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Research on Memorization Pedagogy for Modern Piano Works Based on Multi-Memory Encoding and Analytical Methods

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Abstract: Modern piano works are atonal with thick textures. Students find them hard to memorize and often forget them on stage. This problem has troubled piano teaching for a long time. This paper offers a memorization framework to solve this problem. It comes from cognitive psychology and music analysis. The framework has three parts. Students analyze the musical structure and break the atonal music into logical sections. These sections become easier to understand. This step gives the music clear meaning. Students use verbal strategies and describe the music in their minds. This helps them hold the information in working memory. Students combine visual images with muscle memory. This creates a dual system of image and body feeling as it uses several senses at once. Early analysis suggests this method may help students learn faster and also lower their stage anxiety. It can make modern piano works easier to teach and learn.

Keywords: Multi-memory encoding; Semantic encoding; Memorization pedagogy; Modern piano works; Schoenberg; Scriabin

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1. Introduction

Pianists have played from memory since Liszt's time. This practice is also a basic part of piano teaching. But things changed in the twentieth century. The old tonal system started to fall apart. Composers began to write in new ways. Scriabin's Fifth Piano Sonata (Op. 53, 1907) moved away from traditional major-minor harmony. It created a new musical language outside tonality. It opened a new path for the piano sonata [1]. Schoenberg's Piano Suite (Op. 25, 1923) was the first full twelve-tone work. It marked the start of the atonal era. These works gave the piano a much wider range of sounds. But they also brought a new problem for performers: how do you remember this music?

The difficulty is not just about technique. There is a deeper issue. Older memorization methods depend on tonal expectations and harmonic logic. These methods do not work in atonal music [2]. Studies have found

a clear gap in memory training for post-tonal piano music. Musical memory is not one single skill. It uses several types of memory: aural, visual, tactile, and motor [3]. In tonal music, these types work well together. But in atonal music, the pitch direction and harmony are hard to predict. Performers face two problems at once. They cannot tell where the music is going. They also cannot remember what comes next.

How should music educators respond to this problem? There are two main views. One view supports intentional memorization. This means setting memory goals consciously. It also means using rational analysis. The other view supports unintentional memorization. This means letting memory form naturally through playing the music [4]. But the real question is not "should we memorize deliberately?" It is "how does memory actually work?" For most piano students, rational analysis from intentional memorization is the key. International research supports this view. Stellou and Jakubowski's survey found that most teachers see musical memory as a skill. It can be developed through practice. However, multi-sensory encoding strategies are not used evenly in teaching [5]. Farré Rozada points out that atonal works have existed for over a century. Yet there are still no proper teaching tools for memory training in this repertoire [6]. This paper tries to fill this gap. It proposes a triple-encoding memorization pedagogy based on cognitive psychology.

2. The cognitive-psychological foundations of musical memory

2.1. The nature of musical memory: Multi-system collaboration

Musical memory is not a natural gift. You either have it or you lack it. It is the result of multiple systems working together. McKinnon divides it into memories of the ear, the eye, touch, and movement [7]. Savshinsky looks at it from a pianist's perspective. He identifies analytical-organizational memory, perceptual-contextual memory, affective-gestural memory, and self-regulatory processes [8]. Alexeyev argues that a pianist needs at least three types of memory. These are aural memory, logical memory, and motor memory.

What do these types do? Aural memory encodes and recalls melody, harmony, timbre, and rhythm. It usually plays the dominant role in musical memory [7]. Motor memory encodes performance movements and their combinations. It is the basis of technical skill. Visual memory includes two things. One is the mental image of the score. The other is the "topography" of the keyboard. This means knowing where the white and black keys are. Research shows that when musicians imagine playing, the brain areas for vision and movement are activated. This is similar to actual performance [9]. This finding supports the use of "visual imagination" as a training tool. Logical memory handles the formal structure of the work. It also retains interpretive plans [7]. It is especially important in memorizing atonal works. When tonal hearing cannot guide the performer, the performer must rely on a rational grasp of the work's architecture. Emotional memory deals with the affective character of the music. It also deals with feelings experienced during performance. It contributes to memory consolidation.

In a healthy musical memory, these types work as an integrated whole. The aural component usually takes the lead [7]. But when aural memory is weakened by unpredictability, the other types must step in. They provide support. This point will become central to the pedagogical framework proposed later.

2.2. Reproductive memory and reconstructive memory

Besides classifying memory by sensory modality, we can also divide it by how it operates. Here the distinction is between reproductive (mechanical) memory and reconstructive (creative) memory [7].

