A Multisensory Approach to Memorization

Daniel Linder

A Multisensory Approach to Memorization

A multisensory approach to repertoire preparation combines aural, kinesthetic, visual, and analytical knowledge of music. Such an approach is valuable as a method of learning and memorizing music efficiently, thoroughly, and lastingly, and as a vehicle for developing self-awareness and independence in the learning process. This article will provide suggestions for engaging aural, kinesthetic, visual, and analytical memory and how these cognitive systems can effectively assist the performer in repertoire preparation. In addition to offering a general discussion of memorization strategies for each type of memory, specific ideas will be presented for memorizing two popular teaching pieces: the first movement of Clementi's Sonatina in C Major, Op. 36 No. 1, and "The Bear" from Rebikov's *Les étrennes de Noël*. This article aims to give piano as well as other instrumental teachers and students insight into the process of learning and memorizing music effectively, and to encourage further exploration of the various ways of knowing music.

Strengths of a Multisensory Approach

Sensory information in aural, visual, or kinesthetic form, once committed to short-term memory, is encoded to long-term memory through repeated rehearsals. Most musicians know this intuitively, and have used this information for centuries. A multisensory approach makes use of the intentional targeting of different sensory inputs in repeated exercises to enhance encoding of music to long-term memory. Encoding memory via multiple sensory systems creates what Chaffin et al. call "safety nets" that ensure uninterrupted performance from memory.[1] If a memory lapse occurs in one memory system, the performer can rely on memory in another system to continue the performance uninterrupted.

Short-term memory can only hold a small amount of information: approximately five to nine bits of information according to George Miller's well-established theory.[2] Chunking, the binding together bits of information (e.g. individual notes) into larger meaningful units or "chunks" (e.g. triads), facilitates the encoding of vast amounts of sensory information from short-term to long-term memory.[3] Music has many layers of information that can be chunked in different ways

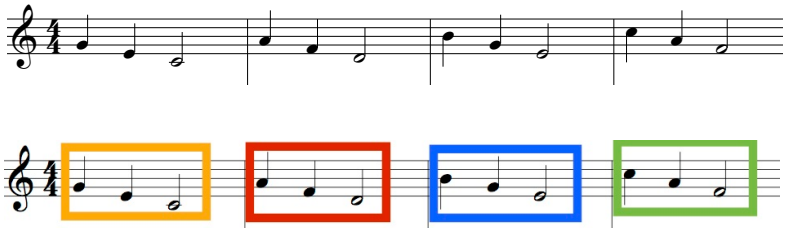
[1] Roger Chaffin, Topher R. Logan, and Kristen T. Begosh, "Performing from Memory" in *The Oxford Handbook of Music Psychology* (NY: OUP, 2009), 353. Dirksen's "multiple shelves" metaphor is similar to the "safety net." See: Julie Dirksen, "How Do We Remember?" in *Design for How People Learn* (Berkeley: New Riders, 2012), 81–121.

[2] George A. Miller, "The Magical Number Seven plus or minus Two: Some Limits on Our Capacity for Processing Information," *Psychological Review* 63, no. 2 (1956): 8–97.

[3] Ibid., 91.

using the various senses: for instance, one can chunk the simple excerpt below (Figure 1) using each of the four memory systems as described in the section that follows.

Figure 1.



Ascending Broken Triads

Aural Chunks

- Each measure has the same melodic contour of two descending thirds.
- Each measure has the same rhythmic pattern.

Kinesthetic Chunks

- The melodic range of each measure spans a 5-finger pattern.
- Each measure can be played with the same fingering (fingers 1, 3, 5) in the right hand.
- The hand position and fingering pattern moves up a step from measure to measure.

Visual Chunks

- There is an alternating pattern of three line notes in the first measure, then three space notes in the second, etc.
- Each triad chunk is built out of two white-note to white-note thirds on the keyboard.

Analytical Chunks

- Each measure includes a major or minor triad. The passage is arranged in the sequence: Major – Minor – Minor – Major.
- The passage is constructed using the first four diatonic triads in C Major presented in ascending order.

These are only a few examples of the many possible chunks that might be derived from this passage. All chunks should be meaningful to the learner; as such, the process of chunking creates deep and lasting knowledge of the music.

