

Mental practice and visualization in Piano performance: A comparative Study of Cognitive memorization techniques

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Abstract: *This article presents a comparative study of various cognitive memorization techniques in piano performance, focused on mental practice and visualization. Drawing on methods from influential pianists and pedagogues such as Walter Gieseking and Heinrich Neuhaus and the author's personal experience, the analysis explores how pianists can internalize music without physical engagement with the instrument. Techniques such as score visualization, aural imagery, and structural analysis are examined in terms of their effectiveness in enhancing musical memory and performance security. The study highlights the cognitive processes underlying these methods, offering insights into how mental preparation complements traditional physical practice for pianists.*

Key-words: *cognitive memorization techniques; piano mental practice; aural imagery; pattern recognition.*

1. Introduction

The emphasis on playing from memory was not always an established tradition. Most instrumentalists playing orchestras or small chamber music ensembles were using scores because the rehearsal time for the musical events and the repeatability of these [always new] repertoires were minimal, sometimes only in one or two public representations. Exceptions were some very gifted interpreters, all of them outstanding composers, too (J. S. Bach, G. Fr. Handel, Domenico Scarlatti, W. A. Mozart, Ludwig van Beethoven), in their young age, virtuoso performing instrumentalists, able to render or to create spontaneous excerpts of solo music (in variations on a given theme), for the amazement of the aristocrats who listened to them, praising and comparing their mastery in musical saloon tournaments.

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The practice of playing without scores in front of the eyes truly gained momentum with Franz Liszt during his solo performances in the early 19th century when he invented the solo concert for one instrument named afterward the Recital. Prior to this, performing from memory was discouraged, as composers felt that instrumentalists of those times were diminishing the value of their work by being victims of lack of memory and inherent score mistakes. Interestingly, Fr. Liszt memorized only a tiny portion of his repertoire because, in many cases, he was “writing” with the hands on the keyboard (improvising like in the final print version of a complex score!) his spectacular music full of virtuosity to impress his listeners... right on the spot.

Due to his fragile physical constitution, which limited his endurance from a young age, the pianist and composer Frédéric Chopin began to favor mental practice over excessive physical rehearsal. He also realized early on that by using mental rehearsal, he could develop a profound interpretive understanding of the music before even touching the keys. This approach allowed him to naturally engage with poetic genres and intellectually philosophical perspectives in miniature forms. While Liszt relied on his tremendous sight-reading and nearly photographic memory to commit music to mind quickly, Chopin cultivated a reflective and mental approach, embodying their distinct artistic philosophies and highlighting the importance of mental engagement in musical mastery.

Moreover, Beethoven, Mozart, and Liszt’s sight-reading and memorization abilities are understood and explained today by their instinctively complex mental visualization techniques, which they used to perform full piano interpretation vision and new music and piano technique approach in their heads in an instant with such a degree of ease and flexibility.

2. Objectives

This article explores various cognitive memorization techniques in piano performance, focusing on mental practice and visualization. It examines historical views and methods developed by influential pianists and pedagogues, such as *Karl Leimer*, *Walter Giesecking*, and *Heinrich Neuhaus*, while incorporating the author’s personal experience to provide a deeper understanding of how pianists can internalize the music and to what degree without physical interaction with the instrument.

Techniques and cognitive processes like score visualization, aural imagery, pattern recognition, mental structural analysis, and many more underlie this

phenomenon. These elements are evaluated for their effectiveness in strengthening musical memory and enhancing performance security.

This research seeks new insights into how mental preparation can complement and enhance traditional physical piano performance practice.

3. Cognitive processes underlying mental practice and memorizing music activity in Piano performance

Several cognitive processes are actively engaged when playing or reading a musical score. *Visual processing* in music involves decoding the score's symbols, notes, rhythms, and dynamic markings. This large-scale data process allows musicians to interpret the written language of music, understanding which notes to play and how to articulate them through variations in timing, volume, and expression. By quickly recognizing these visual cues, musicians can transform the static notation on the page into expressive sound. Derivative-specific cognitive processes developed by visual processing and involved in piano performance are *pattern recognition*, *auditory imagery*, and *aural feedback and monitoring*.

