research in Music Education*, no. 42 (January 1, 2005): 18–26; Don Douglas

In the field of music, the term "mental practice" encompasses multiple modes of intentional and concentrated mental conception—without physical movements or auditory feedback—of some aspect of piano playing. These modes include kinesthetic, aural, visual, psychological, and analytical approaches. Each of these approaches are referred to in multiple terms, often with overlap of words and definitions while still being different enough to warrant distinction.

Don Douglas Coffman described mental practice as "the cognitive rehearsal of a skill that takes place within the individual, in the absence of any gross muscular movement."[9] This kind of mental practice is associated with a kinesthetic component, and the term "visualization" is applied to mental practice strategies of this nature. Edwin E. Gordon developed the term "audiation" as "the process of assimilating and comprehending (not simply rehearsing) music momentarily heard performed or sometime in the past."[10] Gordon informs that when audiation is happening adequately, the performer is giving more importance to what is being heard, rather than the physical body.[11]Any intentional work done to develop one's audiation capability is completely in the mind, and therefore mental practice. In addition, Bernardi et al. in "Mental Practice in Memorization: An Ecological-Empirical Study" found that mental practice techniques

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Coffman, "The Effects of Mental Practice, Physical Practice, and Aural Knowledge of Results on Improving Piano Performance" (1987); James E. Driskell, Carolyn Copper, and Aidan Moran, "Does Mental Practice Enhance Performance?," *Journal of Applied Psychology* 79, no. 4 (August 1994): 481–92, https://doi.org/10.1037/0021-9010.79.4.481.

[9] Don D. Coffman, "The Effects of Mental Practice, Physical Practice, and Aural Knowledge of Results on Improving Piano Performance" (PhD Diss., University of Kansas, 1987).

[10] Edwin E. Gordon, *Learning Sequences in Music: A Contemporary Music Learning Theory*, 2007 ed (Chicago: GIA Publications, 2007), 3.

[11] Ibid., 6.

can lead to this more well-defined "pitch imagery," or, "clear audiation."[12] Mental practice techniques related to this are also referred to as "aural imagery."[13] However, Gordon notes that there is a distinct difference between audiation and "musical imagery," another term that falls under the category of mental practice. "Musical imagery casually suggests a vivid or figurative picture of what music might represent," Gordon states, "It does not require assimilation and comprehension of intrinsic elements of music as does audiation." [14] While "musical imagery" and "aural imagery" are different in their approach and benefits, they both appear in the research as viable strategies within the mental practice literature. Linda Ross Happy uses the term "mental rehearsal" to refer to a concept similar to "mental imagery." She describes mental rehearsal as "vividly picturing, sensing, or experiencing a situation within one's own mind without the gross muscular movements involved in the situation taking place."[15]

Because of the use of varied terms and definitions, the research on mental practice is not easily transferrable across studies and it is difficult to summarize conclusions. Susan Mielke and Gilles Comeau state that "mental practice needs to be precisely defined in order to produce precise study designs and results."[16] Although research on mental practice is available, there are few specific, tested, pedagogical strategies for effectively

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[12] Nicolò Francesco Bernardi et al., "Mental Practice in Music Memorization: An Ecological-Empirical Study," *Music Perception: An Interdisciplinary Journal* 30, no. 3 (2013): 275–90.
[13] Steve Oare, "Aural Image in Practice," UPDATE: *Applications of Research in Music Education* 34, no. 2 (February 2016): 37–44, https://doi.org/10.1177/8755123314550415.
[14] Gordon, 4.
[15] Ross Happy and Fredrickson, 20.
[16] Susan Mielke and Gilles Comeau, "Away from the Piano: Literature Review of the Role of Mental Practice," *Canadian Federation of Music Teachers' Association* 63, no. 1 (September 2012): 25, http://www.cfmta.org/en/wp-content/uploads/2015/10/Away-from-the-Piano-Full.pdf.

incorporating concepts of mental practice into the private piano lesson because of its breath and many subcategories.[17]

Purpose of Study

The purpose of this study was to examine literature on mental practice, such as visualization, audiation, aural imaging, mental imaging, and mental rehearsal, in music and other fields to provide suggestions to teachers and students on how they can better incorporate mental practice in piano study. The study identified major literature resources in fields such as engineering, medicine, business, aviation, design, psychology, and music and other performing arts. The summary of major literature resources served as the basis for a codification of terminology and an examination of mental practice applications for the creation of suggested practices in piano pedagogy. This document serves as a detailed resource for piano teachers and students to more effectively apply mental practice to piano playing.

Need for Study

Mental practice accomplishes many favorable results. Fine offers a list of positive outcomes— compiled from multiple authors who polled conservatory-level musicians— which include

> developing emotional expressivity; enhancing technique and practice efficiency; improving learning and memorization. . . ; heightening sensory awareness; refocusing attention during performance; enhancing general confidence and resilience in a performance situation; enabling greater control over negative emotions; establishing a stronger connection with an audience; and achieving peak experience.[18]

[17] Mary Grace Galvan, "Kinesthetic Imagery and Mental Practice: Teaching Strategies for the Piano Principal" (DMA diss., University of Miami, 1992).
[18] Fine et al., 71.

All of these benefits find a strength in greater concentration, and are skills teachers desire to foster in their students' education.

Similarly to mental practice in terms of heightened attention, Kathy A. Liperote maintains that audiation encourages students to focus on the aspects of the music "such as tonality, style, harmonic progression, and tonal and rhythm function."[19] James S. Hiatt and Sam Cross state that a musical ear is nearly universally accepted as the most important determination of a successful music student.[20] "Most music educators," they write, "believe that without a well-developed ear it's impossible for a musician to function on a professional level as a teacher, conductor, performer, or composer."[21] They also state that learning to play an instrument by fingering—or by extension, a kinesthetic-only approach—is far less reliable than learning to play by audiation.[22]

Specific pedagogical applications of mental practice as well as quantitative studies are sparse, especially in the field of piano pedagogy. Don D. Coffman, and Susan Mielke and Gilles Comeau surveyed literature relating to mental practice in piano performance and teaching and found the research lacking in terms of quantity.[23] Their surveys included a large amount of material concerned with the general music field in an attempt to gather resources helpful to piano playing, though not directly pertaining to it. Galvan discloses that while "mental participation in piano playing is preferred over

[19] Kathy A. Liperote, "Audiation for Beginning Instrumentalists: Listen, Speak, Read, Write," *Music Educators Journal* 93, no. 1 (September 2006): 46–52.
[20] James S. Hiatt and Sam Cross, "Teaching and Using Audiation in Classroom Instruction and Applied Lessons with Advanced Students," *Music Educators Journal* 92, no. 5 (May 2006): 46–49.
[21] Ibid.
[22] Ibid.
[23] Coffman; Mielke and Comeau.

physical practice alone… there are only occasional references to specific imaging and mental practice techniques in twentieth century piano pedagogy."[24] In the general music field, there is a small amount of quantitative research represented. The writings like those of Liperote, and Hiatt and Cross are focused on the aural skills classroom or instruments other than the piano.[25]

A possible explanation is the challenging nature of monitoring brain activity. Mental practice occurs most often without any visual or aural indication, requiring alternate forms of data input. Other career fields, such as aviation and engineering, have made progress in starting to determine reliable ways of understanding and measuring mental practice strategies and outcomes. The Vividness of Visual Imagery Questionnaire (VVIQ) and electroencephalograms are two examples of alternate data input, with the VVIQ being the most widely used.[26] The techniques used to harvest data, as well as the actual data harvested, could be extremely useful to the field of piano pedagogy as it seeks to better define, research, and utilize mental practice. The current literature on mental practice includes a limited body of empirical research, various terminologies that are often inconsistent, and limited development of the concepts and their application in music study. There is a need for an examination and codification of the terminology and

[24] Galvan.
[25] Hiatt and Cross; Liperote.
[26] Florian Jentsch, Clint Bowers, and Eduardo Salas, "Could Mental Practice and Imagery Be Techniques for Enhancing Aviation Performance?," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 41, no. 2 (October 1997): 1172–75, https://doi.org/10.1177/107118139704100210; Babak Mahmoudi and Abbas Erfanian, "Electro-Encephalogram Based Brain–Computer Interface: Improved Performance by Mental Practice and Concentration Skills," *Medical and Biological Engineering and Computing* 44, no. 11 (November 1, 2006): 959–69, https://doi.org/10.1007/s11517-006-0111-8.

definitions, and direct applications to piano pedagogy. This will contribute to the body of research and serve as a resource for future studies.

Limitations

This study was limited to an examination of current literature on mental practice. It examined terminology and its definitions, created a codification of the terminology, discussed the applications of the terminology in fields outside of music study, and suggested applications in the field of piano pedagogy. While other fields were examined, the study was limited to applications of mental practice in the field of piano pedagogy.

Literature Review

"Effects of Mental Practice, Physical Practice, and Knowledge of Results on Piano Performance" by Don D. Coffman and "Away from the Piano: Literature Review of the Role of Mental Practice" by Susan Mielke and Gilles Comeau are two resources that look extensively at the literature already available about mental practice in music and, when applicable, piano study specifically.[27] Coffman's document covers related literature in the broad base of general music up to 1987, and Mielke and Comeau's document examines recent literature. Although they are thorough in their reviews, they both suggest a deep need for further research on this topic, especially in the field of piano performance and pedagogy.

"The Effectiveness of Mental Practice in Improving the Performance of College Trombonists," by Stewart L. Ross, provides a summary of important literature regarding mental practice in the music profession.[28] The study involved testing college trombonists

[27] Coffman; Mielke and Comeau.
[28] Ross.

in five different variations of physical and mental practice. The study concluded that mental practice is effective, but Ross states that there are few studies directly concerned with controlled results in music performance. He also suggests that further research is necessary.

"A Comparative Investigation of Mental Practice Strategies Used by Collegiate-Level Cello Students" by Abigail McHugh-Grifa is a document that studies mental practice applied to violoncello players.[29] This study attempts to find quantifiable differences in the results of three varying types of mental practice: "1) silent, motionless mental practice, 2) singing/vocalizing, and 3) playing 'air cello.'" While the author concedes that the study was inconclusive in determining the differences of effectiveness in the three different kinds of mental practice, she concluded that the study supports the idea that mental practice can be as effective as physical practice.

A current article about mental practice is Scott McBride Smith's "Technique – Let's Get Physical: What Role Does Mental Preparation Play in Piano Technique?"[30] This short article covers a wide breadth of ideas, such as setting goals, positive self-talk, and visually rehearsing performances, and labels them all as mental practice. "PLAYING Healthy STAYING Healthy: Mental Skills And Music Performance: The Teacher's Role" by Vanessa Cornett combines wellness, such as positive self-talk, and visualization under the category of mental practice. While these articles offer helpful suggestions, they do not agree on exact definitions or contains results of qualitative research. Many articles being presented to independent piano teachers follow this similar pattern of varied

[29] McHugh-Grifa.
[30] Scott McBride Smith, "Technique - Let's Get Physical: What Role Does Mental Preparation Play in Piano Technique?," *Clavier Companion* 1, no. 2 (March 2009): 44.

definitions and no precise explanation of how and why mental practice works, as well as a lack of results of qualitative research.

In "Playing Your Best When It Counts," Bill Moore writes about the difference between mental practice in practicing and performing.[31] He suggests that mental preparation for these two modes of learning requires completely different approaches. The majority of the article is spent discussing how to mentally prepare for performance, but the beginning holds pertinent information regarding mental practice and why it is important.

"Mental Practice and Memorization of Piano Music" by Serene Lim and Louis G. Lippman is the only study found on mental practice in piano playing that concluded that mental practice was not effective.[32] In this study, college pianists were given ten minutes to memorize a selected portion of music. The students were tested with various styles of practice: physically playing, only looking at the score, and looking at the score while listening to the selection. The researchers concluded that mental practice in this way was not effective. This article should be considered in order to learn how to construct a better framework to measure the effectiveness of mental practice.

In "Learning Away from the Piano à La Gieseking," Larisa Soboleva presents a brief overview of Gieseking's approach to memorizing music via visualization.[33] As

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[31] Bill Moore and Jane Magrath, "Playing Your Best When It Counts," *American Music Teacher* 60, no. 3 (December 2010): 21–25.
[32] Serene Lim and Louis G. Lippman, "Mental Practice and Memorization of Piano Music," *Journal of General Psychology* 118, no. 1 (January 1991): 21–30, https://doi.org/10.1080/00221309.1991.9711130.
[33] Larisa Soboleva, "Learning Away from the Piano à La Gieseking," *Clavier Companion* 5, no. 6 (November 2013): 68–71.

visualization is a kind of mental practice, the practical steps and ideas in this article are useful to teachers seeking to incorporate mental practice into their students' lessons.