Every individual will naturally gravitate toward one or more select sensory system(s) and may avoid other systems based on his or her personality and aptitudes. The nature of the music being learned might also affect the preference for a specific sensory system. Many students, especially those who do not conceive of memorization as a distinct phase of the learning process, do not possess a "toolkit" for memorizing music and suffer for it: playing from memory contributes to performance anxiety, and poor memorization habits result in inefficient use of practice time. To learn music and memorize efficiently and independently, it is useful for students to learn to "self-regulate," or learn metacognitive strategies to catalyze learning and

self-monitor personal growth.[4] Students with self-regulatory memorization skills have heightened awareness of their natural memorization modes, and are able to consciously strengthen weak memory systems and develop effective processes for memorizing music. Teachers can help their students memorize music and play from memory with confidence by exploring and engaging the various types of memory. They can also help their students develop self-awareness and independence in their learning processes using the various memory systems.

Aural Memory

Aural memory is the ability to recall musical sound, and at its most basic level is manifest in the ability to recognize a melody or musical passage. Deeper aural memory is demonstrated in the ability to reproduce a melody or passage by playing, singing, or hearing it inside one's head. Aural memory is inherently tied to active listening, the most fundamental musicianship skill according to many scholars and pedagogues. Josef Hofmann writes in the "General Rules" section of his 1920 treatise on piano playing to "watch well that you actually hear every tone you mean to produce. Every missing tone will mean a blotch upon your photographic plate in the brain. Each note must be, not mentally but physically, heard…"[5] Hofmann emphasizes the essentiality of active listening while playing, and inherently links this skill with the process of memorization with his reference to the "photographic plate" of the piece forged in the brain.

Walter Gieseking and Karl Leimer similarly emphasize active listening as a fundamental skill for musicians, and frequently refer to the "visualization" of music away from the piano to memorize and maintain memory, a process that requires active inner hearing and sound production.[6] Gieseking and Leimer's "visualization" is similar to Edwin Gordon's concept of "audiation," defined as the process by which musicians "hear and comprehend music for which the sound is no longer or may never have been present."[7] While aural memory can and should manifest itself in the physical sense through the ability to recognize and sing the melodic lines of a piece, a truly secure aural memory comes through the ability to visualize or audiate a particular melody, passage, or entire piece.

As Hofmann, Gieseking and Leimer, and others suggest, slow practice with active listening is an essential step in the process of encoding the aural memory of a piece. In addition, musicians can move beyond this fundamental work using exercises at and away from the instrument to

[4] Monique Boekarts and Marku Niemivirta, "Self-Regulated Learning: Finding A Balance Between Learning Goals and Ego-Protective Goals," in *Handbook of Self-Regulation* (London: Elsevier Academic Press, 2005), 418.

[5] Josef Hofmann, *Piano Playing, with Piano Questions Answered* (Bryn Mawr, PA: Theodore Presser Company, 1920; reprint, Mineola, NY: Dover, 1976), 21.

[6] Walter Gieseking and Karl Leimer, *The Shortest Way to Pianistic Perfection* (Bryn Mawr, PA: Theodore Presser Company, 1932; reprint, Mineola, NY: Dover, 1972), 9–12.

[7] "Audiation," *The Gordon Institute for Music Learning*, accessed July 20, 2017, http://giml.org/mlt/audiation/.

strengthen aural knowledge and memory of a piece. Depending on the nature of the music and the individual student's needs and tendencies, these might include listening, singing, audiation, and transposition.

Listening

- This would include listening to recordings or live performances of the repertoire. Teachers can help their students to listen actively and critically with guiding questions or by asking students to compare performances of a work.

Singing

- Teachers could encourage students to sing individual lines of a piece (the melodies, countermelodies, accompaniments, etc.) utilizing solfège syllables, scale degrees, note names, or finger numbers. They could make up words for the melodic lines to enhance memory and emphasize the character or imagery of the music. Vocalizing a line with nonsense syllables emphasizing the meter, articulation, dynamics, or other salient features of the music might also be beneficial for improving aural memory.