Pattern recognition in music allows musicians to identify recurring elements such as scales, arpeggios, harmonic progressions, and motifs. Recognizing these patterns helps musicians navigate the score efficiently, as musicians can anticipate and structure their movements. This makes complex passages more manageable and facilitates a deeper understanding of the music's structure and style.

VISUAL PROCESSING	ATTENTION & FOCUS	ANALYTICAL THINKING
PATTERN RECOGNITION	WORKING MEMORY	SPATIAL-TEMPORAL PROCESSING
AUDITORY IMAGERY	DECLARATIVE & PROCEDURAL MEMORY	EMOTIONAL PROCESSING
AURAL FEEDBACK & MONITORING	MOTOR PLANNING & EXECUTION	ERROR DETECTION & SELF-CORRECTION

Fig.1 Large-scale data Cognitive Processes and Derivative-specific Cognitive Processes involved in sight-reading and learning musical scores for Piano Performance

Aural imagery, mainly *auditory or musical imagery*, as a specific part of the piano performance cognitive process, plays a significant role in memorizing musical scores and mental practice without touching an instrument. Numerous recent studies have explored how musicians use this form of mental representation to recall and rehearse music without physical instruments. This technique relies on the musician's ability to "hear" the music internally, enabling mental practice and reinforcement of memorization. Aural imagery helps recall musical phrases or complex harmonical and rhythmic textures of the musical scores and supports sensorimotor coordination, assisting in performance accuracy.

Starting with the mid-80s, relevant research on auditory imagery was conducted through functional magnetic resonance imaging (fMRI) that focused on understanding the structural properties of this mental process, particularly by examining essential elements like pitch. The activation was largely symmetrical between the two hemispheres. However, there were slight differences: the left inferior frontal gyri showed higher activation than the right, while the right praecuneus and superior temporal gyri were more active than their left-side counterparts. Similar studies were also carried out to investigate musicians' cognitive perception of the timbre of an instrument, the dynamics, the agogics of a musical text, the melodic contours, and the rhythmic-harmonic textures within the scores they are studying (Hubbard 2010, 303).

We are also learning a lot about aural imagery' action and benefits in Piano Performance activity, studying the affirmations and the written testimonials about legendary and highly praised performers who were also prolific piano music composers (like *Frederic Chopin*, *Franz Liszt*, *Sergey Rachmaninov*) or noted performers who have played vast musical repertoire (Walter Gieseking, Glenn Gould) when they said that they could develop personal techniques for memorizing and for mentally visualizing the music. However, the connection highlights the relationship between the auditory imagery they created and their musical skills, making it a critical aspect of both increasing their memory capacities and enhancing their musical expertise.

Auditory imagery is possible because it involves *internal subvocalization*, which, in consequence, involves *activating the inner hearing mechanism and recalling various information related to the perception of the projection of the sounds and rhythmic and harmonic structures* by reading and understanding them outside the written score, or what we call it *aural feedback and monitoring*.

This attests that the phonological loop, a *working memory* (short-term memory) component, plays a key role in supporting this mental process. By reinforcing *auditory-motor loops* (Hubbard 2010, 324), musicians better recall musical sequences in their minds.

Derivative-specific cognitive processes developed by attention and focus cognitive processes and involved in piano performance are *working memory* (short-term memory), *declarative and procedural memory* (consolidated memory), and *motor planning and execution*.

An intriguing distinction must be made between cognitive processes such as *declarative and procedural memory* in piano practice involved in right-hand and left-hand recall.

In most cases, right-hand recall depends more on aural skills, which means the ability to hear and reproduce music internally. In contrast, left-hand recall relies on analytical music processing, mainly through a structured music analysis process during practice (Loimusalo and Huovinen 2018, 222).