"Effects of Auditory and Motor Mental Practice in Memorized Piano Performance" by Zebulon M. Highben and Caroline Palmer outline a study that tested adult pianists with score study practice with and without physically playing the music and with and without auditory feedback.[34] The findings indicate auditory forms (instead of kinesthetic or physical) were most advantageous for learning new music.

A study conducted by Linda Ross Happy and William E. Fredrickson, called "The Effect of Mental Imaging Rehearsal on the Study of Black-Key Major Scales in a College Piano Class," focuses on determining whether or not mental practice is effective in learning black-key major scales.[35] College-age pianists were tested in the study—one third with physical practice, one third with mental practice, and one third with no practice. The authors determine that mental practice is effective, but inform of the need for further research to better determine the difference between the benefits of mental practice versus physical practice. A brief and concise overview of mental practice studies in music is included in this article.

Edwin Gordon's book *Learning Sequences in Music: A Contemporary Music Learning Theory* provides information on his definition and application of audiation.[36] Gordon defines audiation as "the process of assimilating and comprehending (not simply rehearsing) music momentarily heard performed or heard sometime in the past," as well

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[34] Zebulon M. Highben and Caroline (psychologist) Palmer, "Effects of Auditory and Motor Mental Practice in Memorized Piano Performance," *Bulletin of the Council for Research in Music Education,* no. 159 (2004): 58–65.
[35] Ross Happy and Fredrickson.
[36] Gordon.

as "assimilat[ing] and comprehend[ing] in our minds music we may or may not have heard but are reading in notation or composing or improvising."[37] Audiation is the basis for Gordon's child learning sequence.

"Could Mental Practice and Imagery Be Techniques for Enhancing Aviation Performance?" by Florian Jentsch, Clint Bowers, and Eduardo Salas, "Electro-Enchephalogram Based Brain-Computer Interface: Improved Performance by Mental Practice and Concentration Skills" by Babak Mahmoudi and Abbas Erfanian, and "Mental Imagery as a Design Tool" by Uday A. Athavankar are examples of studies examining mental practice in aviation, engineering, and design.[38] All three of these studies share the commonality of being early studies on mental practice in these fields and cite the need for further research. Both the findings and ideas for further research are useful in defining research on mental practice in the field of piano pedagogy. Mahmoudi and Erfanian also make the distinction between mental practice and mental practice training. They assert that to mentally practice well, one must learn and rehearse how to mentally practice. This idea may be very important in the research of mental practice in piano pedagogy.

In their article, "EEG Brain Activity in Dynamic Health Qigong Training: Same Effects for Mental Practice and Physical Training?" Diane Henz and Wolfgang I. Schöllhorn study the difference between physically partaking in the Qigong relaxation technique Wu Qin Xi and mentally rehearsing the technique with no physical

[37] Gordon, 3.
[38] Jentsch, Bowers, and Salas; Mahmoudi and Erfanian; Uday A. Athavankar, "Mental Imagery as a Design Tool," *Cybernetics and Systems* 28, no. 1 (January 1, 1997): 25–42, https://doi.org/10.1080/019697297126236.

movement.[39] They report that both physical and mental practicing activate the same part of the brain and are useful. This study, as well as others like it in the field of psychology, give credibility to the need for mental practice research in piano pedagogy.

Design and Procedures

The document is comprised of four chapters and a bibliography. Chapter one consists of an introduction, explanation, need for the study, literature review, limitations, and design and procedure of the study. Chapter two consists of an overview of mental practice in music as it relates to piano playing and codification of terms. Chapter three examines mental practice in other career fields. Chapter four describes practical implications and applications of mental practice in the field of piano pedagogy, and includes a summary and recommendations for further study.

[39] Diana Henz and Wolfgang I. Schöllhorn, "EEG Brain Activity in Dynamic Health Qigong Training: Same Effects for Mental Practice and Physical Training?," *Frontiers in Psychology*, accessed September 23, 2018, https://www.frontiersin.org/articles/10.3389/fpsyg.2017.00154/full.

CHAPTER 2

A BRIEF HISTORY OF MENTAL PRACTICE IN PIANO PEDAGOGY

There are multiple anecdotes in the history of piano playing about master performers learning music away from the keyboard. Jorge Bolet (1940-1990) is cited as having regularly mentally practiced, even stating that he ". . . never solved a major mechanical or interpretative problem at the keyboard. [He] always solved it in [his] mind."[40] Glenn Gould (1932-1982) used mental practice to overcome the challenges of concertizing in less-than-ideal conditions.[41] Walter Gieseking (1895-1956) is said to have had the ability to learn music while en route to a performance.[42] Franco-American composer E. Robert Schmitz (1889-1949) wrote about the importance of aural perception of music away from the score in his book *The Capture of Inspiration* (1935).[43] In her dissertation, "Kinesthetic Imagery and Mental Practice: Teaching Strategies for the Piano Principal," Mary Grace Galvan writes that Schmitz "is one of the first to link the process of mental practice to piano playing, acknowledging its participatory role in sight reading, interpretation, and tone production" and "laid the groundwork for twentieth-century inquiries into the importance of away-from-instrument practice."[44]

[40] Galvan, 51.
[41] Ibid.
[42] Soboleva, 68.
[43] Galvan, 35.
[44] Ibid., 51–52.

Mental practice in piano study has been discussed in magazines such as *American Music Teacher* and *Clavier Companion*. Scott McBride Smith wrote a technique column on mental preparation that included brief descriptions of audiation and visualization.[45] In "Your Musical Performance Abilities," Lesley Sisterhen lists several mental approaches found in sports psychology and suggests ways to implement them in piano study.[46] She includes the terms "imagery" and "mental practice," although they are treated as separate categories.[47] Heather Arden shares her personal journey about learning to memorize as an adult in her article, "My Quest for Successful Strategies."[48] She includes brief comments on "aural and visual memory" and "mental playing."[49] Vanessa Cornett comments on the importance of mental wellness in a student's life and practice time in her article, "Toward Integrated Teaching."[50] Ideas for teaching students to have habitual thought streams that help them perform their best are given in Terre L. Manno's article, "What Are They Thinking? The Key to Your Students' Best Performances."[51]

There are a limited number of online blogs that offer information on mental practice in music, the most notable of which are by Noa Kageyama, and Andrea Dow. Kageyama has written five blog posts on various aspects of mental practice on the

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[45] Smith.
[46] Lesley Sisterhen, "Enhancing Your Musical Performance Abilities," *American Music Teacher 54, no. 1 (August 2004): 32–35, 109.*
[47] Ibid., 34.
[48] Heather Arden, "My Quest for Successful Strategies," *Clavier Companion* 5, no. 4 (August 7, 2013): 38–41.
[49] Ibid., 40.
[50] Vanessa Cornett, "Toward Integrated Teaching," *Clavier Companion* 10, no. 4 (August 7, 2018): 46–47.
[51] Terrie L. Manno, "What Are They Thinking? The Key to Your Students' Best Performances," *Clavier Companion* 8, no. 3 (June 5, 2016): 22–25.

website Bulletproof Musician.[52] These articles range from anecdotes about personal mental practice experiences to conversational reports on mental practice research studies. On the Teach Piano Now website, Dow wrote a three-part article series on teaching away from the piano that included suggestions for score study and visualization.[53]

General research studies on mental practice date back to the early twentieth century, and numerous studies have discovered a positive correlation between mental practice and increased success at motor skills.[54] However, mental practice as it relates to piano playing—or even the general field of music—was not researched until the mid-twentieth century, and even then, there are few sources that deal with this pairing.[55] The first was a study conducted by Grace Rubin-Rabson in 1941, which focused on using

[52] Noa Kageyama, "Does Mental Practice Work?," Bulletproof Musician, August 14, 2009, https://bulletproofmusician.com/does-mental-practice-work/; Noa Kageyama, "How Effective Is Mental Practice, Really?," Bulletproof Musician, April 3, 2016, https://bulletproofmusician.com/how-effective-is-mental-practice-really/; Noa Kageyama, "Research Suggests That While Mental Practice Is Good, This Hybrid Approach Is Even Better," Bulletproof Musician, July 1, 2018, https://bulletproofmusician.com/research-suggests-that-while-mental-practice-is-good-this-hybrid-approach-is-even-better/; Noa Kageyama, "Learning Something New? Try This Mental Practice Tweak That Could Accelerate the Learning Process.," Bulletproof Musician, November 13, 2016, https://bulletproofmusician.com/learning-something-new-try-mental-practice-tweak-accelerate-learning-process/; Noa Kageyama, "Should You Be Using a Metronome When You Do Mental Practice?," Bulletproof Musician, November 18, 2018, https://bulletproofmusician.com/should-you-be-using-a-metronome-when-you-do-mental-practice/.

[53] Andrea Dow, "3 Ways to Practice Away From The Piano: Part 1," Http://Www.Teachpianotoday.Com/ (blog), July 22, 2014, https://www.teachpianotoday.com/2014/07/22/3-ways-to-practice-away-from-the-piano-part-1/.

[54] Mielke and Comeau, 9–10; Coffman, 18.

[55] Mielke and Comeau, 9–10.

visual imagery in the process of memorizing music and found a positive result.[56] In 1976, Lawrence Naai-Lei Lo conducted a study with similar focus and outcome.[57]

Don D. Coffman produced an in-depth analysis and study on mental practice in piano playing in his 1987 dissertation, "Effects of Mental Practice, Physical Practice, and Knowledge of Results on Piano Performance."[58] He concluded that even novice pianists could effectively use both mental practice and mental practice mixed with physical practice.[59]

In 1992, Mary Grace Galvan published her dissertation "Kinesthetic Imagery and Mental Practice: Teaching Strategies for the Piano Principal."[60] Her document is designed to provide practical strategies for non-piano major students to employ mental practice. She draws from sports psychology and theater movement artists to suggest strategies such as relaxation, self-talk, and thought stopping.[61] Galvan states that in music, kinesthetic imagery requires visual and aural imagery to promote cognitive learning.[62]

More specified studies on mental practice in music began to be conducted in the twenty-first century. In 2012, Susan Mielke and Gilles Comeau published a literature

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[56] G. Rubin-Rabson, "Studies in the Psychology of Memorizing Piano Music. VI: A Comparison of Two Forms of Mental Rehearsal and Keyboard Overlearning," *Journal of Educational Psychology* 32, no. 8 (1941): 593–602, https://doi.org/10.1037/h0058481.
[57] Lawrance Naai-Lei Lo, "The Effect of Visual Memory Training on the Ability to Memorize Music Within Class Piano Instruction." (D.Mus.Ed., Indiana University, 1976), http://search.proquest.com/pqdtglobal/docview/302812339/citation/5CB942B9511641D6PQ/1.
[58] Coffman.
[59] Ibid., 106–7.
[60] Galvan.
[61] Ibid., 24.
[62] Ibid., 1.

review that thoroughly examined nine of these sources.[63] Of particular interest is Zebulon M. Highben and Caroline Palmer's 2004 article, "Effects of Auditory and Motor Mental Practice in Memorized Piano Performance."[64] This study was conducted to determine what combination of physical versus non-physical practice and presence of auditory feedback versus absence of auditory feedback was most effective. The findings indicated that auditory forms of non-physical (mental) practice were most effective in learning new music. The authors note that their study differs from previous ones, such as those by Coffman and Ross, because it focused on a specific aspect of mental practice—auditory forms—rather than an "overall efficacy of mental practice in music performance."[65]

Mielke and Comeau reference two studies that surveyed the general comprehension and application of mental practice by experienced musicians.[66] These studies found that while almost all respondents "agreed with the definition of musical mental imagery as 'rehearsing music in your head,' multiple other definitions were given and there was no consensus on terms.[67] These studies also revealed that though participants indicated mental practice useful, they also suggested it the "least popular aspect of music learning," even though it has been shown to enhance preparation for performance.[68]

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[63] Mielke and Comeau, 11.
[64] Highben and Palmer.
[65] Highben and Palmer, 7.
[66] E. Haddon, "What Does Mental Imagery Mean to University Music Students and Their Professors?," *Proceedings of International Symposium of Performance Science*, 2007, 301–6; Fine et al., "Performing Musicians' Understanding of the Terms 'Mental Practice' and 'Score Analysis.'"
[67] Haddon, 303; Mielke and Comeau, 11.
[68] Mielke and Comeau, 11–12.