Audiation

- This skill can be fostered by mentally producing the individual musical lines in the mind's ear without playing or singing. Students could work towards eventually attempting to audiate two or more lines simultaneously in solfège, using other meaningful syllables, or with an imagined piano sound.

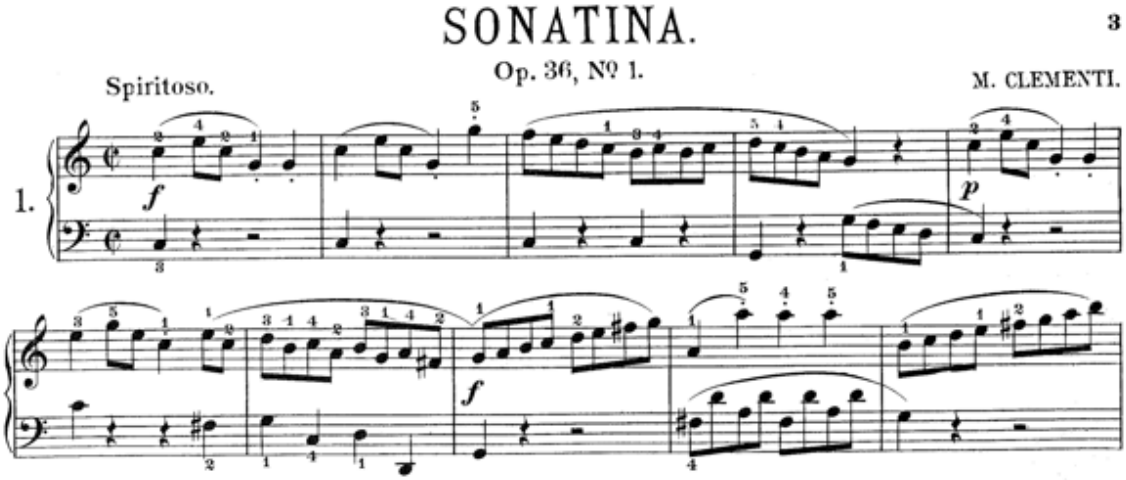
Transposition

- By transposing—sections or entire works to related and distant keys by ear, students can strengthen their aural memory of tonal works.[8]

Because the first movement of Clementi's Sonatina in C Major, Op. 36 No. 1 (Figure 2) epitomizes classical tonal language, singing and audiating both the left and right hand parts of the piece using solfège syllables or scale degree numbers will help reinforce the aural memory of the piece. This is perhaps preferable to singing on neutral syllables because it creates confluence with the analytical memory by reinforcing the tonal plan of the piece. Singing finger numbers for the musical lines in each hand is another strategy for memorization that will simultaneously engage the tactile or kinesthetic sense.

[8] Abby Whiteside discusses the value of transposition for strengthening active listening and aural memory. See: Abby Whiteside, *Indispensables of Piano Playing* (New York: C. Scribner's Sons, 1955; reprint, Portland, OR: Amadeus Press, 1997), 62–63.

Figure 2.