Reproductive memory relies on mechanical repetition. It builds neural connections. But it has a clear limitation. It works only under the original conditions. Even a small change in the environment can disrupt it [8]. Reconstructive memory is different. It is based on active processing. It selectively organizes information. It associates and re-creates information. As one researcher put it, "memory is not a photograph of reality. It is a complex process that develops over time" [7].

Why does this matter for modern piano works? Think about how tonal music works. Tonal music gives the performer a clear plan. Pitch direction and harmonic function are like a road map. This helps reproductive memory work well. The performer only needs to remember the changes and small details in that plan. But atonal music is different. It takes away this plan. Pitches do not have clear connections. Rhythms often break normal patterns. The performer cannot guess the next note. So the performer must rebuild the music's logic from the beginning. This means finding the rules of pitch organization by studying the music. It also means turning abstract note groups into clear, easy-to-understand pieces of information. This is done with semantic encoding. This idea is the basis of the memory strategy in this paper. Modern works need active, creative rebuilding. They cannot rely on mechanical repetition.

3. Pedagogical framework: The triple-encoding memorization method

Based on the theoretical groundwork above, the author proposes a memorization pedagogy with three progressive steps. The guiding logic is simple. It moves from understanding to internalization. It moves from analysis to automation. The process begins with rational analysis to build cognition. It proceeds to consolidation through verbalization. It ends with deepened, automated memory through multi-sensory integration.

3.1. Step one: Structural analysis and semantic encoding

The usual way to memorize tonal music starts with listening. You use aural recognition of tonal relationships and melodic direction. You build a cognitive map. This method does not work for atonal works. There is no tonality to "hear." There is no functional logic connecting the pitches. The analytical phase of memorizing modern works must shift. It must shift from "listening" to "deconstructing." The performer needs to analyze the work's compositional logic. This means identifying the prototypes and transformations of its pitch series. This is done through pitch-structural analysis. It also means finding one's own segmentation through structural division. The goal of this phase is no longer to "understand" the music aurally. It is to "comprehend" its structural logic on an intellectual level.

3.1.1. Methodological principles and operations

Semantic encoding is the most basic step. Its core operation is systematic structural analysis of the work. You break down the chaotic atonal material. You classify it. You organize it into logical units that the mind can grasp. Mutsmakher points out that modern psychology divides textual memorization into three operations. These are semantic grouping, identification of semantic anchor points, and correlation processes [3].

What does semantic grouping mean? It means breaking a piece into parts. Each part has its own logic. These parts can be big sections. For example, exposition, development, and recapitulation. They can also be small units. Primary and secondary themes are units. Transitional passages are units. Short phrases and motivic figures are also units. Each part should make musical sense by itself.

Semantic anchor points are another part of the process. They are key memory markers inside each unit. A thematic entry point can be a marker. A turning point in the row can be another marker. These markers work like "re-entry triggers." If you lose your place during a performance, they help you get back on track.

The correlation process ties these units together. It finds thematic changes. It tracks row shifts. It follows motivic developments. When these links are made, the parts start to join into a whole. Memory is no longer a pile of separate bits. It becomes a stable, connected network [3].

Mutsmakher also makes an important point. In works with repetition or similar structures, you need to know what is the same and what only looks the same. Imitations need careful checking. Varied repetitions need careful checking. Modulating sequences need careful checking [3]. This point matters a lot in modern works. In atonal music, "repetition" is often not a direct copy. It is a changed return in a new pitch or rhythm setting.

These points lead to four teaching steps. The first step is to see the whole structure. This gives a first look at the work's form. The second step is to name themes or motives. Give each theme a name, like "soaring theme" or "will theme." Naming is a type of encoding. A named musical part changes from a "sound event" into a "concept." The third step is pitch-structural analysis. This finds the work's "organization code." The fourth step is to draw a structural diagram. This turns the analysis into a visual "cognitive map." Students can then recall the work from memory without the score. You can put this diagram on the score. You can also draw it on a separate page. The real test is whether the student can recall its contents from memory.

3.1.2. Practical analysis I: Schoenberg's Piano Suite, Op. 25

Schoenberg's Piano Suite, Op. 25, is the first complete twelve-tone work. It has six movements. They are Prelude, Gavotte, Musette, Intermezzo, Minuet, and Gigue. The work uses the framework of the Baroque dance suite. This work provides very clear semantic encoding material.