Memory consolidation and recall are processes involved during a memorized performance, as the brain stores learned material in long-term memory and retrieve it accurately in real-time. This involves derivative specific cognitive processes, *procedural memory* for muscle memory and technique, and *declarative memory* for recalling specific notes, phrases, and interpretive nuances, allowing for seamless and expressive execution of the music. Listening to the score (in the pianist's internal hearing as aural imagery or various recorded renditions of the music), while often seen as complementary to performing, can sometimes replace the act of playing by providing an indirect experience based on simulated rather than performed action, with trained musicians accessing this sensory-motor simulation; moreover, aesthetic listening—where one perceives, understands, enjoys, and evaluates music—engages specific brain networks and regions (Reybrouck, Vuust and Brattico 2018, 10).

This indicates that different cognitive strategies depend on the hand and musical task. *Aural skills* play a key role in right-hand memory, while *logical reasoning* guides the left hand, likely due to its more frequent and complex involvement in harmonic and accompaniment structures.

Several interconnected cognitive processes work to create a cohesive and expressive musical experience in piano performance and mental practice. Music sight-reading demands the rapid integration of multiple elements, including pitch, rhythm, key, meter, familiar patterns, sound prediction, and motor planning, all of which rely on attention and focus, pattern recognition, aural imagery, and procedural and working memory. Each cognitive process enables sight-readers to interpret and execute music accurately in real-time, with distinct neuropsychological mechanisms (Peretz and Zatorre 2005, 101) working in tandem.

Analytical thinking, a large-scale data cognitive processing, enables the pianist to understand the score's musical structure, form, and harmonic relationships, providing a foundation for interpreting the composition. This understanding supports derivative-specific cognitive processes like *spatial-temporal processing*,

which coordinates timing and rhythm, ensuring each note and measure aligns precisely with the overall temporal framework. As the pianist plays on the instrument or in his mind as a mental practice, the musical score, *error detection*, and *self-correction processes* allow for real-time adjustments, with the brain actively monitoring for discrepancies between intended and actual sound, facilitating immediate corrections in finger movements or phrasing. These processes enable *emotional processing*, interpreting, and expressing the music's emotional content and dynamics. This final layer brings life to the performance, infusing each passage with expressive depth and nuance.

All these processes can also be specific to mentally rehearsing musical material, working together to ensure musicians can accurately interpret and perform from a musical score.

4. Key Insights from Karl Leimer's Writings on the Leimer-Giesecking Method of mental practice

In 1896, **Karl Leimer (1858-1944)**, a young German piano teacher, converted to music studies from a rather prosaic profession (civil engineering) and trained at the Stuttgart Conservatory, moved to Hanover city, where he founded a private music school, the current internationally renowned College of Music and Theatre, together with two guild colleagues. A real success, his piano school obtained Conservatory status (1912) and State recognition (1926) thanks to its students' reputation, becoming more and more well-known nationally and internationally. They were trained from the first stages of learning, passing through the intermediate stages and ending up with advanced stages of musical-pianistic knowledge.

The common bond of these achievements turned out to be, in fact, the fruit of the systematic application of his observations and experiments conducted in the field of instrumental pedagogy, aspects that he would theorize for posterity in 1918, in a well-received by interested readers, treatise on the title "*Handbuch für den Klavierunterricht in den Unter- und Mittelstufe*" [Practical manual for teaching beginner and intermediate level piano].

As with any great teacher, in his career, there is the possibility of meeting at least one exceptionally musically gifted student. The opportunity came with the training of the young man who developed a great interwar European piano concert performance career, **Walter Giesecking**. Alongside him, Leimer published pedagogical works on piano playing in 1931, and they co-wrote "*Modernes Klavierspiel nach Leimer-Giesecking*" [The Shortest Way to Pianistic Perfection], a work which was translated into English a year later (1932), intended to instruct above all, non-

experienced piano teachers. The book was so successful that Leimer wrote another related material, „*Rhythmics, Dynamics, Pedal, and Other Problems of Piano Playing*,“ published in 1938.