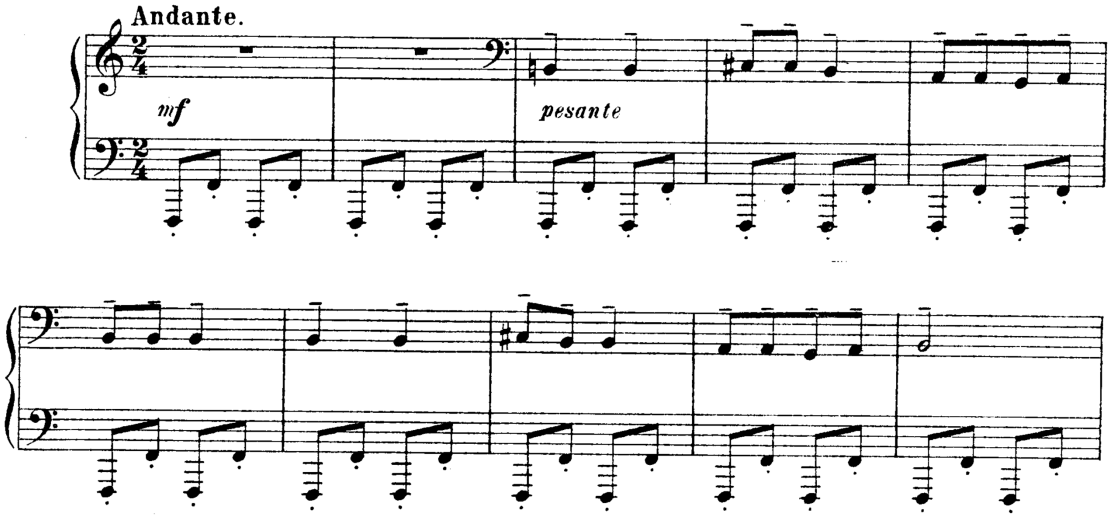


Muzio Clementi, Sonatina in C Major, Op. 36 No. 1: I. Spiritoso, mm. 1–10[9]

Solfège syllables are less useful for encoding aural memory in a piece like "The Bear" by Vladimir Rebikov, since it utilizes the whole tone scale. It would be useful to practice singing and audiating the whole tone scale starting on G before singing and audiating the melody. Students might enjoy singing the melody with made-up words such as the following:

Bears come out to play,
Little bears come out to play.
It is Christmas Day,
And they want to play.

Figure 3.



Vladimir Rebikov, Ours, from Les étrennes de Noël*, mm. 1–10*[10]

[9] Muzio Clementi, *Six Sonatinas for the Piano*, Op. 36 (New York: Schirmer, 1904), 3.
[10] Vladimir Rebikov, *Les étrennes de Noël* (Moscow: P. Jurgenson, 1913), 5.

Kinesthetic Memory

Kinesthetic memory is not one unified system but rather a larger category that includes motor memory (for automatic execution of a movement), tactile memory (of how it feels to play a passage), and spatial memory (of the distances between notes in a passage, or of how the arms and hands must move in space to execute a passage). Performers, pedagogues, and scholars universally recognize the existence of kinesthetic memory, and it is generally understood to be basic and easily developed, although unreliable.[11] The fundamentality and unreliability of kinesthetic memory, and particularly motor memory, are tied to the tendency of physical sensation to be encoded in memory through horizontal associative chains in which each action cues the subsequent action in the sequence.[12] Associative chains facilitate playing a piece from beginning to end but are easily disrupted. Furthermore, because the kinesthetic sense is closely linked to the emotions and the endocrine system, kinesthetic memory is often weakened and eroded during the excitement and anxiety of performance.[13] It is therefore dangerous to rely only on kinesthetic memory in performance, and it is essential to couple this memory system with more reliable systems such as aural, visual, or analytical memory.

Slow practice as well as rehearsing at tempo will naturally build up motor, tactile, and spatial memory over time, but students can learn to consciously encode kinesthetic memory in a variety of ways using eurhythmic exercises, choreography, and physical visualization.

Eurhythmic exercises

- Clapping, tapping, or dancing the rhythm can be used to effectively encode the motor and tactile memory of the music. Students can also conduct the meter of a passage while singing or vocalizing individual lines of the music.

Choreography

- Mapping hand positions and silently moving hands to the positions required for playing a passage can encode spatial memory. Memorizing and rehearsing fingering patterns away from the instrument will also aid in encoding tactile memory. Rehearsing larger arm movements such as hand crossings and leaps away from and at the instrument is another effective way to encode tactile and spatial memory.

Physical visualization

- This practice is akin to audiation and might include mentally simulating a play-through of a passage (for motor memory), imagining the sensation in the hands, arms, and body while playing a passage (tactile memory), or imagining the movements across the topography of the keyboard (spatial memory). Research in sports medicine and cognitive science shows that mentally simulated movement engages the same neural mechanisms as actual movement.[14] This research suggests that visualization of movement is similar to physical motor movement in terms of the neural pathways activated in the brain, and that

[11] Roger Chaffin, Gabriela Imreh, and Mary Crawford, *Practicing Perfection: Memory and Piano Performance* (Mahwah, NJ: Lawrence Erlbaum, 2002), 37.

[12] Chaffin et al. (2009), 355.