In 2005, Linda Ross Happy and William E. Fredrickson conducted a study that sought to determine whether or not mental practice was effective in learning black-key major scales.[69] The authors determined mental practice to be effective, but discussed the need for further research on differentiating the benefits of mental practice from physical practice.

Dan Cahn conducted a study in 2008 that compared two kinds of mental and physical practice combinations with only mental practice and only physical practice.[70] While the findings showed no significant difference between the groups, Cahn observed that successful mental practice is contingent on the difficulty of the task— if the task is too easy for the subjects, the results will not be significant.[71] This a possible factor for why his study did not show large variants in success. From this he concluded that a logical next step is to formulate a systematic approach for teaching mental practice skills.[72]

Peter Miksza and his colleagues also did not see significant difference between mental and physical practice in their study, "The Effect of Mental Practice on Melodic Jazz Improvisation Achievement." They list several potential explanations, including the difficulty of grading an improvisation, the possibility that mental practice is more useful to beginners than advanced musicians, and the fact that jazz musicians may already be

[69] Ross Happy and Fredrickson.
[70] Dan Cahn, "The Effects of Varying Ratios of Physical and Mental Practice, and Task Difficulty on Performance of a Tonal Pattern," *Psychology of Music* 36, no. 2 (April 1, 2008): 179–91, https://doi.org/10.1177/0305735607085011.
[71] Ibid., 189.
[72] Ibid., 189.

using mental practice as part of their fundamental learning strategy, rendering the results indistinguishable.[73]

The interrelationships between sightreading, performing rehearsed music, playing by memory, playing by ear, and improvising were studied by Gary E. McPherson, Michael Bailey, and Kenneth E. Sinclair. From their research they concluded that common practice skills that required aural imaging, such as playing from memory and composing, were "significantly correlated with the ability to play by ear and improvise."[74]

Nicolò Francesco Bernardi and his colleagues published a study in 2013 that was designed to create an open setting for musicians to use varying types of mental practice at their discretion in an attempt to discover how "different musicians use different [mental practice] strategies, with which results."[75] Overall they concluded that mental practice was less effective than physical practice, but found that the effectiveness of mental practice was most strongly influenced by the participants' experience with the process and execution of mental practice.[76]

In the same year, Nicolò Francesco Bernardi and another set of colleagues concluded from a study using motion capture equipment that mental practice aided in

[73] Peter Miksza, Kevin Watson, and Iantheia Calhoun, "The Effect of Mental Practice on Melodic Jazz Improvisation Achievement," *Psychomusicology: Music, Mind & Brain* 28, no. 1 (March 2018): 46–47, https://doi.org/10.1037/pmu0000206.
[74] Gary E. McPherson, Michael Bailey, and Kenneth E. Sinclair, "Path Analysis of a Theoretical Model to Describe the Relationship among Five Types of Musical Performance," *Journal of Research in Music Education* 45, no. 1 (1997): 105, https://doi.org/10.2307/3345469.
[75] Bernardi et al., 24.
[76] Bernardi et al., 24.

movement anticipation.[77] In another study 2013, Rachel M. Brown and Caroline Palmer discovered auditory imagery to have a positive impact on "pitch accuracy and vulnerability to interference."[78]

In 2007, Clemens Wöllner and Aaron Williamon analyzed the time it took pianists to aurally image a piece compared to the time it took for them to physically play the same piece in order to determine how accurately and clearly they were able to mentally rehearse.[79] The authors intent was to begin indexing ways to assess the quality of an individual's mental practice, which would then lead to systematic strategies for establishing mental practice.[80]

Definition and Codification of Terms

Across these studies and writings, multiple terms have been used. It is agreed that the general term "mental practice" refers to "the cognitive rehearsal of a task in the absence of overt physical movement."[81] However, many other terms have been used within the broad category of "mental practice," such as "guided imagery," "auditory imagery," "kinesthetic imagery," "visual imagery," "mental rehearsal," "meditation,"

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[77] Nicolò Francesco Bernardi et al., "Mental Practice Promotes Motor Anticipation: Evidence from Skilled Music Performance," *Frontiers in Human Neuroscience* 7 (2013), https://doi.org/10.3389/fnhum.2013.00451; Mielke and Comeau, 13.
[78] Mielke and Comeau, 19; Rachel M. Brown and Caroline Palmer, "Auditory and Motor Imagery Modulate Learning in Music Performance," *Frontiers in Human Neuroscience* 7 (2013), https://doi.org/10.3389/fnhum.2013.00320.
[79] Clemens Wöllner and Aaron Williamon, "An Exploratory Study of the Role of Performance Feedback and Musical Imagery in Piano Playing," *Research Studies in Music Education* 29, no. 1 (December 1, 2007): 51, https://doi.org/10.1177/1321103X07087567.
[80] Ibid., 51.
[81] Driskell, Copper, and Moran, 481.

"score study," "audiation," and "musical imagery."[82] For clarity during cross-discipline examination, the eight most common mental practice terms have been divided into four technique categories: Visualization (kinesthetic imagery and musical imagery), Aural (aural imagery and audiation), Psychological (mental wellness and guided imagery), and Hybrid (practice away from the piano and score study) (see Table 2.1).

Table 2.1 Organization of Terms

Visualization	**Aural**	**Psychological**	**Hybrid**
Kinesthetic Imagery Musical Imagery	Aural Imagery Audiation	Mental Wellness Guided Imagery	Practice away from the piano Score Study

Visualization Techniques

The idea of visualization—seeing with the mind's eye—is most well-known for its presence in sports psychology. In sports, visualization refers to the idea of mentally picturing or feeling motor movements without actually moving the body. For instance, a baseball player might imagine the perfect swing to help master his batting technique. Though visualization is heavily associated with sports training, it can be applied to any

[82] Coffman, 3; Driskell, Copper, and Moran, 481; Fine et al., 70; Christine Guptill and Christine Zaza, "Injury Prevention: What Music Teachers Can Do," *Music Educators Journal* 96, no. 4 (June 2010): 31; Jentsch, Bowers, and Salas, 1172; William J. Hochkeppel, "Systematic Score Study: Effects of Four Methodologies on Error Detection Achievement in Instrumental Conducting Students" (D.M.E. diss., Indiana University, 1993), 13, http://search.proquest.com/pqdtglobal/docview/304037178/abstract/B51A53CEEC1E4347PQ/2; Mielke and Comeau, 4; Ross Happy and Fredrickson, 20.

mental practice technique that uses an image created within the mind. In music, the two primary kinds of visualization are *kinesthetic imagery* and *musical imagery*.

Kinesthetic Imagery

Kinesthetic imagery, sometimes referred to as "motor imagery," is the cognitive ability to perform and sense motor movements within the mind without any external muscular movement. This is the kind of visualization that is most closely associated with sports psychology.[83]

Musical Imagery

According to Edwin Gordon, *musical imagery* "suggests a vivid or figurative picture of what music might represent."[84] *Musical imagery* uses extra-musical ideas to enhance character, interpretation, flow, understanding, and unification in practice and performance. Other sources used to develop artistry may include emotions, landscapes, non-musical sounds, instruments, movement, or other fine arts such as art, dance, and literature—the possibilities are endless. Using *musical imagery* can help students conceptually organize formal structures, emotionally connect to musical ideas, inform their articulation and dynamic choices, and help them play with greater sensitivity.

Aural Techniques

While research on *kinesthetic imagery* in sports psychology can be helpful to musicians, music adds an important second component to physical movement that sports does not—organized sound output. Where visualization techniques deal primarily with the mind's eye, aural mental practice techniques deal with the mind's ear. Because it is

[83] Coffman, 21.
[84] Gordon, 4.

chiefly concerned with muscular movement, *kinesthetic imagery* often does not effectively encourage intellectual or cognitive learning, but aural forms of mental practice can and do.[85] The two primary kinds of aural mental practice techniques discussed in related literature are *aural imagery* and *audiation*.

Aural Imagery

Aural imagery refers to the ability to hear sound in the mind without hearing external auditory feedback. This is similar to mentally hearing one's own voice. Bernardi and colleagues found *aural imagery* was "the most important and predictive single strategy our subjects could apply while mental practicing."[86] Highben and Palmer make the observation that while other studies have shown the overall effectiveness of musical mental practice in general, their study shows that auditory forms in particular are most effective in helping students learn new music.[87] In another study, Steve Oare discusses how students' ability to create an accurate aural image is directly linked to their ability to read music.[88] Their capability to create an aural image also helped determine their practice strategies (what and how to practice), impacted how accurately and fluently they played their music, and influenced how well they were able to assess their own performance.[89] Further, both Highben and Oare suggest that a student's ability to access and utilize an aural picture may be a distinguishing factor in terms of skill level—much in the same way that *kinesthetic imagery* is for athletes.[90]

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[85] Galvan.
[86] Bernardi et al., 25.
[87] Highben and Palmer, 7.
[88] Oare, 39–40.
[89] Ibid., 41.
[90] Highben and Palmer, 1; Oare, 41.

Audiation

Aural imagery is closely associated with *audiation*, but while it is true that the capability to produce an aural image is vital to the *audiation* process, *aural imagery* and *audiation* are not synonymous. The practice of *aural imagery* deals with the basic ability to conjure sound in one's mind, whereas individuals who employ *audiation* are organizing and understanding that "imaginary sound." Gordon, the developer of this term, described *audiation* as "the process of assimilating and comprehending (not simply rehearsing) music momentarily heard performed or heard sometime in the past," as well as "assimilat[ing] and comprehend[ing] in our minds music we may or may not have heard but are reading in notation or composing or improvising."[91] Where *aural imagery* may encourage a student to have a general sense of understanding (of gesture, overall shape, general feeling), *audiation* is used to help students understand the components of music and how they interplay (tonality, keyality, rhythm, form, etc). *Audiation* is more accurately labeled a learning strategy—a theory applied to the entire process and philosophy of childhood education that has clear goals and benchmarks—rather than a practice strategy—one of many techniques used in combination for effective practice, but with no strict linear progression. Still, the ideas associated with *audiation* (thinking critically about the music and aurally understanding the structure) are helpful in achieving successful mental practice.

One of the biggest benefits of *audiation* is that when musicians are audiating well, what they are hearing is more prominent in the mind than how they are moving.[92] If a

[91] Gordon, 3.
[92] Gordon, 6.

student is more focused on creating a particular sound or harmonic progression, technical challenges that may have hindered their playing are overcome without conscious awareness. In essence, their bodies naturally overcome technical challenges for the sake of keeping up with the ear.

Psychological Techniques

While visualization techniques are concerned with the mind's eye and aural techniques are concerned with the mind's ear, psychological techniques are concerned with the mind itself. Being aware of how the mind is thinking, what the mind is feeling, and how the mind is adapting are central concepts in the psychological realm of mental practice. These practice techniques deal chiefly with personal awareness, flexibility of the mental process, and healthy thinking patterns. The primary psychological mental practice strategies discussed in music literature are *mental wellness* and *guided imagery*.

Mental Wellness

Mental wellness is concerned with the state of an individual's mind while practicing and performing. Vanessa Cornett, in her article, "Playing Healthy Staying Healthy," discusses the mental strain performance can have on a musician.[93] Because of long practice hours, an often-competitive atmosphere, high-pressure performance situations, and refined motor skills, musicians can often leave practice session with "stress, anxiety, self-doubt, destructive criticism and depression."[94] Cornett suggests that *mental wellness* skills such as positive self-talk, goal setting, self-awareness, mindfulness, and life balance can help students manage the negative feelings and mindsets associated

[93] Vanessa Cornett, 28.
[94] Ibid.

with practice.[95] Since positive mindsets are often not the natural reaction to stressors, these strategies must be practiced regularly so that they become habits and patterns of life. The goal is a consistently healthy state of mind, even under stressful conditions.

Guided Imagery

Guided imagery, according to Christine Guptill and Christine Zaza, is the process of "imaging oneself going through all the steps in a performance, right through to a successful result."[96] It is conceptualizing your own body moving, thinking, and feeling in a hypothetical performance situation. It is also a synthesis of *kinesthetic imagery*, *aural imagery*, *audiation*, and *mental wellness*. Students must imagine what it feels like and looks like to play (*kinesthetic imagery*), imagine the sound they are producing (*aural imagery*), test their understanding and memory of the music with no auditory feedback (*audiation*), and remain self-aware and sensitive to their mental/emotional state (*mental wellness*). Because of these layers, *guided imagery* requires significant concentration, and is a learned practice.