Today, the pianist **Walter Giesecking (1895-1956)** is especially celebrated for his recordings of Mozart’s complete piano works and the impressionist compositions of Claude Debussy and Maurice Ravel. Nearly all of Debussy’s and Ravel’s solo piano pieces were recorded by Giesecking for EMI in the early 1950s, with earlier recordings for Columbia in the 1930s and 1940s. Thanks to his remarkable natural technique, perfect pitch, and extraordinary ability for memorization, Walter Giesecking was able to master a lot of historical repertoires and a new (contemporary) repertoire with minimal practice. From early on, he was taught by his teacher Leimer to study away from the piano using the Leimer method, a habit that became well-known to the public. It was widely reported that Giesecking memorized new works while traveling. His extensive repertoire spanned from Bach and Beethoven’s central works to Rachmaninov’s concertos and modern compositions by Hindemith, Schoenberg, and many more.

The Leimer-Giesecking method, as outlined in the original book, emphasizes several key principles for learning and mastering piano performance through mental and cognitive preparation rather than excessive mechanical repetition.

In this text, four key directions in the mental conceptualization of piano performance, entirely innovative in the 1940s, we could identify:

- mental rehearsal before physical practice:
- silent reading of the musical score:
- holistic memorization:
- focus on musical interpretation purposes right from the sight-reading phase:
- intellectual engagement with the music.

The method strongly emphasizes *mental practice as the foundation of learning a piece*. Leimer and Giesecking advocated memorizing and mentally rehearsing the music away from the instrument before attempting to play it on the piano. They discuss the importance of mentally visualizing and hearing the music before attempting physical practice; by focusing on internalizing the music in advance, a pianist could increase efficiency in learning. (Giesecking and Leimer 2010, 6-8). Students are encouraged to visualize the score, hear the music internally, and practice mental finger movements, which enhances their internalization of the piece before physical performance. A critical part of the method involves *silent score reading*, where students study and internalize the music's structure, dynamics, and expression without playing it on their instrument. This technique improves memory and interpretative insight.

By focusing on silent study, pianists can develop a clear mental picture of the piece, which makes actual physical practice more efficient and precise (Giesecking and Leimer 2010, 12-14).

Leimer and Giesecking emphasized *memorizing the entire piece before playing it on the piano*. This includes memorizing not only the notes but also the phrasing, dynamics, and emotional content. The method emphasizes memorization through understanding, ensuring the pianist fully grasps the musical architecture. This allows for more expressive and confident performance (Giesecking and Leimer 2010, 18-20).

Unlike methods that separate technical mastery from musical interpretation, the Leimer-Giesecking method advocates *integrating interpretation right from the beginning of the learning process*. This involves thinking about the piece's emotional content and expressive qualities during the memorization and mental rehearsal stages. (Giesecking and Leimer 2010, 24-26). The method encourages *intellectual engagement with the music*. Pianists are urged to understand the theory and structure behind the composition, thus fostering a deeper connection with the music beyond mere technical proficiency (Giesecking and Leimer 2010, 30-32).

The book is not limited solely to mental learning and memorization; it also addresses individual instrumental study, approaching it from a perspective that combines insights from the mental approach with traditional instrumental practice methods. It offers suggestions that today are seamlessly integrated into the high-level pedagogical practice of modern performers.

The method advises against excessive physical repetition, which they believed could lead to mechanical and uninspired playing. Instead, by relying on mental rehearsal and focusing on thoughtful practice, pianists can avoid over-practicing and develop a more artistic and controlled technique. Leimer and Giesecking recommend starting practice by working with hands separately, especially in complex passages. This approach helps students focus on the technical and expressive details of each hand's parts before combining them.

Once mental preparation is complete, physical execution is introduced slowly and methodically. The student is initially encouraged to play at a slow tempo to ensure accuracy and control. Gradual increases in tempo are applied only after the piece has been thoroughly internalized mentally and physically.

The method promotes active listening while playing, focusing on the tone quality and sound production. Pianists are encouraged to focus on how each note is produced and continuously refine their touch and sound.