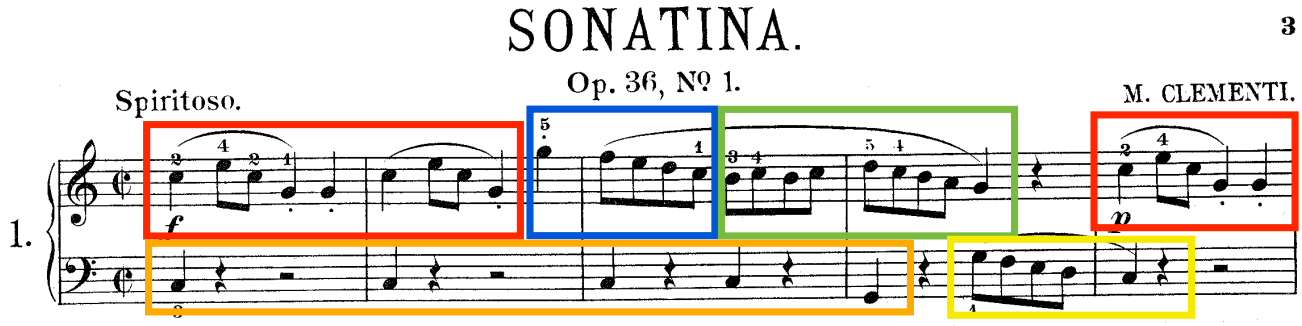
[13] Carrol McLaughlin, *Power Performance* (Tucson, AZ: IntegrityInk, 2008), 29–30.

[14] Muriel Roth et al., "Possible Involvement of Primary Motor Cortex in Mentally Simulated Movement: A Functional Magnetic Resonance Imaging Study," *NeuroReport* 7, no. 7 (1996): 1280–1284.

> visualization of movement could help to better encode and reinforce kinesthetic memory of a passage. This fact is of particular use to musicians who cannot spend long periods at their instrument due to injury, busy schedules, or lack of consistent access to a practice space.

In addition to clapping or tapping the rhythm of a piece hands together, a student might benefit from rehearsing articulation gestures found in the Clementi Sonatina (Figure 2) away from the piano on a flat surface. This choreography activity would be particularly useful for the four-note slur followed by two staccato notes in mm. 1 and 2 and could be further strengthened by visualizing the movement. The numerous hand shifts throughout the piece present a challenge, and a student might benefit from identifying all the hand shifts and rehearsing these movements by silently moving the hands from position to position. Performance of the first system requires three shifts in the right hand and one in the left, as illustrated in Figure 4.

Figure 4.



Hand Shifts in Muzio Clementi, Sonatina in C Major, Op. 36 No. 1: I. Spiritoso, mm. 1–5[15]

A regular and consistent ostinato is essential for capturing the character of "The Bear," (Figure 3) and students might enjoy marching the rhythm of the left hand eighth note pattern and imitating the heavy, lumbering movements of a bear. To fully engage the kinesthetic system, the student can clap the rhythm of the right-hand melody while continuing to march.

Visual Memory

The visual system does not interact with music with the same directness of aural, kinesthetic, or analytical knowledge. Visual memory is discussed notably less than other types of memory in the literature and it seems that performers use this memory system less frequently. Of the forty-six pianists whose interviews were compiled by Imreh and Crawford, only eight mentioned visual memory as valuable. Twenty of the forty-six pianists did not mention visual memory at all, and most of the remaining eighteen who did mention it referred to it as dangerous, unreliable, or personally unimportant.[16]

[15] Muzio Clementi, *Six Sonatinas for the Piano*, Op. 36 (New York: Schirmer, 1904), 3.

[16] Chaffin, Imreh, and Crawford (2002), 26–65; Abby Whiteside similarly refers to visual memory as "unreliable." See: Whiteside (1955/1997), 62.

The visual system typically engages with music and encodes memory in confluence with another memory system. For instance, actively looking at or visualizing a score engages the analytical system, and actively looking at or visualizing the keys necessary to play a passage or the hands playing a passage engages the kinesthetic sense. Visual memory can perhaps be understood as a secondary system that partially relies on memory in other systems but nonetheless contributes to comprehensive knowledge of a piece of music. Because visual memory seems to be naturally accessible and strong for some and weak for others, this is an area where a metacognitive approach is particularly useful: musicians with strong visual memory can capitalize on their strength, and those with weak visual memory can actively work to improve it. Exercises targeting visual memory might include use of intentional gaze, visual aids, and visualization exercises.