The whole piece is based on a single twelve-tone series. It has four transformations. These are prime, retrograde, inversion, and retrograde inversion. In teaching, you can guide students to extract this series. You can visualize its pitch order. Then you can trace how the four transformations are distributed across the movements. This tracking process is itself a form of semantic encoding. Students no longer remember "isolated notes." They remember "the four forms of a series and their appearance across different movements." Also, although Op. 25 is a strictly twelve-tone work, its serial material contains "different tonal elements." The first note of the series is E. It is "placed in important structural positions throughout the development of the musical idea. It is supported by other pitch levels. This creates an implicit tonal center around E at the subsurface level of the work"[9]. Teachers can help students recognize these hidden tonal anchors. They serve as extra semantic reference points. This further reduces the burden of memorization.

3.1.3. Practical analysis II: Scriabin's Fifth Piano Sonata, Op. 53

Scriabin's Fifth Piano Sonata was composed in 1907. It marks the composer's decisive turn in sonata form. He abandoned the multi-movement classical model. He adopted a single-movement structure.

The epigraph before the work provides a semantic framework for the whole piece. It says: "I call you forth to life, hidden desires! You who are drowned in the dark depths of the creative spirit, you timid germs of life, to you I bring daring!" [1]. In teaching, students can map the epigraph onto the musical structure. The introduction corresponds to "dark depths." The exposition corresponds to "the emergence of desire." The

development corresponds to “struggle and transformation.” The coda corresponds to “ecstatic flight.” The various themes of the Fifth Sonata are sharply contrasted in character [1]. The introductory theme is chaotic and violent. The primary theme is light and soaring. The transition theme is imperious and forceful. The secondary theme is lyrically yearning. The closing theme has a horn-call-like quality. Each theme should be given a descriptive name in teaching. This helps students connect abstract notes to concrete character images. The “mystic chord” runs through the whole sonata. It is a key unifying element [1]. Once students can recognize “here again is a transformation of the mystic chord,” the confusing sounds gain a logical “sense of belonging.” Some researchers have also noted that Scriabin uses motivic rhythm. He uses it to symbolize the opposition of “masculine” and “feminine.” This symbolic system itself is a form of semantic encoding [1].

3.2. Step two: Verbalization strategies and working memory reinforcement

Memorizing tonal music relies on singing the melody in your mind. This consolidates memory. But this approach often fails with modern works. Atonal melodies cannot be sung. Serial melodies carry no aural expectation. Modern works need a different approach. You need to shift from “audible” memory to “articulable” memory. You use language to describe structural features and pitch relationships.

What does this look like in practice? You transform abstract cognition into verbal expression through structural recitation. You link language encoding to motor execution through thematic/motivic labeling. You reinforce the connection between logic and movement through verbalized slow practice. You test memory sufficiency through instrument-free verbal recitation.

3.2.1. Methodological principles and operations

The core of verbalization strategies is transforming musical information into language encoding. You use inner vocalization and verbal description. You reinforce information retention in working memory. From a cognitive psychological perspective, working memory is the critical gateway. Information moves from sense memory into long-term memory through this entry point. Baddeley’s model splits working memory into parts. These parts include a main control system and three smaller systems. The smaller systems are the phonological loop, the visuospatial sketchpad, and the episodic buffer. The sound loop deals with keeping and repeating language information for a short time [10]. Talking methods switch on the sound loop. They change musical information into language form. This makes musical memory stronger through the sound coding path.

Studies show that musicians read the score without playing to help memory. This involves pictures in the mind and careful study skills [11]. One finding stands out. Remembering the left-hand part connects to a word-based thinking habit. It also connects to a careful music-analysis habit [12]. This matters because modern piano works often have hard left-hand parts. These passages are much harder to memorize. Talking methods may be especially helpful in those passages.

Talking about music is not a new idea in music education. Teachers have not given enough importance to its role in remembering modern piano pieces. You cannot use singing to help with atonal music. Talking provides another way to store information. Word-logic memory is a known separate type of musical memory. It needs more focus in memorization [7]. Stellou and Jakubowski’s survey agrees with this. Methods that use analysis are important in teaching. Training the hearing and seeing paths also matters [5].

Teachers can use several ways of using talk to help students. Describing the structure aloud is one

option. Students tell about the shape of a piece in their own words. This turns vague ideas about structure into clear words. Naming the themes is another technique. Students give each theme a name before playing it. This connects words to action. Slow practice while speaking is a third option. Students speak about what they play while practicing slowly. This links speaking to body movement. Reciting without the instrument is the last one. Students tell about the structure of the work without playing. This checks their true memory and helps logical remembering [4].