If well executed, *guided imagery* can greatly enhance performance confidence and decrease performance anxiety, as well as improve quality of focus.[97] There are many possible focal points for *guided imagery*, such as state of mind (calm, nervous, excited, focused, distracted), movement of arms (tension, efficiency, hand distances, close to keyboard or far away), self-talk (what is the inner commentary), performance setting (bright lights, full audience, dry room), error-free performance (hearing/anticipating error

[95] Ibid., 29.
[96] Guptill and Zaza, 31.
[97] Ibid., 31.

free playing to solidify memory and bolster confidence), and keyboard awareness (imagining keyboard layout, fingers on keyboard).

Hybrid Techniques

The last category includes mental practice techniques that do not occur entirely within the mind. While there is still a large component of the practice conducted within the mind, these techniques also use some other "outside" source to assist the "inside" practice. The two hybrid techniques discussed in this section are *physical practice away from the instrument*, and *score study*.

Physical Practice Away from the Instrument

Physical practice away from the instrument involves practicing motor movements without auditory feedback. Practicing in this way can help students focus on physical issues (such as tension) and encourage the development of *aural imagery* and *audiation* (students should mentally "fill in" the sound they are used to hearing, otherwise this is simply a rote physical exercise). Research has shown it has also led to enhanced memory in performance.[98] This kind of practice may occur on the fallboard of the piano, at a table, on one's knees, at a "dummy" keyboard that produces no sound, or elsewhere.

Score Study

Score study entails any visual examination of a score that is not accompanied by a physical realization of the music. This can be done in small segments at the instrument in between physical practice sessions or in larger segments away from the instrument. Elements studied can include form, articulation, harmonic analysis, phrases, or any written text. Singing, *aural imaging*, *audiation*, *kinesthetic imagery* and *physical practice*

[98] Bernardi et al., 25.

away from the instrument can all be employed during *score study*. *Score study* enhances students' analytical understanding of the music, encourages organization, boosts confidence, strengthens memory, and increases attention to details.

CHAPTER 3

MENTAL PRACTICE IN OTHER CAREER FIELDS

Psychology

Diane Henz and Wolfgang I. Schöllhorn studied the difference between physically partaking in the Qigong relaxation technique Wu Qin Xi and kinesthetically imaging the technique with no physical movement.[99] By observing brain activity through electroencephalograms (EEGs), they determined that both physical practice and *kinesthetic imagery* activate the same part of the brain and are useful. This gives credibility to the process of kinesthetic imaging and shows it can be effective in the same ways as physical practice. The authors also studied eyes-open verses eyes-closed *kinesthetic imagery*, finding benefits to both. In addition, the authors write that in closed-eyes scenarios, "internalized attention might be reached more easily when attention and breathing behavior is guided by movements" in techniques such as Wu Qin Xi or those found in Buddhist meditation.[100]

"Predicting and Understanding Mental Practice" was written by David Trafimow and Andy Miller, who sought to apply the Theory of Reasoned Action to mental

[99] Diana Henz and Wolfgang I. Schöllhorn, "EEG Brain Activity in Dynamic Health Qigong Training: Same Effects for Mental Practice and Physical Training?," *Frontiers in Psychology* 8 (2017), https://doi.org/10.3389/fpsyg.2017.00154.
[100] Ibid.

practice.[101] This theory suggests that "behavior is determined by. . . intentions," "intentions are determined by attitudes," and "attitudes are determined by behavioral beliefs."[102] The authors tested this theory with members of a college football team, and results indicated that the players' beliefs about mental practice directly correlated to their positive attitudes, intentions, and execution of mental practice.[103] In addition, the researchers found that positive beliefs (such as mental practice supplying relaxation or focus) positively affected attitude while normative manipulations (such as disappointing an authority figure) did not.[104]

Erica L. Wohldmann and associates conducted a study to determine the differences between mental practice and physical practice in skill transfer and presence of retroactive interference.[105] The two experiments conducted involved participants typing in a set of four-digit numbers in various combinations and with differing hands.[106] This study used *kinesthetic imagery* primarily, though the instructions given orally to participants were reminiscent of *guided imagery*. The authors clarified both to participants and readers that first-person imagery was necessary for optimal effectiveness.[107] Participants first typed the number combinations with the same hand,

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[101] David Trafimow and Andy Miller, "Predicting and Understanding Mental Practice," *Journal of Social Psychology* 136, no. 2 (April 1996): 174, https://doi.org/10.1080/00224545.1996.9713991.
[102] Trafimow and Miller, 174.
[103] Ibid., 173.
[104] Ibid., 178.
[105] Erica L. Wohldmann, Alice F. Healy, and Lyle E. Jr. Bourne, "A Mental Practice Superiority Effect: Less Retroactive Interference and More Transfer than Physical Practice," *Journal of Experimental Psychology: Learning, Memory, and Cognition* 34, no. 4 (July 2008): 823–33, https://doi.org/10.1037/0278-7393.34.4.823.
[106] Ibid., 824.
[107] Ibid., 826.

leading to perfect execution by both physical and mental practice groups. Next, they typed the same combinations with the opposite hand, and the physical practice group experienced "significant forgetting" and "no evidence of transfer of previously acquired ... skill" when response conditions were altered.[108] Conversely, the mental practice group maintained perfect execution during the modified response situation, suggesting that *kinesthetic imagery* can lead to better skill transfer.[109] This study displayed a circumstance where mental practice was superior to physical practice.[110]

Mackenzie Sunday and colleagues designed a study to test if vividness of visual imagery was positively affected by domain-specific expertise, or if vividness was a domain-general construct.[111] The clarity of mental imagery could affect *kinesthetic imagery*, *musical imagery*, and *guided imagery*. The authors conducted the study around persons with automobile knowledge, and concluded that experts in a field are not necessarily able to create a clearer mental image than persons outside of their field.[112] They note that analyzing the quality of one's own visual imagery compared to someone else's is virtually impossible, and this could affect the ability to distinguish the clarity of an expert's visual imagery versus that of a non-expert.[113] They suggest further research

[108] Wholdmann, Healy, and Bourne, 827.
[109] Ibid.
[110] Ibid., 832.
[111] Mackenzie Sunday, Rankin W. McGugin, and Isabel Gauthier, "Domain-Specific Reports of Visual Imagery Vividness Are Not Related to Perceptual Expertise," *Behavior Research Methods* 49, no. 2 (April 2017): 733, https://doi.org/10.3758/s13428-016-0730-4.
[112] Ibid., 737.
[113] Ibid.

using functional magnetic resonance imagery (fMRI) to measure neural signals during visual imagery to better determine if experts have superior vivid imagery skills.[114]

In 1991, Karin E. Hinshaw conducted meta-analysis over twenty-one empirical research studies on the effects of mental practice on motor skills.[115] Her main findings were that mental practice had more effect than no practice, and both "imaginal style" and length of time spent mentally practicing affected the quality of the outcome. Internal imagery was more effective than external imagery, and practice time of less than one minute or between ten and fifteen minutes was ideal.[116] She concluded that there is "complexity of the relationships between variables that influence the effectiveness of mental practice."[117]

Engineering

Dirk C. Prather, and Florian Jentsch and colleagues conducted studies concerning imagery in aviation.[118] Prather concludes from his 1973 research that *guided imagery* combined with physical practice is more effective "when learning a perceptual motor skill" than physical practice alone.[119] He implies that *guided imagery* could be useful in training individuals in fields where training resources are sparse or expensive.[120] Jentsch et al. surveyed pilots in 1997 to determine the potential usefulness of mental practice in

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[114] Ibid.
[115] Karin E. Hinshaw, "The Effects of Mental Practice on Motor Skill Performance: Critical Evaluation and Meta-Analysis:," *Imagination, Cognition and Personality* 11, no. 1 (1991): 3–35, https://doi.org/10.2190/X9BA-KJ68-07AN-QMJ8.
[116] Ibid., 3.
[117] Ibid., 27.
[118] Dirk C. Prather, "Prompted Mental Practice as a Flight Simulator," *Journal of Applied Psychology* 57, no. 3 (June 1973): 353–55, https://doi.org/10.1037/h0034711; Jentsch, Bowers, and Salas.
[119] Prather, 354.
[120] Ibid.

aviation by discovering if and how it was already being used.[121] The responses indicated that pilots used more internal than external imagery, reported more vivid imagery skills than the general population, and were more likely to engage in mental imagery the more experience they had in their field.[122] The authors mention that first-person imagery (participants seeing themselves as the subject, seeing out of their own eyes, feeling in their own muscles) has been found more effective than third-person imagery (participants observing themselves from afar).[123] They suggest educating "rookies" on mental practice may be beneficial in earlier development of this framework.[124]

A study by Anders Meland and colleagues tested the effects of mindfulness-based mental training on Norwegian military airmen.[125] The authors identified mindfulness as, "paying attention in a particular way, on purpose, in the present moment, and nonjudgmentally."[126] This is a form of *mental wellness*. Over a twelve-month period, participants attended three-hour plenary sessions every three weeks that included lectures on why and how mindfulness could be helpful, yoga, body scan awareness, and sitting meditation.[127] Participants were also instructed to conduct mindfulness exercises individually. At the end of the study, participants had better self-regulation of attention and less somatic anxiety.[128] The authors conclude that mindfulness training could be a

[121] Jentsch, Bowers, and Salas, 11.
[122] Jentsch, Bowers, and Salas, 1174–75.
[123] Ibid., 1174
[124] Ibid., 1175.
[125] Anders Meland et al., "Mindfulness-Based Mental Training in a High-Performance Combat Aviation Population: A One-Year Intervention Study and Two-Year Follow-Up," *International Journal of Aviation Psychology* 25, no. 1 (January 2015): 48, https://doi.org/10.1080/10508414.2015.995572.
[126] Ibid.
[127] Ibid., 50.
[128] Ibid., 58.

useful tool for persons in high-performance environments, but that more research is needed regarding effectively implementing it and measuring its effects.[129]

A study by Michael Kalicinksi, Otmar Bock, and Nadja Schott was conducted to determine if astronaut trainees could use *kinesthetic imagery* to practice body movements only possible in anti-gravity situations.[130] To test accuracy of imagery, they used the Controllability of Motor Imagery Test, which has "subjects generate and manipulate imagined postures of body parts in response to verbal instructions, and afterwards assume the final imagined body position."[131] The researchers concluded that a quicker response indicated a more accurate mental image and that previous experience with the conditions (such as anti-gravity) could help maximize effectiveness.[132]

Tim Bauerle, Michael J. Brnich, and Jason Navoyski conducted a study on coal miners to determine if "virtual mental practice in maintenance task training" was effective.[133] While the author's definition of mental practice is broad, it most closely relates to *kinesthetic imagery*. The authors developed a computer software that served as a replacement for hands-on training in assessing adequacy of below-ground breathing devices by simulating the inspection process. The inspection process is known as "benching."[134] The authors note that benching is both a motor skill (physical movement)

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[129] Ibid., 59.
[130] Michael Kalicinski, Otmar Bock, and Nadja Schott, "Motor Imagery of Body Movements That Can't Be Executed on Earth," *Journal Of Vestibular Research: Equilibrium & Orientation* 27, no. 4 (2017): 217–23, https://doi.org/10.3233/VES-170621.
[131] Ibid., 218.
[132] Ibid., 221.
[133] Tim Bauerle, Michael J. Brnich, and Jason Navoyski, "Exploring Virtual Mental Practice in Maintenance Task Training," *Journal of Workplace Learning* 28, no. 5 (July 11, 2016): 294, https://doi.org/10.1108/JWL-10-2015-0078.
[134] Ibid., 295.

and a cognitive skill (processing and applying information, procedural knowledge).[135] They write that mental practice may need an interactive component for it to be most useful for "complex cognitive and psychomotor tasks," especially if external imagery is involved.[136] The authors also discuss the problems with traditional hands-on training, including cost and time demands.[137] Participants experienced a 45-60 minute training session on the developed mental practice software.[138] They had positive reactions to the training and indicated that they perceived it as useful for supplementing traditional training.[139] The results, though preliminary, suggest support for pairing mental practice with an interactive virtual component.[140] The study relied on personal feedback from participants, and therefore a lack of tested transfer to performance was a significant limitation of the study.[141]