Intentional gaze

- This practice can be described as consciously directing visual attention at the score, keyboard, or hands to support the processing and encoding of relevant visual information. A student might first engage the visual system by practicing slowly while intently keeping the eyes on the score, and then by practicing slowly from memory while intently watching the hands playing. Next, the student brings his or her visual attention to each key needed to play a passage. Intentional gaze can also be used to guide hand shifts by purposefully directing the eyes to a destination on the keyboard before moving the hands there.

Visual aids

- These may include creating and referencing annotated scores or maps of repertoire. The simplest form of a visual aid might be simple markings on the score—for instance, circling all the notes affected by a key signature, or circling each hand position as demonstrated in Figure 4 above. Students might use colored pencils to mark repetitions of various motives in a piece, dynamic levels, or entries of a fugue subject among other things. Teachers and students can also experiment with drafting personalized maps highlighting melodic contour, texture, dynamics, or other salient features of a piece.[17]

Visualization

- This practice is akin to audition and includes imagining the score, hands, or instrument in the mind's eye. Visualization exercises might take the form of imagining a light illuminating each note of an individual melody, or eventually a polyphonic passage on a keyboard in the mind's eye, visualizing one's hands playing a passage, or visualizing sections of the score.

Intentional gaze and visualization exercises can easily be practiced with both the Clementi and Rebikov examples by watching the hands and score while playing each piece, intentionally gazing at the keys required to play specific passages of each, and visualizing the same passages. Because each of these pieces strictly adheres to its tonal system, it would be useful to visualize the notes of the C major and G major scales, and the whole tone scale, to support visual memory of the Clementi and Rebikov, respectively.

[17] For a guide to musical mapping, see: Rebecca Payne Shockley, *Mapping Music: For Faster Learning and Secure Memory* (Madison, WI: A-R Editions, 1997).

Annotating the Clementi score to illustrate hand shifts, as in Figure 4 above, will strengthen visual memory in concert with kinesthetic memory. Similarly, Figure 5 combines visual and analytical memory, and the formal maps for each piece, seen in Figures 6 and 7 (all discussed in the next section) further strengthen visual and analytical memory.

Analytical Memory

Many scholars, pedagogues, and performers recognize analytical memory as the essential and most reliable memory system.[18] Of the forty-six pianists studied by Crawford and Imreh, thirty-nine make some mention of this memory system, and twenty-four identify it as personally important.[19] Chaffin and Imreh identify this system as a base-line stream of consciousness or map that prompts the retrieval of motor, aural, (and perhaps also visual) information. Using the term "conceptual memory" instead of "analytical memory," they write, "when things go wrong during a performance, as they inevitably do, the pianist must know where he or she is in the piece, and be prepared to put the performance back on track. This requires use of conceptual memory to restart the motor sequence."[20] Rebecca Payne Shockley makes conceptual memory concrete with her practical guide to drawing conceptual maps of pieces to be memorized.[21] Her method cultivates a confluence of the visual and analytical memory systems by guiding students to draw visual representations of the conceptual memory maps.

Although they did not use the same terminology, historical pedagogues including Gieseking and Leimer, and Hofmann also advocate for the primacy of the analytical system in memorizing and playing from memory. For instance, Hofmann asserts, "the first requirement seems to be that your interest in the pieces you are to play be awakened. This interest usually comes with a deeper understanding of the music."[22] This "deeper understanding" would certainly involve a solid understanding of the structures and patterns of the piece.

Slow practice with an active mind will encode superficial analytical memory of a piece, but on its own is inadequate for cultivating deep and secure analytical knowledge of any complex work. Targeted analysis on both the micro- and macro-level is the only way to cultivate a deeper understanding of the music. Analytical memorization techniques will vary depending on one's age and knowledge, as well as on the nature of the piece to be memorized. Exercises to engage the analytical memory system might include the use of chunking in various ways, mapping, and the explicit articulation of formal and conceptual information about a piece.