3.2.2. Practical analysis I: Schoenberg's Piano Suite, Op. 25

We can check the effect of these talking techniques with the Prelude of Schoenberg's Piano Suite, Op. 25. Teachers can ask questions to activate students' understanding of serial music. For example, teachers ask about the first row form of the opening section. Students give the right answer. The P-0 form starts on pitch E. Then teachers ask about tonal changes. Students find the inverted rows at measure 16. They confirm it is the I-5 form [9,13]. This kind of interactive questioning makes students explain abstract twelve-tone theory in their own words. So the complex modern music theory becomes easier to understand. It also helps students remember the knowledge for a long time.

3.2.3. Practical analysis II: Scriabin's Fifth Piano Sonata, Op. 53

The benefits of talking techniques also show in teaching more traditional modern piano works. Scriabin's Fifth Piano Sonata, Op. 53 is a good example. Early in learning, teachers can help students find the main thematic materials. Students can recognize the soaring theme marked Presto con allegrezza after the introduction. They can also tell the difference from the intervening will theme that breaks the melodic line [1]. This kind of verbal identification training changes how students remember single notes. It helps them see the whole melodic connection and thematic layout. This systematic way of thinking gives them a strong base for accurate and stable musical memory.

3.3. Step three: Visual-muscle dual-track integration

Unlike tonal music, modern works offer no aural guidance for navigation. We must strengthen the visual and tactile channels. On the visual front, you need to cultivate a keen perception of keyboard topography. You imagine keyboard positions with your eyes closed. You mentally play complex leaps in your mind. This reinforces spatial memory. Research shows that when musicians simply imagine playing, the visual and motor regions of the brain are already activated [11]. This suggests that visual imagination itself is an effective form of neural training. On the tactile front, every interval in modern works is "non-standard." The fingers must learn to measure each distance precisely. They cannot rely on habitual movement patterns. Once you choose fingerings, you must not change them. This is the foundation of reliable muscle memory. The core task at this stage can be summed up simply. In the absence of aural navigation, you maintain memory stability through visual and tactile backup channels. If the ears "fail" on stage, the eyes and fingers can still guide the way.

3.3.1. Methodological principles and operations

This is the last step of the three-step method. It is important for making memory solid and automatic. The main idea is to use visual imagination and muscle memory at the same time. This creates a multi-sensory

system where different types of memory work together.

Hoffmann created a well-known formula for memorization. He broke it into four stages. The first stage is studying the score without the instrument. You read the music carefully and hear it in your head. The second stage is studying the score at the instrument. You practice the piece in sections. You choose fingerings and plan your movements. The third stage is playing without the score. You play from memory. This strengthens aural, motor, and logical memory all at once. The fourth stage goes further. You play without the score and without the instrument. You rely only on your inner hearing and mental images [7]. Hoffmann said this last stage is the hardest. But it gives the most solid memory [7].

New research in neuroscience supports this old method. Farré Rozada's work also shows that mental practice is valuable. It strengthens memory and helps reduce performance anxiety [2,6]. Mental practice is not just "thinking about the music." It creates brain activity that is close to real playing. This finding supports the use of visual imagination in teaching. Visual-muscle integration is more than a memory tool. It also gets the mind ready for performance. It helps build confidence on stage.

The practical operations can be implemented in several dimensions. Fixed fingerings: in the early stages of learning, determine optimal fingerings for each difficult passage. Keep them fixed. Changing fingerings disrupts the establishment of muscle memory. McKinnon stated clearly: "The fingering chosen should suit both the hand and the musical meaning of the passage. Once decided, it should not be changed" [8]. Eyes-closed slow practice: after students have mastered the fingerings, have them play at an extremely slow tempo. They keep their eyes closed. They focus entirely on tactile sensations and the topography of the keyboard space. By eliminating visual feedback, this exercise compels performers to depend on tactile and motor sensations for orientation. In the silent internal playing technique, students close their eyes and mentally "play" the work, imagining finger movements, sound production, and musical expression. Because it requires no piano, it can be practiced anywhere, and it ranks among the most effective methods of memory consolidation [7]. A survey of practice strategies among advanced pianists revealed that keyboard imagery became the most favored method, a result that signals a meaningful shift away from aural imagery toward visual-motor imagery [11].

How can performers prevent memory from becoming overly attached to a single practice setting? Hoffmann addressed this concern by recommending environmental variation. He observed that memory often becomes tied to specific environmental cues, warning that "if we make such a mistake in the concert hall, memory will let us down in the most unexpected ways." To counteract this tendency, he advises practicing the piece in many different places, a strategy that helps separate the familiar environment from the musical work in memory [8].