The authors stressed the importance of relaxation and avoiding unnecessary tension during practice. They advocated for an economy of movement, where the hands and fingers only engage the muscles needed for efficient playing. This approach helps prevent fatigue and injury.

These characteristics define the Leimer-Giesecking approach as a method that prioritizes mental preparation, deep understanding, and thoughtful practice, all contributing to a more profound and expressive performance. The Leimer-Giesecking method did not view visualization as a complete replacement for physical practice but as a complementary tool to enhance learning efficiency and musical understanding. Visualization and mental rehearsal were intended to prepare the pianist thoroughly before physical practice, reducing the mechanical repetition needed for the instrument. By mentally internalizing the score, fingerings, and expressive elements in advance, pianists could approach physical practice with a more precise, focused intent, leading to more efficient and effective sessions.

5. Key Insights from Heinrich Neuhaus's writings on Mental practice

None other than the most famous mentor of the 20th century, teacher of the greatest pianists trained at the Moscow Conservatory like *Sviatoslav Richter*, *Emil Gilels*, *Radu Lupu*, *Igor Zuhov*, *Viktor Eresko*, *Emil Mogilevsky*, *Boris Petrushansky*, among others, **Heinrich Neuhaus (1888-1964)** manages to collect in writing in 1958 for the first time a compendium book that deals extensively issues related to internalized auditory visualization of a musical text in the form of a mental performance.

Full of practical suggestions, *“The Art of Piano Playing” (1958)* also pleads to encourage the development of musicality in the stage personality of the concert pianist performer and the cultivation of a varied sonority, much amplified dynamically, of the standard repertoires that they study and play in concerts.

He was the first modern pianist and pedagogue to emphasize on a large scale through his long-lived pedagogy legacy – both proved during the piano performance classes he conducted and theorized in writing - *the significance of mental practice and visualization in mastering piano performance*. Neuhaus believed that mental practice was integral to both the technical and expressive aspects of playing. A pianist's mental conception of a piece should be previously concluded and well-precepted before approaching the physical instrument.

He primarily advocated for *visualization*, which involves *mentally “seeing” and “hearing” the music internally*. He emphasized that pianists should be able to visualize the notes, dynamics, phrasing, and even finger movements without physically playing the piece. This visualization method was decisive in developing consistency in quality performances in his pupils' playing merely because his teaching method was based on enhancing the vivid internal connection with the score (Neuhaus 1973, 38-40, 75).

Moreover, H. Neuhaus believes that thoughtful, intellectual engagement is the key to mastering technical and musical challenges at the piano. *Mental engagement in high-quality performance problem-solving* is required when addressing how pianists should tackle technical challenges without relying solely on mechanical repetition.

He discusses the *importance of mental problem-solving* when a pianist:

- approaches difficult passages, advocating for a thoughtful analysis of the music and technique before physical practice.
- highlights the role of mental preparation in overcoming technical difficulties.
- engaging the mind first can make physical practice more effective (Neuhaus 1973, 82-85, 109).

Even though he was a devoted advocate of mental practice, Heinrich Neuhaus *did not view visualization methods as a replacement for physical practice* but as a complementary tool. He believed combining mental and physical practice leads to better overall performance and a deeper musical understanding. By alternating between the two, pianists can avoid repetitive strain and ensure their practice remains thoughtful and efficient.

6. Conclusions

Heinrich Neuhaus's writings did not directly influence Walter Gieseking. Gieseking's formative years as a pianist and his approach to mental rehearsal were shaped primarily by his teacher, Karl Leimer, and the method they developed together, known as the Leimer-Gieseking method. This method emphasized mental practice, memorization, and internal visualization, key principles central to Gieseking's approach to learning and performing music. While Neuhaus's ideas on piano pedagogy and mental engagement share similarities with the Leimer-Gieseking method—such as the importance of mental visualization and inner hearing—it is unlikely that Neuhaus influenced Gieseking. The two had different educational backgrounds and operated within different pedagogical traditions. Gieseking developed his approach in Germany, while Neuhaus, a Russian-German pianist, had a distinct lineage of pedagogy rooted in Russian piano traditions. Neuhaus's seminal work, *The Art of Piano Playing*, was published in 1958 after Walter Gieseking established his career and pedagogical ideas.