[18] Roger Chaffin and Gabriela Imreh, "Practicing Perfection: Piano Performance as Expert Memory," *Psychological Science* 13, no. 4 (2002): 342–349; Chaffin, Logan, and Begosh (2009), 352–354; Payne Shockley (1997), 4; Gieseking and Leimer (1932/1972), 11; Hofmann (1920/1976), 112–116.

[19] Chaffin, Imreh, and Crawford (2002), 26–65.

[20] Chaffin and Imreh (2002), 342.

[21] See footnote 17.

[22] Hofmann (1920/1976), 115.

Chunking

- Chunking into motives, phrases, phrase groups, and larger subsections and sections will vary depending on the scope of the work, and can be meaningfully applied and practiced at all levels of musical complexity. Teachers can cultivate analytical ability at the elementary level of study by asking students to identify repetition and contrast (same or different) in their first pieces. Intermediate and advanced students can chunk their pieces into stylistically appropriate formal units. For instance, they might chunk Classical *sonatinas* and sonatas by analyzing motives, phrase structure, cadences, and the larger sections (e.g. exposition, development, and recapitulation.) Any musical work can be chunked through the process of analysis and be broken down into its constituent parts.
- An extension of the chunking process is the establishment of starting points other than the beginning of the piece. These should be chosen based on salient features of the form. For example, the beginning of major sections such as the development and recapitulation in sonata form, and at the beginnings of structurally important phrases such as the second and closing themes of the exposition of a sonata-form movement could be used as starting points.

Mapping

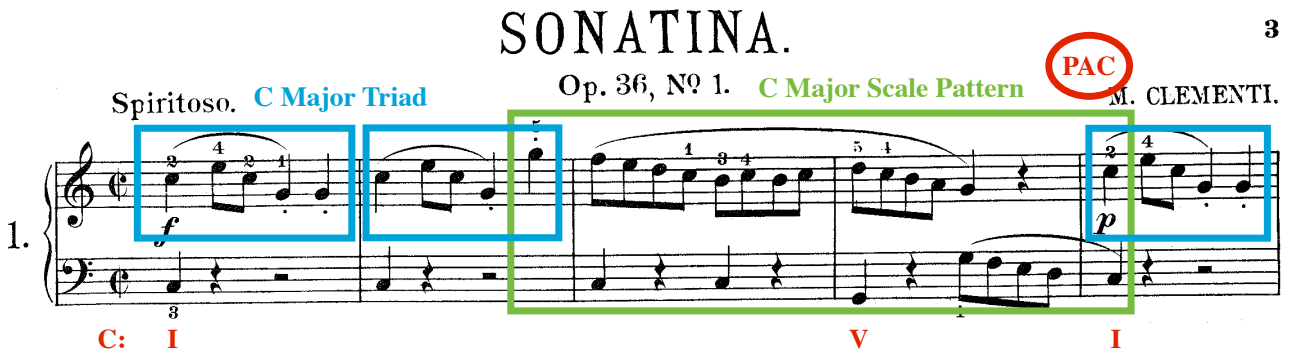
- Mapping combines the visual and analytical systems to communicate the salient features of the music. Students can create maps that communicate aspects of form, harmony, rhythm, and timbre among other features in personally meaningful ways.

Articulation of formal and conceptual information

- Articulation of analytical knowledge of the music demonstrates deep understanding and firm memory of the work through recalling and putting into one's own words details of the form, harmony, rhythm, or other features of the music verbally or in writing. Reproducing (writing out) the score from memory or creating visual maps of the music highlighting the form, melodic contour, or other features also demonstrates this knowledge.

Figures 5 and 6 below illustrate micro- and macro-level analyses of the first movement of Clementi's Sonatina in C Major, Op. 36 No. 1. Figure 5 is an annotated score with a harmonic and figural analysis of the first phrase of the movement. The act of annotating the score in this way will reinforce visual and analytical memory of the music, and also provides useful chunks (the C Major triad and C Major scale pattern) for performing the phrase from memory. Figure 6 is a formal map of the entire movement. Creation of a skeletal map of the movement is certainly not adequate on its own to encode analytical memory, but is nonetheless an essential step in encoding large-scale analytical memory of the movement and placing the individual phrases in context. Ideally a student would memorize each phrase of the movement as analyzed in Figure 5 and be able to place these micro-analyses within the larger structure illustrated in Figure 6.