3.3.2. Practical analysis: Scriabin's Fifth Piano Sonata, Op. 53

Consider the development section of Scriabin's Fifth Sonata. This is the most technically complex part. It is also the most easily forgotten part. Visual-muscle dual-track integration training can be implemented as follows. Determine fingerings for each figuration in the development's rapid passages. Mark them on the score. Never change them thereafter. Play the development with eyes closed at an extremely slow tempo. Focus on tactile sensations and finger movement trajectories. When away from the piano, close your eyes. Imagine the hand crossings. Imagine the sense of distance in leaps. Imagine the positions of chords on the keyboard. Before sleep or during breaks, close your eyes. Completely "play" through the development in your mind. Do this from the first note to the last. Include dynamic changes and expressive nuances. Through

this systematic multi-sensory training, performers build memory "backups" across multiple channels. Even if one channel fails temporarily on stage, the others can still compensate.

4. Synergistic effects and pedagogical implementation of the triple encoding

4.1. How the three encodings work synergistically

The three encoding ways do not work alone or in a set order. They work together and help each other during music memorization. Meaning encoding builds a clear mental map for the player. It makes the structure and melody of the whole piece clear. Muscle memory without this structure can lose direction easily. A complete mental map helps the player recall the music correctly on stage. Word encoding gives steady support to the player's working memory in daily practice. It turns unclear musical ideas into clear word cues. These word cues help the player during a concert. Strong word memory helps the player recover fast after a memory slip. Body encoding builds automatic playing habits. It changes careful technical practice into smooth body movements. After this becomes automatic, technique uses little mental effort. The player can focus more on musical feeling and emotion during a public show.

To put it simply: semantic encoding answers "what." Verbal encoding answers "how." Sensory encoding makes the "how" feel natural. All three are necessary. Memory is lost without semantic encoding. Memory is weak without verbal encoding. Memory is tense without sensory encoding. Research supports this idea. Fonte *et al.* found that professional pianists often use mental practice, chunking, and different types of memory when learning modern works [14]. These strategies are very close to the triple-encoding model. Pineda *et al.* also found that performers build their mental picture of music through multiple channels and layers of processing [15]. This gives further support to the framework proposed here.

4.2. Phased implementation arrangements

Teachers may wonder about the specific classroom application of this memorization framework. The whole teaching process can be split into four progressive stages. Every stage carries unique teaching priorities and training goals.

The initial stage centers on semantic encoding training. Learners sort out musical structures and mark core thematic materials. They build a complete cognitive framework for targeted piano works. Verbal encoding practice dominates the second training stage. Students conduct oral recitation and slow, verbally guided practice. All internal cognitive structures are converted into explicit linguistic expression.

Sensory encoding serves as the core task of the third stage. Learners adopt fixed fingerings for standardized practice. They try slow practice and visual imagery training with eyes closed. Such practice helps form stable automatic musical memory. The final stage integrates all three encoding modes as a whole. Students finish simulated stage performances and full-memory playing. They also complete self-checking and learning reflection after practice [7].

Individual differences always exist in students' musical learning styles.

Some learners achieve better results through auditory perception. Other learners rely more on visual observation and kinesthetic practice. Teachers can adjust the teaching focus at each stage in a flexible way. These adjustments should match students' dominant learning habits and strengths [5,7].

5. Conclusion

This paper draws on cognitive psychology theories. It develops a triple-encoding memorization method. The method aims to solve common memorization difficulties in modern piano works. This systematic strategy includes three core training dimensions. Structural analysis and semantic encoding help students build clear musical cognitive maps. Verbalization practice strengthens learners' working memory during learning. Visual and muscular sensory integration further automates long-term musical memory formation.

This study has two notable research values for piano pedagogy. It turns abstract memory theories into practical classroom teaching tools. Traditional piano memorization training usually depends only on auditory and muscle memory. The proposed framework combines semantic, verbal, and sensory memory modes. It gives students more effective ways to memorize atonal piano repertoire. This research also fills a clear gap in post-tonal music education. Farré Rozada points out that targeted memory training for modern non-tonal music is still insufficient. The triple-encoding model fills this research gap[6].

The framework still has limitations. It focuses more on theoretical construction at this stage. Practical teaching effects need further empirical verification. Future studies can test this method with piano pieces of different difficulty levels. Researchers can also explore its use in teaching other instruments. These limitations do not reduce the value of this paper. It provides solid theoretical support for modern piano memorization teaching. It also offers feasible practical guidance. The tonal music system has changed continuously over the past century. Traditional memorization strategies for tonal music no longer fit contemporary piano learning needs. Modern piano repertoire needs new memorization training systems. This is the core standpoint of this research.

Disclosure statement

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