Babak Mahmoudi and Abbas Erfanian conducted a study crafted to test the effects of *kinesthetic imagery* on improving the accuracy of EEG-based brain computer interfaces (BCIs).[142] Their research demonstrated that *kinesthetic imagery* did improve the accuracy in communication between the human brain and a computer.[143] These results were obtained by emphasizing clarity in image by experiencing the actual physical action (opening and closing the hand) before mental imaging (*kinesthetic imagery*) and by training the participants in mental relaxation and concentration strategies (*mental*

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[135] Bauerle, Brnich, and Navoyski, 296.
[136] Ibid., 298.
[137] Ibid., 297.
[138] Ibid., 300.
[139] Ibid., 301.
[140] Ibid., 303.
[141] Ibid.
[142] Mahmoudi and Erfanian, 959.
[143] Ibid., 968.

wellness).[144] Another study by Erfanian related to using EEG-based BCIs found similar results.[145]

Business

In a study conducted by Lucie Morin and Gary P. Latham, supervisors in a pulp and paper mill were tested to see if *guided imagery* combined with goal setting was effective in promoting self-efficacy and implementing new communication skills on the job.[146] A holistic approach to *guided imagery*, including engaging all of the senses, was used to help participants create a mental plan for achieving the set goals.[147] The study revealed three main outcomes: 1) guided imagery is an effective tool for transferring self-efficacy from the learning environment to the performance environment (in this case, classroom to job), 2) effectiveness of *guided imagery* is dependent on the participants' imagery abilities, and 3) goal setting, on its own, may not be effective in transferring skills.[148] The authors also write that *guided imagery* may engage three of the main indicators of self-efficacy—"mastery, self-modeling, and self-guided verbal persuasion"—by serving as a figurative way of experiencing these attributes, thus

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[144] Mahmoudi and Erfanian, 960.
[145] A. Erfanian and A. Erfani, "ICA-Based Classification Scheme for EEG-Based Brain-Computer Interface: The Role of Mental Practice and Concentration Skills," in Conference Proceedings. 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 1-5 Sept. 2004, vol. Vol.1, *Conference Proceedings. 26th Annual International Conference of the IEEE Engineering in Medicine and Biology Society* (IEEE Cat. No.04CH37558) (IEEE, 2004), 235–38.
[146] Lucie Morin and Gary P. Latham, "The Effect of Mental Practice and Goal Setting as a Transfer of Training Intervention on Supervisors' Self-Efficacy and Communication Skills: An Exploratory Study," *Applied Psychology: An International Review* 49, no. 3 (July 2000): 566.
[147] Ibid., 568.
[148] Ibid., 574–75.

positively affecting an individual's self-efficacy.[149] According to their findings, the authors state that mental practice "may be an optimal way to facilitate the discovery of strategies for attaining a learning goal, and hence mastering the task."[150]

Medicine and Rehabilitation Services

Marina Yiasemidou and her colleagues conducted a study to determine if *kinesthetic imagery* with 3D visual aids enhanced surgical performance.[151] The authors set up three groups to experience a 25-minute preparation session before performing a given surgical procedure.[152] The first group kinesthetically imagined with a step-by-step text guide and an interactive 3D model to reference, the second group kinesthetically imagined with a step-by-step text guide but no interactive 3D model to reference, and the third group watched an educational video of the procedure and served as the control. The study revealed that the control group took more time to conduct the procedure and made more movements than both mental practice groups, indicating that *kinesthetic imagery* heightened efficiency.[153] The authors also suggest that *kinesthetic imagery* with 3D-modeling enables participants to better apply problem-solving strategies to a wider range of issues, rather than only direct comparisons as with *kinesthetic imagery* alone.[154]

In a rehabilitation study that tested the cerebral and cerebellar sensorimotor plasticity resulting from physical practice, mental practice (*kinesthetic imagery*), and no

[149] Moran and Latham, 575.
[150] Ibid., 576.
[151] Marina Yiasemidou et al., "Mental Practice with Interactive 3D Visual Aids Enhances Surgical Performance," *Surgical Endoscopy* 31, no. 10 (October 1, 2017): 4111–17, https://doi.org/10.1007/s00464-017-5459-3.
[152] Ibid., 4111.
[153] Ibid.
[154] Ibid., 4115.

practice, Michael Lacourse and his colleagues found that "while the pattern of functional plasticity is similar following [physical practice] in a subset of the sensorimotor structures . . . an alternative neuronal substrate exists that is affected by [*kinesthetic imagery*] and not by [physical practice]."[155] In its basic form, this means that there is a part of the brain that is affected specifically by mental practice, not physical practice.

A study in rehabilitation of chronic stroke survivors conducted by Stephen J. Page and his colleagues revealed that mental practice (a combination of *mental wellness* and *guided imagery*) was more effective in twenty-minute increments three times a day than in a sixty-minute session once a day.[156] The stroke survivors saw more reduction in upper extremity limitation with the more frequent sessions.[157]

Numerous other studies have researched using mental practice as rehabilitation for individuals who have suffered from a stroke. Techniques in these studies include mirror therapy, virtual reality mirror therapy, augmented reality, and BCI-driven hand exoskeletons.[158] These resources primarily deal with individuals who have suffered

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[155] Michael G. Lacourse et al., "Cerebral and Cerebellar Sensorimotor Plasticity Following Motor Imagery-Based Mental Practice of a Sequential Movement," Journal of Rehabilitation Research & Development 41, no. 4 (August 7, 2004): 519.
[156] Stephen Page, Erinn Hade, and Juan Pang, "Retention of the Spacing Effect with Mental Practice in Hemiparetic Stroke," *Experimental Brain Research* 234, no. 10 (October 2016): 2841–47, https://doi.org/10.1007/s00221-016-4686-5.
[157] Ibid., 1.
[158] Anirban Chowdhury et al., "Active Physical Practice Followed by Mental Practice Using BCI-Driven Hand Exoskeleton: A Pilot Trial for Clinical Effectiveness and Usability," *IEEE Journal of Biomedical and Health Informatics* 22, no. 6 (2018): 1786–95, https://doi.org/10.1109/JBHI.2018.2863212; Andrea Gaggioli et al., "Computer-Guided Mental Practice in Neurorehabilitation," in Advanced Technologies in Rehabilitation: Empowering Cognitive, Physical, Social and Communicative Skills Through Virtual Reality, Robots, Wearable Systems and Brain-Computer Interfaces, vol. 145, *Studies in Health Technology and Informatics* (IOS Press, 2009), 195–208, https://doi.org/10.3233/978-1-60750-018-6-195; J.A. Lozano et al., "VR-Mirror: A Virtual Reality System for Mental Practice in Post-Stroke Rehabilitation," in Smart

traumatic brain injuries. Because this document is primarily intended to provide an overview of mental practice strategies for generally healthy individuals, these resources will not be reviewed in further detail; however, it could potentially be useful to reference this research in regards to injured musicians.

Sports

K. Richard Ridderinkhof and Marcel Brass wrote an article with the intent of observing *kinesthetic imagery* in sports from a neurophysiological perspective.[159] In this article, they estimate that 70 to 99% of elite athletes now use *kinesthetic imagery* in their training.[160] The authors suggest *kinesthetic imagery* often distinguishes between amateur and elite athletes based on how strongly the benefits—acquisition of kinesthetic skills, the maintenance and memory of already acquired skills, confidence in executing skills, and forming a relaxed technique—affect the individual athlete. The main idea argued in the body of this article is that *kinesthetic imagery*

> is based on the activation of an anticipatory image of the sensory consequences of action. The activation of this motor representation leads to an internal emulation process of the planned motor act that has a high degree of similarity to the actual motor output.[161]

This means that when an individual kinesthetically imagines an action, the brain is anticipating the sensory responses that correspond with that action—in essence, the brain is pre-feeling the action just as it would before an actual movement. The "internal

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Graphics. 5th International Symposium, SG 2005. Proceedings, 22-24 Aug. 2005, (Springer-Verlag, 2005), 241–51; Tamise Aguiar Caires et al., "Immediate Effect of Mental Practice with and without Mirror Therapy on Muscle Activation in Hemiparetic Stroke Patients," *Journal Of Bodywork And Movement Therapies* 21, no. 4 (October 2017): 1024–27, https://doi.org/10.1016/j.jbmt.2016.12.010.

[159] Ridderinkhof and Brass.

[160] Ibid., 54.

[161] Ibid., 62.

emulation" that proceeds is therefore much like physically completing the action. The authors explain this by stating that the parts of the brain that deal with *kinesthetic imagery* and actual motor movement are "highly overlapping but not identical."[162] This means that the process of imaging can be transferred to actual motor movement, and practicing imagery can enhance motor performance.

A study by Cornelia Frank and colleagues tested a group of twenty-four skilled futsal players to determine if *guided imagery* could enhance their functional structure of team-level tactics.[163] Futsal is a sport similar to soccer, played on a hard-surface court. For four weeks, players continued to practice futsal normally, while also engaging in *guided imagery* session three times a week. The first session served as an introduction to the new tactic, the second session was a *guided imagery* exercise led by an instructor, and the third session was the same *guided imagery* exercise, but completed without an instructor.[164] The study revealed that *guided imagery* training enhanced the players' ability to accurately represent tactical skills in their minds.[165] The authors observed that after this four-week intervention concepts of the same kind were mentally more closely related and concepts of different kinds were more distinctly differentiated.[166] They also concluded that repetition appears necessary to use *guided imagery* successfully.[167] The study did not determine if these findings would result in a more successful team

[162] Ridderinkhof and Brass, 62.
[163] Cornelia Frank et al., "Team Action Imagery and Team Cognition: Imagery of Game Situations and Required Team Actions Promotes a Functional Structure in Players' Representations of Team-Level Tactics," *Journal Of Sport & Exercise Psychology* 40, no. 1 (February 1, 2018): 20–30, https://doi.org/10.1123/jsep.2017-0088.
[164] Ibid., 24.
[165] Ibid., 27.
[166] Ibid.
[167] Ibid.

performance, but, the authors suggest that further research could reveal positive performance results.[168] The authors note that the imagery measuring tool they used did not distinguish between kinds of mental imagery or specific participants' imagery abilities.[169] They also suggest that further research specified to particular "sports, skill levels, and age groups," is needed "to most effectively design imagery training."[170]

Music and Other Performing Arts

Gir¢n, McIsaac, and Nilser conducted a pilot study to test the efficacy of *kinesthetic imagery* on two dance movements.[171] While the sample size was small, the results support the theory that the benefits of kinesthetic imagery differ depending on the task.[172] This suggests that some tasks are better suited to mental practice than others. The authors proposed further study on this topic, stating that it could be a "valuable technique" to "prevent chronic injuries due to kinetically hazardous alignment."[173]

Observing the imagery-measuring devices in other career fields, such as the Sports Imagery Questionnaire, Sanna M. Nordin and Jennifer Cumming designed a dance-specific measuring tool called the Dance Imagery Questionnaire (DIQ).[174] The authors note that a questionnaire particularly for dance, rather than just sports or exercise,

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[168] Frank, et al., 27.
[169] Ibid.
[170] Ibid., 28.
[171] Elizabeth Coker Gir¢n, Tara McIsaac, and Dawn Nilser, "Effects of Kinesthetic Versus Visual Imagery Practice on Two Technical Dance Movements: A Pilot Study," *Journal of Dance Medicine & Science* 16, no. 1 (February 2012): 36–38.
[172] Ibid., 37.
[173] Ibid., 38.
[174] Sanna M. Nordin and Jennifer Cumming, "Measuring the Content of Dancers' Images Development of the Dance Imagery Questionnaire (DIQ)," *Journal of Dance Medicine & Science* 10, no. 3/4 (May 2006): 85.

was needed due to the unique components of dance.[175] More than physical movement alone, dance incorporates cognitive and artistic elements that require specific training, and therefore the field needed an imagery-measuring tool that could adequately incorporate all aspects.[176] The end result was a questionnaire that examined what kinds of imagery dancers employ in order to help further mental practice research.[177] Tested three times for efficacy, the questionnaire already revealed that imagery is associated with confidence.[178]

Uday A. Athavankar conducted a study regarding mental imagery as a design tool.[179] Typically, designers use sketching to problem-solve and create products. In this experiment, Athavankar blindfolded a designer and instructed the participant to use mental imagery instead of sketching. The participant had to manipulate the mental image according to the problems given by the experiment administrator. At the end, the participant was instructed to sketch his mental image as quickly as possible.[180] Athavankar observed that the participant was able to complete the task with ease.[181] He concluded that because design relies on sketching, the field has not yet completely realized the potential value in visualization displayed in this study.[182] He also noted that imaging appears to be "particularly useful in dealing with creative tasks that are ill-structured and also require controlled processing."[183]

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[175] Nordin and Cumming, 86.
[176] Ibid.
[177] Ibid., 97.
[178] Ibid.
[179] Athavankar.
[180] Ibid., 29–30.
[181] Ibid, 33.
[182] Ibid., 34.
[183] Ibid.