Across all the sources, mental practice emerges as a central theme, especially in the teachings of Leimer-Gieseking and Heinrich Neuhaus. Both methods advocate for cognitive rehearsal and visualization as essential tools in the pianist's toolkit, allowing musicians to mentally internalize music before approaching the instrument.

Both authors and the contemporary pedagogical approach that followed point on three significant achievements, using these techniques:

- enhanced memorization is a mental practice:
- deeper musical understanding:
- problem-solving for technical mastery achievement.

Mental practice aids in more effectively committing music to memory, reinforcing the piece's aural and visual memory. Through mental rehearsal, musicians gain a more profound conceptualization of the piece, including its structure, dynamics, and emotional content. By mentally rehearsing difficult passages, pianists can troubleshoot technical challenges without resorting to mindless repetition of the instrument. Neuhaus and the Leimer-Giesecking method both emphasize the value of reducing the strain of physical practice by engaging in mentally focused work. This reinforces the idea that mental and physical practice complement each other, with the former providing a solid conceptual foundation and the latter refining execution.

One of the core components of these methods is the use of mental imagery and aural visualization. This refers to *visualizing the score* (seeing the notes, phrasing, and finger movements in the mind's eye), and *hearing the music internally through auditory imagery*, which is essential for refining the sound and interpreting the dynamics, articulation, and emotional aspects of the piece. In alignment with studies that *support mental rehearsal for enhancing motor and sensory coordination*, neurological evidence shows that cognitive rehearsal, enhancing all *derivative-specific cognitive processes* involved in piano playing, strengthens the mental links between sound, movement, and expression. A common thread across these studies is *the reduced need for repetitive physical practice*. The Leimer-Giesecking method minimizes physical strain by promoting mental work first. Heinrich Neuhaus also argues that too much mechanical repetition can be counterproductive, resulting in fatigue and technical errors that become ingrained through habit. *By incorporating mental practice, pianists can improve their efficiency*: Musicians can focus on the mental aspects of playing, honing their understanding and then translating that clarity into more efficient physical practice. *By balancing mental and physical practice, pianists can avoid overuse injuries and mental burnout*. Mental rehearsal becomes restorative, allowing for more focused, effective physical playing.

Both the Leimer-Giesecking method and Neuhaus *stress a holistic approach to piano performance*. Mental practice is about solving technical problems and *integrating technique and emotion*. Connecting deeply with the emotional and interpretive aspects of the music, a pianist is prepared to problem-solve any instrumental technique challenge. H. Neuhaus emphasizes that musical performance is as much about emotional communication as technical proficiency. Mental

rehearsal allows pianists to emotionally connect with the piece in advance, leading to more expressive, artistic performances

Modern research supports the efficacy of mental practice from a neuroscientific standpoint. Contemporary studies show that mental practice engages the brain's auditory and motor regions (through auditory-motor loops), reinforcing the neural pathways necessary for performance without actual physical movements. Mental rehearsal enhances the ability to memorize music through visualization and auditory imagery, helping to strengthen the connections between sound, visual symbols (notation), and physical movement (playing).

Neuhaus's writings align with these modern findings, advocating for the inner hearing and visualization that prepares the brain for performance in the same way physical practice would.

To conclude, *the synthesis of Heinrich Neuhaus's writings, the Leimer-Giesecking method, and modern research* on mental practice suggest that an integrated approach to piano performance, combining mental and physical practice, is an important key to achieving technical proficiency and artistic mastery. By leveraging the power of mental practice, musicians can approach their craft with greater focus, artistry, and confidence, achieving excellence in their technical and expressive abilities.

The research affirms that mental engagement with music enriches emotional interpretation, making mental practice an essential tool for artistic development, not just technical precision.

7. References

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