Figure 5.



Muzio Clementi, Sonatina in C Major, Op. 36 No. 1: I. Spiritoso, mm. 1–5[23]

Figure 6.

1	6	9
"Exposition"		
First Theme	*Transition*	*Second Theme*
C:	**G:**	

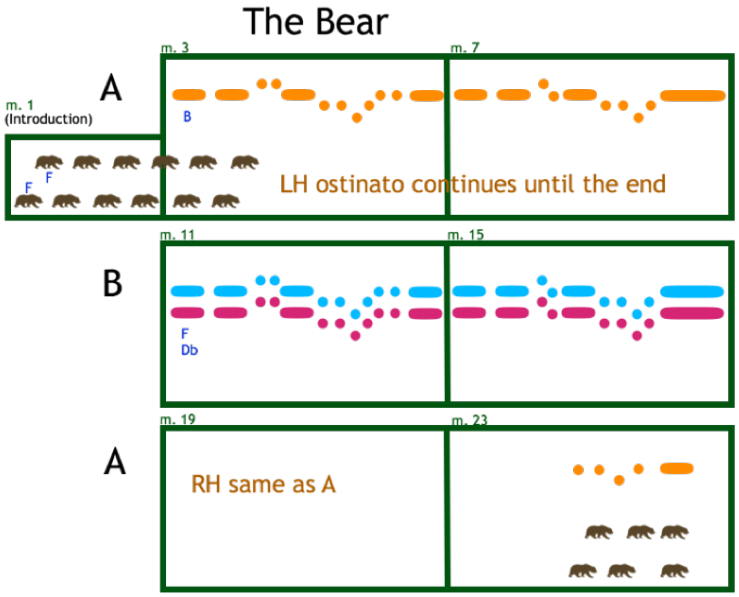
16	24	30	32
"Development"	**"Recapitulation"**		
First, then Second Theme	*First Theme*	*Retransition*	*Second Theme*
(c:)	**C:**		

Formal Analysis of Muzio Clementi, Sonatina in C Major, Op. 36 No. 1: Spiritoso

Figure 7 below is a formal and melodic-contour map of "The Bear." This map communicates the large-scale structure of the piece (ABA) as well as its phrase structure. It provides graphic representations of the left hand ostinato and right hand melody and text indicating repetition of material. Creating a map in this style encodes micro- and macro-level analytical memory in concert with the visual system. The map itself serves as an iconic representation of the piece, which may be referenced later.

[23] Muzio Clementi, *Six Sonatinas for the Piano*, Op. 36 (New York: Schirmer, 1904), 3.

Figure 7.



Formal and Melodic Contour Map of Vladimir Rebikov, Ours, from Les étrennes de Noël

A Multisensory Approach to Memorization

A multisensory approach cultivates efficient, thorough, as well as lasting learning and memorization of music. It is also valuable for promoting self-awareness and independence in the learning process. The most important aspect of this approach is the creation of multiple independent streams of sensory knowledge (or "safety nets"). These four memory systems work best in concert, but it is not necessary that all musicians engage all systems at all times in all music. This approach should be used strategically: certain music is better suited to certain memory systems, and every individual has his or her own cognitive tendencies, aptitudes, and a unique relationship with each memory system. Hopefully this article has provided you with some ideas for engaging the four memory systems in your teaching and practicing. A further hope is that you will explore and discuss memorization strategies using these and other memory systems with your colleagues and students.

Daniel Linder *is pursuing a DMA in piano performance at the USC Thornton School of Music, where he studies with Bernadene Blaha and serves as a keyboard studies graduate teaching assistant. He holds BM and MM degrees in piano performance from Northwestern University and the University of Arizona respectively.*

Dan has performed in venues across the United States and Europe, and recordings of his performances have aired on KUAZ Classical Radio in Tucson, Arizona. He is President of the MTNA USC Collegiate Chapter, and presented an earlier version of this article at the 2016 CAPMT State Conference. Visit www.drlpianist.com for more information about his performing and teaching.