Score study is considered an essential skill for all conductors, primarily so that they are able to plan rehearsals effectively.[184] A famous 19th century conductor, Hans von Bülow, said a conductor should have "the score in the head rather than the head in the score."[185] In a document that surveys numerous conducting texts that include comments on *score study*, William J. Hochkeppel notes that "score study involves the combined aural-visual skills required to relate the written score and the sounds it represents."[186] This explanation is important as the term "score study" is sometimes substituted with "score reading" in conducting texts. Hochkeppel writes that this can be misleading, as "score reading" can mean a variety of things for different instrumentalists, such as orchestral score reduction for pianists.[187] Other texts apply the term "score study" to knowing how to read the contents of a score (clefs, instruments, etc.) and consider "silent score study" (and the aural component it implies) a separate skill.[188] While conducting texts tend to focus primarily on the physical components of conducting, many include strategies for *score study* as it is defined in this document. Note that though this survey covers numerous *score study* subjects found in well-known conducting texts, it is not comprehensive, and other conducting texts may be used as supplements.

Emil Kahn includes two brief chapters on the process of *score study* in his book *Elements of Conducting*. In the first chapter, he asserts that "a good conductor must be able to read a score like a book: the better his ear, the greater his mastery over his

[184] Hochkeppel, 1.
[185] Peter Paul Fuchs, *The Psychology of Conducting* (New York: MCA Music, 1969), 26.
[186] Hochkeppel, 14.
[187] Ibid., 27.
[188] Ibid., 30.

orchestra."[189] Kahn suggests students should learn to read a score with their inner ear by utilizing Bach's two- and three-part inventions.[190] With no instrument aid, the student should mentally read the top voice for eight measures until they have it memorized. Next, they should mentally read the bottom line. Finally, the two lines should be combined together so that they are both being "heard" by the inner ear at the same time. Kahn suggests that if there are three voices, the top and the bottom lines should be memorized before reading the inner line.[191] He states that, with enough practice of this technique, the student will be able to read multiple voices without having to memorize any of them. He suggests that once students master Bach inventions, they can move on to Bach fugues, Haydn string quartets, and Haydn and Mozart symphonies.[192] Kahn also states that both students with excellent ears and weak ears should practice in this way, as it will allow them to better identify when wrong notes are played and by which instrument.[193] The second chapter on *score study* in Kahn's text includes transposing instruments, score reading at the piano, and writing condensed scores, of which he says, "when the student has learned to write well-organized condensations he will be better equipped to visualize the full score, and thus gradually to become aware of its sound with his inner ear."[194]

In *The Grammar of Conducting,* Max Rudolf writes that *score study* serves two purposes, "to learn the music in terms of notes and markings, and to establish a

[189] Emil Kahn, *Elements of Conducting*, 2nd ed. (New York: Schirmer Books, 1975), 103.
[190] Ibid., 107.
[191] Ibid.
[192] Ibid., 108.
[193] Ibid.
[194] Ibid., 113.

conception of the composition in the broadest sense."[195] Rudolf lends advice on several aspects of *score studying*, such as being sure to select a trustworthy score, only marking the score to provide clarification (not duplicating information already contained in the score), and keeping style and authenticity in mind when interpreting a score during *score study*.[196] He writes that some musicians can memorize music after thorough *score study* alone.[197] Rudolf suggests the first step of *score study* is "perusing the score on a getting-acquainted basis," then form analysis (such as phrasing and longer sections), and then analysis of harmonic and contrapuntal structures.[198] He also writes that it is important that the conductor be able to clearly determine what each musician is doing at all times, even during aural practice with *score study*.[199]

In their text *The Art of Conducting*, Donald Hunsberger and Roy E. Ernst write that *score study* is important for putting "every *note, symbol,* and *marking* on the page. . . in its appropriate relationship to the composition as a whole."[200] They propose that the gestures needed for conducting "grow out of the musical requirements indicated in the score; all you must do is find and identify these requirements and then apply the right set of gestures."[201] A three-phase approach to *score study* is suggested. Phase one is called "Title Page and Overview" and includes studying the composer, title, dedication, historical context, instrumentation, clefs, concert pitch and transposition, tempo

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[195] Max Rudolf, *The Grammar of Conducting: A Practical Guide to Baton Technique and Orchestral Interpretation*, 2nd ed (New York: Schirmer Books, 1980), 313.
[196] Ibid., 314–20.
[197] Ibid., 317.
[198] Ibid., 315.
[199] Ibid.
[200] Donald Hunsberger and Roy E. Ernst, *The Art of Conducting*, ed. Allan Schindler, 2nd ed (New York: McGraw-Hill, 1992), 51.
[201] Ibid.

indications and metronome markings, expressive and dynamic markings, text and translation, publisher, and unusual notation.[202] For each of these categories, Hunsberger and Ernst provide multiple questions, such as "What do you know about other works by this composer?" and "Does the opus number indicate whether this is an early, middle, or late work by the composer?"[203] Phase two is titled "Structural Features," and includes analysis of the formal design, melodic development, harmonic organization, rhythmic development, texture, text, and conducting problems.[204] Examples of prompts in this section are "Identify the main melodic materials. Think about their characteristics. Look for *motives* and *imitation*," and "What are the distinctive rhythmic qualities of the piece?"[205] Phase three is titled "Interpretation," and the authors provide five subjects for examination, such as "How does the piece evolve? Think in terms of bringing out the new structural features of each section so that the audience will hear them," and "How do you want your audience to respond to this work? How can you project your concept to the audience?"[206] Hunsberger and Ernst suggest that *score study* be approached in a systematic way "to ensure that score study progresses in a logical, efficient manner, covering all the important aspects of the score."[207]

Joseph A. Labuta gives two primary purposes of *score study* in his text *Basic Conducting Techniques*.[208] The first is to solidify an "ideal inner hearing" of the music

[202] Hunsberger and Ernst, 52.
[203] Ibid., 51–52.
[204] Ibid., 52–53.
[205] Ibid.
[206] Ibid., 53.
[207] Hochkeppel, 18; Hunsberger and Ernst, 197.
[208] Joseph A. Labuta, *Basic Conducting Techniques*, 4th ed. (Englewood Cliffs, N.J.: Prentice-Hall, 2000).

before rehearsal with which to compare the actual playing of the ensemble.[209] The second is to anticipate problems and have solutions ready before they happen.[210] Labuta offers a three-step plan for *score study*, of which the first step, "Acquire a conception," is very similar to Hunsberger and Ernst's first and second phases. In addition, he includes studying the dynamic plan and singing through each part (melodically and harmonically, by arpeggiating chords).[211] The second step, "Anticipating problems of conducting," is designed to help conductors identify potential problems and mark them helpfully.[212] Labuta suggests using a color-coding system, such as blue for dynamics and red for cues. He suggests looking for possible trouble spots for the ensemble, such as "meter changes, tempo changes, cues, fermatas, dynamics, style, accents, caesuras, fractional pickup notes, subito changes of dynamics and style, asymmetrical meter groupings, phrasing, important lines, agogics, doubled parts, and definitions of musical terms."[213] The third step, "Anticipate problems of ensemble and rehearsal" is about noticing technical and interpretive issues that may arise, such as wrong notes or rhythms, balance or blend, or articulation, and having a pre-determined correction plan should they occur.[214]

Frank L. Battisti and Robert Joseph Garofalo in their text *Guide to Score Study for the Wind Band Conductor,* provide a detailed explanation, with practical application to Percy Grainger's "Irish Tune from County Derry," of their four-step score study

[209] Labuta, 61.
[210] Ibid., 62.
[211] Ibid.
[212] Ibid., 63.
[213] Ibid.
[214] Ibid.

plan.[215] The plan is as follows: Step 1 – Score Orientation, Step 2 – Score Reading, Step 3 – Score Analysis, and Step 4 – Score Interpretation. While a complete review of this text is outside the scope of this document, it should be noted as a valuable resource on *score study* in conducting, offering numerous helpful figures such a "Score Analysis Guide," "Master Flow Chart Outline," "Analysis Checklist," "Guide to Research – Score Context," and "Summary of the Score Study Process." A brief summary of each of these five references can be found in Table 3.1.

Table 3.1 Summary of Five Resources from Battisti and Garofalo[216]

Title	**Page**	**Brief Summary**
Score Analysis Guide	30-31	Specific and detailed instructions on analyzing a score, divided into five categories: Melody, Harmony, Form, Rhythm, and Orchestration. Essentially comprehensive.
Master Flow Chart Outline	34	A template for developing an overall framework of a work. Suggests summaries of formal scheme, melodic design, rhythmic elements, orchestration, harmonic structure, texture, and dynamic curve. Includes example diagrams for formal scheme analysis and dynamic curves.
Analysis Checklist	35	A short checklist of large sections of score analysis (such as melody, harmony, and form) intended to monitor overall progress, especially for extended works that take significant time to study.
Guide to Research - Score Context	56	A series of thirteen study suggestions for learning about the composer, the composition, and the style period.
Summary of the Score Study Process	69	A concise summary of all steps in their *score study* process. Four sections: Score Orientation, Score Readings, Score

[215] Frank L Battisti and Robert Joseph Garofalo, *Guide to Score Study for the Wind Band Conductor* (Ft. Lauderdale, Fla.: Meredith Music Publications, 1990).
[216] Battisti and Garofalo.

		Analysis, and Score Interpretation, all with clearly stated objective and methods.

Battisti and Garofalo also suggest that *score study* is vital to a conductor's preparation *before* rehearsal, stating that

> Many novice conductors learn the craft of conducting before they learn how to study a score. This reversed learning sequence often creates a peculiar situation where a neophyte conductor begins to conduct an ensemble before he or she has developed an interpretive mental image of the music.[217]

Edward Eugene Pierce wrote a dissertation about Julius Herford's influence on the art of choral conducting.[218] Herford is known in part for his teaching of such influential conductors of the 20th century as Robert Shaw.[219] Pierce explains that Herford believed that the first step of learning any work was silent *score study*.[220] Herford advocated that *score study* not only aided the learning of a work, but also helped develop "aesthetic or critical insight and knowledge."[221] The process started at the macro level—in the case of a choral score, the text, and then large subdivisions.[222] Though Herford did not record specific techniques for analyzing rhythm, cadences, and phrase structure, he did expect this kind of specificity from his students.[223] He emphasized the uniqueness of each work, advising, in Pierce's words, that students should not "force the music into a preconceived frame or textbook idea of what the form should be, but [should] see and

[217] Battisti and Garofalo, iii.
[218] Edward Eugene Pierce, "Julius Herford: His Life, Teaching, and Influence on the Choral Art in the United States" (DA diss., University of Northern Colorado, 1988).
[219] Steven M. Demorest, *Herford [Goldstein], Julius* (Oxford University Press, 2010), http://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-1002087377.
[220] Ibid., 63.
[221] Ibid., 33.
[222] Ibid., 61.
[223] Ibid., 62.

understand what was actually there."[224] This philosophy of flexibility was also applied to the understanding of timing, musical structure, melody, and texture.[225] Herford proposed that once students were intimately acquainted with all of these aspects of the score, they should condense the information into a "structural memorization graph."[226] "By looking at this graph," Pierce comments, "the [student] should be able to hear the music in his inner ear, and memorize it."[227] Pierce summarizes that, by using this technique, students are able to get a sense of the overall form and feeling of a completed work, informed by even the smallest details.[228] Bruce Chamberlain's analysis and commentary on Vivaldi's *Gloria* (RV589) contains examples of this kind of graph.[229] Figure 3.1 shows the division of phrases (and measure lengths of those phrases) by section, overall harmonic progression, text, tempo, and time signature. Chamberlain provides similar graphs for the entirety of Vivaldi's work. It would seem that this graphing technique is in widespread use among the choral conducting community.

[224] Pierce, 62.
[225] Ibid., 63.
[226] Ibid.
[227] Ibid.
[228] Ibid.
[229] Heather J. Buchanan et al., eds., *Teaching Music through Performance in Choir*, vol. 3 (Chicago: GIA Publications, 2005), 573–92.

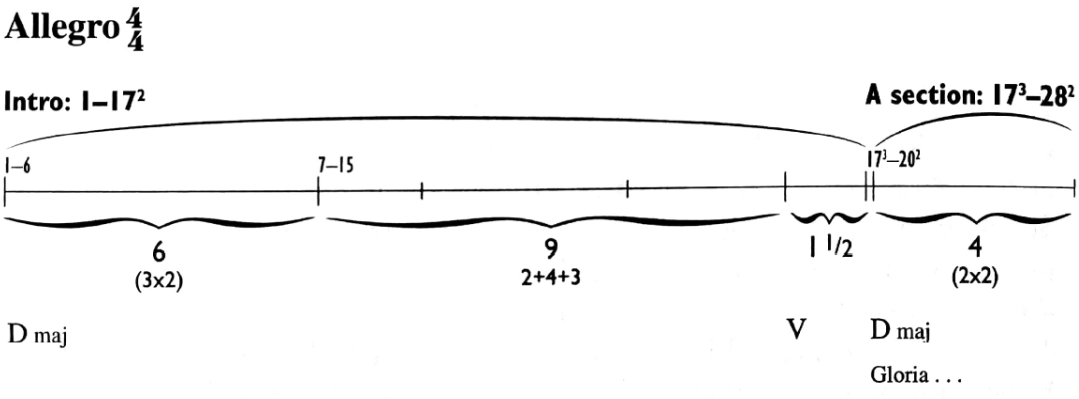

Figure 3.1 Excerpt from Bruce Chamberlain's analysis of Vivaldi's *Gloria* (RV589)[230]

[230] Buchanan et al., 3:574.

CHAPTER 4

PRACTICAL IMPLICATIONS AND APPLICATIONS OF MENTAL PRACTICE IN THE FIELD OF PIANO PEDAGOGY

Of the studies in and writings of other career fields reviewed in this document, the distribution of terms is as follows:

- 10 examples discuss *kinesthetic imagery*
- 7 examples discuss *score study*
- 6 examples discuss *guided imagery*
- 3 examples discuss *mental wellness*
- 5 examples discuss non-specified mental practice or imagery.

In this chapter, the implications and applications of these findings in the field of piano pedagogy will be discussed. Observations are loosely organized by both type of mental practice and positive outcome. The first three paragraphs focus on the general perception of mental practice in the field of piano pedagogy; *kinesthetic imagery*, *guided imagery*, and *mental wellness* are discussed next; and lastly, *score study*. Non-specified mental practice or imagery studies are discussed throughout at appropriate times.

Trafimow and Miller's study displays the importance of positive perception of mental practice as a whole within a career field.[231] Valuing mental practice is at the root of its effective execution; therefore, piano teachers must both overtly and covertly establish a culture in which mental practice is valued, respected, and practiced regularly in order for it to be most successful. To achieve this, teachers must themselves place

[231] Trafimow and Miller.

importance on mental practice. This begins with an understanding of what mental practice is and how it can be applied, and a systematic approach to incorporating it within piano lessons as with any other practice technique.

Athavankar discovered that a designer who primarily sketches to develop creative ideas displayed relative ease in replacing sketching with visualization.[232] The designer mentally imaging the sketching process would be similar to a pianist using *kinesthetic imagery* to imagine movement at the piano, and the manipulation of the sketch in the designer's brain would be similar to a pianist using *aural imagery* to engage with and manipulate sound output. The conclusion that imagery, though effective and achievable, may be underutilized in design because the field relies so heavily on sketching may translate to imagery being under-utilized in piano study because the field relies so heavily on physical practice. Athavankar also states that imaging seems to be fruitful for creative tasks that involve controlled manipulation, but are also loosely structured. A similar task in piano study could be improvisation. Further research on mental practice and improvisation may be useful, perhaps drawing from the thought processes of jazz musicians as seen in Peter Miksza and colleagues' writing.[233]

Ridderinkhof and Brass make the argument that the benefits of *kinesthetic imagery*—many of which are directly relatable to piano playing, such as forming relaxed technique and memory of acquired skills—are significant enough that the majority of elite athletes use it in their training.[234] This information should motivate the pedagogy community to adapt their training procedures to take advantage of a technique that has

[232] Athavankar.
[233] Miksza, Watson, and Calhoun.
[234] Ridderinkhof and Brass.

widespread results. Ridderinkhof and Brass also contribute to the credibility of *kinesthetic imagery* in their explanation of how *kinesthetic imagery* interacts with the brain.

Similarly, Henz and Schöllhorn's study revealed that *kinesthetic imagery* utilized similar parts of the brain as physical practice.[235] This shows that it can be helpful in comparable ways, and gives validity to the use of *kinesthetic imagery* in situations where physical practice is unavailable or harmful. The most obvious of these situations are practice-related injury and the absence of an instrument, though there is potential for others.

Conversely, Lacourse's finding that a specific part of the brain reacts only to *kinesthetic imagery* and not physical practice is important in its validation of *kinesthetic imagery* outside of its relationship to physical practice.[236] Though Lacourse's research focused on details of the brain and not practical application, this information, along with Henz and Schöllhorn's, should add gravity to the other *kinesthetic imagery*-related results discussed in this document. Additionally, the potential that a part of the brain is not yet understood or used to maximum effectiveness in piano playing should spur further research in this area.

While numerous studies on mental practice in music have found it to be useful in conjunction with physical practice, or useful on its own but not to a greater extent than physical practice alone, Wohldmann and colleagues' research shows that *kinesthetic imagery* can be superior to physical practice, specifically in the realm of skill transfer.[237]

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[235] Henz and Schöllhorn.
[236] Lacourse et al.
[237] Wohldmann, Healy, and Bourne.

This is, perhaps, a practical instance where Lacourse's statement that *kinesthetic imagery* affects a part of the brain that physical practice does not can be observed. Wohldmann and colleagues' study reveals that using physical motion to complete a task can cause the brain confusion when attempting to complete a similar task with a different movement. Conversely, *kinesthetic imagery* can better transfer skill to a new movement because a rote movement is not associated with the task. Specifically, the authors had participants switch between the right and left hands for the changed movement, which is directly applicable to piano playing; however, this foundational theory could be applied to different movements within one hand or among other body parts as well. For instance, a student kinesthetically imaging the "123 1234 123 1234(5)" pattern of a scale in their fingers may help them transfer the finger pattern across various black-and-white key scale groupings with more ease. Research concerning *kinesthetic imagery* and skill transfer in piano playing could be tremendously helpful in building students' systematic approach to transferring knowledge, overcoming technical and movement-related issues, and quickening their overall learning process.

Morin and Latham's study corroborates that skill transfer is a benefit of mental practice.[238] In their work, *guided imagery* shows effectiveness in transferring self-efficacy from training situations to performance situations. The confidence and independence of goal-reaching found in self-efficacy is central in both healthy practice and performance environments for piano students, and therefore *guided imagery* could be a valuable tool for teachers to adopt. Morin and Latham also note that goal setting alone did not show effective outcomes, but goal setting in conjunction with *guided imagery*

[238] Morin and Latham.

(mentally seeing the process through to the end) helped participants actualize the goals. They suggest that *guided imagery* is an ideal way for participants to create strategies for achieving their goals.

Multiple studies included evidence that *kinesthetic imagery* was most effective when the participants had previous experience with the specific conditions or task to be imagined. Mahmoudi and Erfanian substantiate the theory that individuals can maximize effectiveness of *kinesthetic imagery* by experiencing the actual physical sensation before attempting mental imagery.[239] Jentsch and colleagues associated better use of imagery with more experienced aviators, which supports experience directly relating to efficacy of imagery.[240] Kalicinski, Bock, and Schott conclude that previous experience with specific conditions could help maximize effectiveness of mental practice.[241] This implies that a pianist might have better success practicing by using *kinesthetic imaging* if they have already had a physical experience with the chosen task. Mahmoudi also notes that clarity of image is important for the success of *kinesthetic imagery*, which is something also true about *guided imagery*, according to Morin and Latham. Theoretically, these two ideas go together, as the more experience an individual has with a task, the more clearly they will be able to imagine it. Therefore, piano teachers should make sure their students have high-quality models and personal experience with tasks before using *kinesthetic imagery*.

Sunday and colleagues' findings that vividness of visual imagery was not affected by domain-specific expertise may seem to contradict the aforementioned studies; however, their study focused on visualizing images rather than *kinesthetically imaging*

[239] Mahmoudi and Erfanian.
[240] Jentsch, Bowers, and Salas.
[241] Kalicinski, Bock, and Schott.

(which involves mentally sensing movement).[242] The studies listed dealing specifically with *kinesthetic imagery* all promoted very specific physical familiarity with a task before attempting to imagine it. Sunday's study relied on a general knowledge of automobiles to assist persons in visually recalling images of cars. These skills are inherently different, rather than conflicting. A more easily transferable subject to this discussion is Sunday and colleagues' observation that there is difficulty analyzing one's own imagery skills compared to another's, which is an important problem to consider in terms of data collection for further research. As Sunday suggests, using fMRI or other devices to empirically determine the effects of visualization among experts and non-experts alike could be valuable in objectifying results as research on imagery continues. This applies to piano pedagogy as well as other career fields.

Gir¢n, McIsaac, and Nilser's observation that the benefits of *kinesthetic imagery* differ depending on the task has significant implications in the field of piano pedagogy.[243] This means that teachers should not assume that all kinds of mental practice are appropriate for all skills and techniques. Research is needed to determine what kinds of tasks are most positively affected by various kinds of mental practice. In addition, Gir¢n, McIsaac, and Nilser state that *kinesthetic imagery* specifically could be valuable in preventing injuries related to improper alignment and technique. This could be of use to pianists learning to perform technically difficult passages at any level, as well as to pianists attempting to change their technique in recovery from past injuries.

[242] Sunday, McGugin, and Gauthier.
[243] Gir¢n, McIsaac, and Nilser.

The study conducted by Bauerle, Brnich, and Navoyski primarily applies to first-responder training; however, the idea that external imagery can be made more effective with an interactive virtual component is of interest to the field of piano pedagogy.[244] The benching task shares commonality with piano playing in that it is both a motor and cognitive skill, and the authors indicate that external imagery could be a useful training tool for developing complex skills such as these. Though some interactive computer software has been developed in the field of piano pedagogy, specific research on how virtual reality could be employed to maximize imagery-related mental practice could be useful. Likewise, Yiasemidou suggests that in surgical training, an interactive 3D model enhances the potential of skill transfer in *kinesthetic imagery*.[245] Wholdmann and colleagues, and Morin and Latham both report on the potential of skill transfer from *kinesthetic imagery*, even without a 3D model. Thus, it could be useful to study how an interactive 3D model could assist *kinesthetic imagery* and transfer of skills in situations where a physical piano is not present. There is potential for an added component of virtual reality.

Mahmoudi and Erfanian also promote the utilization of *mental wellness* techniques, such as relaxation and concentration strategies, to enhance *kinesthetic imagery*. In their study, they trained their participants in concentration ("self-regulated attention [to make] the mind firm and steady") by using mindfulness meditation.[246] This meditation, a series of five prompts to calm the breathing and focus the mind, was

[244] Bauerle, Brnich, and Navoyski.
[245] Yiasemidou et al.
[246] Mahmoudi and Erfanian, 960–61.

practiced for twenty minutes once or twice a day for thirty days, outside of the kinesthetic imagery sessions. The script read as follows:

> 1. Sit upright in a comfortable chair.
> 2. Hold the head up, with attention flowing into the area between the eyebrows and higher brain.
> 3. Inhale and exhale once or twice to relax. Remaining still for a few moments until you feel centered. Be aware of your natural breathing rhythm. Notice that your breathing is calm and steady.
> 4. When inhalation occurs naturally, mentally listen to a pleasant word that is agreeable to you. When exhalation occurs, again mentally listen to the word. Feel that the sound of the chosen word is blossoming in mind or your field of awareness. Continue doing this, without effort and without anxiety about results.
> 5. When a state of conscious, calm awareness is experienced, discontinue listening to the word. Be [sic] still continue to practice for several minutes until you feel inclined to conclude the practice session.[247]

Teaching individuals how to independently concentrate proved effective in the overall efficacy of *kinesthetic imaging* in this study, and could be extremely helpful in fostering useful imagery skills in young piano students.

Similarly, in the realm of *mental wellness*, Henz and Schöllhorn's study suggests that attention may be honed in closed-eye practice by utilizing breathing and movement techniques like those found in Eastern traditions such as Buddhism and Wu Qin Xi.[248] Research relating techniques such as these to mental practice and piano playing could be useful, such as studying yoga practices as a way to enhance *kinesthetic imagery* experiences, both inside and outside of the piano lesson. A possible resource for piano teachers to experiment with yoga aiding mental practice in the piano lesson is Paola Savvidou and Haley Myers lesson book, *At the Piano with Yoga: Imaginative Duets and*

[247] Mahmoudi and Erfanian, 961.
[248] Henz and Schöllhorn.

Yoga Poses for Beginning Pianists.[249] Other resources on yoga and piano, such as Jennifer Yu and Katie J. Lanzer's dissertations, could be helpful in beginning to understand how mindfulness and movement practices could enhance mental practice.[250]

Meland and colleagues also concluded that mindfulness was useful in building self-regulation of attention and calming bodily anxiety.[251] While positive outcomes on their own, they are also beneficial in maximizing effectiveness of other mental practice techniques. Research on cultivating mindfulness and *mental wellness* in piano students could be helpful in determining ways to encourage healthy behaviors that positively affect piano-specific activities.

Page, Hade, and Pang's observation that a combination of *mental wellness* and *guided imagery* was more effective for stroke rehabilitation in smaller increments multiple times a day than one long session once a day could influence the way teachers incorporate mental practice into the piano lesson and what they ask of students in practice.[252] Direct transfer of techniques from studies such as these is difficult due to the presence of traumatic brain injuries which affect motor and cognitive abilities. Thus, piano-specific research in this area is needed to determine exactly how much of each kind of mental practice is most effective and in what frequency.

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[249] Paola Savvidou and Haley Myers, *At the Piano with Yoga: Imaginative Duets and Yoga Poses for Beginning Pianists*, 2017, https://www.paolasavvidou.com/piano-and-yoga-book.
[250] Jennifer Yu, "Music, Somatics, and Transformation: My Personal Journey through the 24 Debussy Preludes and Yoga" (ProQuest Information & Learning, 2016), (2016-42146-233); Katie J. Lanzer, "Yoga and Piano: A Journey towards Awareness" (University Microfilms International (UMI), 2008).
[251] Meland et al.
[252] Page, Hade, and Pang.

Hinshaw revealed that there are many interdependent variables in the realm of mental practice that can affect its efficacy, including time spent mentally practicing, the kind of mental practice used, previous experience with mental practice, frequency of mental practice, and vividness and control of imagery.[253] Therefore, in addition to research on frequency and quantity of mental practice in piano playing as seen from Page, Hade, and Pang's study, research that takes Hinshaw's variables into account is needed to determine which kinds of mental practice are most effective for different elements of piano playing and varying levels of students.

Prather indicates that *guided imagery* is useful in training individuals when resources are unavailable or expensive. In this instance, *guided imagery* is used to train, rather than practice, which is in opposition to the idea that imagery is most effective when an individual has had physical experience prior to imagining. In this case, instead of a student conducting a *guided imagery* experience on their own, an instructor details the situation to be imagined in order to teach new information in the absence of usual equipment. This approach could be applied to piano both in individual and group classes in situations where pianos are unavailable. Prather also concludes from his research that guided imagery enhances the effectiveness of physical practice. For this reason, it could be beneficial to regularly incorporate mental practice into piano instruction. Research on how frequently, how much in each session, and which kinds for what purpose would be useful in helping teachers and students to successfully employ mental practice.

[253] Hinshaw.

Frank and colleagues' study revealed that *guided imagery* should be repeated in order for it to be successful.[254] Piano teachers should note that repetition is vital to achieving the results Frank and colleagues' document outlined, such as mentally tying similar concepts together and concretely differentiating disparate concepts. This implies that a systematic approach to incorporating *guided imagery* is needed when applied to private or group piano instruction. In addition, Frank and colleagues studied a sports team and their ability to conceptualize team-level tactics. This questions whether or not mental practice techniques could be useful in more than solo settings, such as in chamber music playing or collaborative piano work.

Nordin and Cumming developed a dance-specific imagery measuring questionnaire to take into account various imagery components unique to dance.[255] Developing a music or piano-specific imagery measuring questionnaire may be helpful in refining and specializing imagery research in this field.

Kahn's suggestion of conducting students mentally rehearsing multiple-voice works is a form of *score study* that uses *aural imaging*, as well as potentially *audiation*.[256] Kahn proposes that this kind of study helps conductors identify individual lines of orchestral music with more accuracy in order to pinpoint incorrect notes and quickly find the source of the problem. Similarly, Rudolf writes that a conductor should know what every musician in his ensemble is doing at all times.[257] Pianists also need the ability to hear individual lines and multiple parts between the hands in an egalitarian

[254] Frank et al.
[255] Nordin and Cumming.
[256] Kahn.
[257] Rudolf.

manner in order to voice melodies, balance the hands, subdue subordinate voices, and provide appropriate accompaniment. Therefore, Kahn's practice technique is directly transferable to piano study.

Kahn also suggests that conducting students learn to condense scores to strengthen the capability of *audiation* by obtaining an overall idea of the entire score. Rudolf corroborates the idea of condensation, indicating one of the main purposes of *score study* is understanding "the composition in the broadest sense."[258] While pianists do not have multiple instrumental parts to compress, it may be helpful for students to take lengthier or more complex works and simplify the content into basic harmonic progressions. This could strengthen the harmonic framework of their inner ear so that when they play the full realization, they are more easily able to *audiate* while playing, thereby strengthening memory, interpretation, and musicality. Herford also taught his conducting students to condense score information, but instead of condensing from an orchestral score to a piano score, his approach condensed from an orchestral score to a structural graph.[259] It was to serve a similar purpose as the piano reduction, and is easily applicable to piano study (see Figure 3.1 for a graph example).

The other purpose of *score study* Rudolf discusses is to learn the markings, notes, and details of the music.[260] Hunsberger and Ernst's three-phase plan could be an excellent resource to give piano students a structure to follow. Other than a few questions about transposition and lyric translations, the categories they present are directly transferable to piano music. Even the category on instrumentation could be adapted to piano playing—

[258] Rudolf, 313.
[259] Pierce.
[260] Rudolf, 313.

e.g. what instrument of an orchestra might this melody or accompaniment be played with if it were a symphonic work? The first two steps of Labuta's plan, though not as comprehensive, are similar to Hunsberger and Ernst's three phases, and may also be a useful resource.[261] In addition, the figures from Battisti and Garofalo summarized in Table 3.1 could be advantageous in directing students' *score study*.[262] Teachers could also reference their text for additional ideas on *score study*.

Hunsberger and Ernst write that *score study* before conducting is important because the appropriate gestures for conducting a work are determined by the markings in the score. This suggests that pianists could benefit from doing *score study* before reading a new piece to determine the overall gestures needed, as well as to eliminate unnecessary or inappropriate gestures. Similarly, Labuta promotes *score study* as a way to anticipate problems that may occur and to have solutions for them before they happen.[263] This could dispose of a wide range of unhealthy habits often formed when a piano student "fumbles" through sight-reading a piece. Battisti and Garofalo also encourage *score study* before rehearsal, writing that it is imperative for conductors to have a clear mental interpretive image of the music before possible ensemble issues can pollute it.[264] For pianists, this could be an extremely useful practice in order to overcome technical challenges by strengthening the ear, a key benefit of *audiation*.

Peirce also notes Herford's emphasis on flexibility during *score study*. Students may have a tendency to want to find uniformity in pieces to make their *score studying*

[261] Labuta.
[262] Battisti and Garofalo.
[263] Labuta.
[264] Battisti and Garofalo.

easier; however, Herford disputes this idea by speaking frequently about embracing the uniqueness of each work. Teachers should keep this in mind when instructing students about *score study*.

Summary

As seen in writings inside and outside of the music field, mental practice in its varying forms can be a viable and effective tool. Codification of terminology enables individuals to understand the differing kinds of mental practice, draw helpful conclusions and applications from various documents that may use differing terms, and create more specific studies to further mental practice research in piano pedagogy. The codification suggested in Table 2.1 (recreated below for ease of access) suggests an organization of terms into four categories: Visualization (*kinesthetic imagery* and *musical imagery*), Aural (*aural imagery* and *audiation*), Psychological (*mental wellness* and *guided imagery*), and Hybrid (*practice away from the piano* and *score study*) techniques.

Table 2.1 Organization of Terms

Visualization	**Aural**	**Psychological**	**Hybrid**
Kinesthetic Imagery	Aural Imagery	Mental Wellness	Practice away from the piano
Musical Imagery	Audiation	Guided Imagery	Score Study

In the Visualization category, *kinesthetic imagery* is performing and sensing motor movements within the mind without any external muscular movement, and *musical imagery* is using imagined ideas (pictures, feelings, non-musical sounds) to enhance

musicality, understanding, or interpretation. In the Aural category, *aural imagery* is hearing sound in one's mind without hearing external auditory feedback, and *audiation* is organizing and understanding the context of internally heard sound. In the Psychological category, *mental wellness* encompasses the well-being of a musician's mind during learning, practicing, and performing, and *guided imagery* is thinking through (usually) a performance scenario while employing a variety of other mental practice techniques. In the Hybrid category, *practice away from the instrument* employs physically moving the fingers to enhance other mental practice techniques such as *aural imagery*, and *score study* is the visual examination of a score that is not accompanied by a physical realization of the music.

Studies in other career fields reveal that mental practice has great potential and is being used effectively in a variety of settings. Several documents, such as those by Ridderinkhof and Brass and Lacourse, validify the beneficial interaction between the brain and *kinesthetic imagery*.[265] Wholdmann and colleagues, and Morin and Latham write that *kinesthetic imagery* and *guided imagery*, respectively, promote skill transfer.[266] Studies such as those by Henz and Schöllhorn, and Kalicinski, Bock, and Schott offer ways to make various kinds of mental practice more effective, including mindfulness techniques and having previous experience with the task being practiced.[267] Several studies offer useful strategies for measuring effectiveness of imagery, such as fMRI and EEGs, and creating career-specific vividness of imagery questionnaires.[268] Others

[265] Ridderinkhof and Brass.
[266] Wohldmann, Healy, and Bourne.
[267] Henz and Schöllhorn.
[268] Sunday, McGugin, and Gauthier; Gir¢n, McIsaac, and Nilser,; Henz and Schöllhorn.

propose that mental wellness can potentially maximize the effectiveness of other mental practice techniques.[269] Conducting texts suggest numerous practical ways to analyze a score to prepare for actualization.[270]

As a result, it appears that piano teachers would benefit from incorporating mental practice in a systematic way in their teaching sequences.

Recommendations for Further Study

There is potential for *kinesthetic imagery* to be useful in similar ways as physical practice, but also for it to be useful in ways physical practice is not. For this reason, further research is needed in understanding how the brain reacts to *kinesthetic imagery* versus physical practice. Research using fMRI, EEGs, and other such devices could be useful in objectively studying mental imagery of varying kinds among pianists of all skill levels. Research on how *kinesthetic imagery* interacts with skill transfer could be helpful in maximizing imagery effectiveness. Depending on the findings, this could also shift the perspective on the importance of *kinesthetic imagery*. Should the results continue to trend positive, the data may be a convincing reasoning for a widespread, systematic incorporation of *kinesthetic imagery* in piano teaching and learning. *Aural imagery* has been identified as potentially as useful to musicians as *kinesthetic imagery* is to athletes, and thus, significant research is needed to define, explain, and strategize *aural imagery* practices. Research is needed to determine what kinds of tasks are most positively affected by various kinds of mental practice, as well as to determine the appropriate frequency and duration of mental practice techniques among differing student

[269] Mahmoudi and Erfanian; Henz and Schöllhorn; Meland et al.
[270] Kahn; Rudolf; Hunsberger and Ernst; Labuta; Battisti and Garofalo.

populations. *Mental wellness* studies on incorporating techniques such as mindfulness and Eastern breathing and movement techniques both in and out of the piano lesson could prove useful in maximizing effectiveness of various kinds of imagery. Developing a music or piano-specific vividness-of-imagery questionnaire could make further research on imagery in piano pedagogy more reliable and easily applicable. There is potential for valuable application of computer software and virtual reality to mental practice, and this relationship has no current research.

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