By Bang Lang Do, NCTM

Memorizing

The Webs We Weave

***Bang Lang Do**, NCTM, is a pianist, chair of the Theory Committee for the Iowa State Teacher Association (IMTA) and associate professor at Divine Word College. She teaches piano, world music, American music, music theory, ear training and song writing.*

Block out either column A or column B and try this experiment on the column you see: You will read two words. The second word has a missing letter. Complete the second word to make an English word.[1]

A	B
BOWL	WASH
SO_P	SO_P

For those of you who chose column A, was "soup" the first word that popped into your mind? If you chose column B, you probably thought of the word "soap." In either case, the first word you read automatically activated a web of associative ideas in your brain.[2]

Memory Networks

Cognitive scientists no longer think of the mind as processing a sequence of ideas one at a time.[3] The concept of a complex web of many interacting ideas has been supported by neurological research since the 1980s. Brain scans via Magnetic Resonance

Imaging (MRI) have shown that when musicians imagine sounds, the motor region used when they actually play their instruments is similarly activated.[4] In this network view of the brain, "our internal memory is associational, not linear."[5] The more associations a new piece of information has, the more it is connected to the network of things we already know, and the more likely it will remain in our long-term memory. How can we create associations to add to our memory web? The answer may lie in the way we practice.

Types Of Memory

There are many types of memory. When we learn to recognize patterns, chords, cadences, and thus, can analyze pieces, this is called **semantic memory** (knowing "what"). It is basically a collection of facts. This kind of memory can be retrieved more easily than the **procedural memory** (knowing "how"). Procedural memories, such as riding a bike or tying shoe laces, are gained through repetition. Because the brain is efficient, the procedures become automatic as soon as the skill is learned. This type of memory involves our senses and motions. In music, the procedural memory of how to play an instrument, a piece of music or even a particular section, is based on our audio, visual and kinesthetic (motion) senses. **Episodic memory** stores personally experienced events. Attaching a story or emotions to our music is an episodic memory. Most often, these various types of memories are integrated as musicians repeat a piece of music multiple times. What would happen if we forced ourselves to recognize each type of memory separately to discover which one we depend on the most, which one is the weakest and then attended to them individually?

Here are some possible questions students might ask themselves: "Can I pretend to play this without hearing the real sound?" "Can I see the pages in my mind without playing?" "Can I hear the entire piece in my mind without playing?" "Can I draw a summary of the analysis of this piece?" Or, "Can I create a story for this piece?" When students question how they learn and develop an understanding of how they practice, they take charge of their own learning and their skills will become more transferable.

Recognizing A Component Of Procedural Memory: Our Visual Memory

Students may find it difficult to read the same piece from a different score than the one they have been accustomed to using. A coffee stain on a page might be missing, and it had been the anchor that helped their visual memory. A new edition may reveal musical signs they have not noticed before. Different measures ending a page requiring a turn might make them feel differently about a phrase. Thus, changing format (another edition, for example) is a good way to test their visual memory and their level of dependence on it.

If a student's visual memory is strong, he or she should use it. For instance, a student could lightly color-code chords, progressions, cadences or a motif and all its variations. Some students even color-code emotions that are similar throughout the piece. Another example of visual memory reinforcement can be found below in the semantic memory section.

A researcher at Princeton University gave two groups of students a test with three tricky questions. Called the Shane Frederick Cognitive Reflection Test, it consisted of three questions that evoke an immediate intuitive answer, but one that is incorrect. For the first group of students, the test paper had a barely legible font, whereas the other group received tests with normal print. Surprisingly, the group that had difficulty reading the questions performed better[6] because an initial effort had to be made to read the questions, and that extra effort was sufficient to engage the brain. I have a student who likes to print out scores where the notes are small and the layout undecipherable. Perhaps this student's dependence on the audio memory is stronger, and his engagement and focus operate at their limits whenever he practices.

Recognizing Another Component Of Procedural Memory: Our Kinesthetic Memory

Have you played the charade game for pianists? Try to mime playing the beginning of these pieces: Beethoven's *Waldstein*, Grieg's *Concerto*, Villa-Lobos's *Punch Doll* and Liszt's *La Campanella*.

Not only can we recognize a piece through motions, sometimes musicians depend on them. Most performers have experienced moments of distraction during a performance. Inner dialogues that disrupt optimal performance have been researched by many sports psychologists. Musicians rely on their kinesthetic memory to keep playing. We can reinforce this type of memory, and our audio memory, by pretending to play without sound.

A fun game for beginners to check their kinesthetic and audio memory is the "ping pong" game. It works for those playing the same piece from memory, and it is often used in Suzuki camps. Students need to know what phrases are, and two pianos are necessary because participants will alternate

their playing. The goal is to carry on playing the piece continuously when the other person stops. By demonstration, a teacher can explain that possible stop points are at the ends of large sections, and from there, gradually move students to stop at the ends of phrases. Once the piece is mastered, the teacher could allow students to decide when to stop—even in the middle of a phrase or at the end of any measure. As a competitive game, students could try to surprise each other, or as a collaborative game, students can try to fool the blindfolded teacher, who guesses whether one or both played the song. This last variation of the game teaches the skill to imitate another person's articulation, dynamic and sound. A teacher can also play alternately with students. If students can start at the beginning of any phrase, they will have the confidence to continue playing no matter what happens on stage. If fear and anxiety are learned, so are self-assurance and self-efficacy.

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For our individual practice, if the piece has identified main motifs and cadences, we can try to play only the measures with main motifs or cadences and imagine the rest in our mind or "inner ears," in tempo. Beware—we have a tendency to accelerate when we imagine music. Next, reverse the procedure, playing everything except the main motifs and cadences. This is usually more challenging because it is harder to recall how to start anywhere other than the beginning of a main motif or section. This is what psychologists call the Serial Position Effect. People tend to recall the first and last item on a list.

Just as sound can exist in our inner ears, our physical movements can also be rehearsed in our virtual inner world. I learned downhill skiing when I was an adult. On my first day, I spent seven hours skiing and falling. The thrill of those slopes made such an impression I could still feel the motions of skiing when I lay in bed that night. For those who have practiced a sport's move intensely during a short period of time, this experience may sound familiar. After hours of rehearsing a gesture during the day, you may have re-experienced the same motion as you fell asleep. When you wake up, the motions in your mind continue, as if that gesture was rehearsed while you were dreaming. Sports require bigger muscle groups, but perhaps smaller gestures mindfully repeated can also be continued in our dreams. Research shows that breaks are essential to motor learning. The practiced skills continue to develop off-line during a period of consolidation.[7] "Storing a motor skill during sleep reorganizes its brain representation toward enhanced efficiency."[8] We should try to practice pieces requiring more motion or faster reflexes right before going to sleep, and let our kinesthetic memory continue rehearsing the motions for us during sleep.

Recognizing Another Component Of Procedural Memory: Our Audio Memory

This is a game for teachers without the threat of failure for students: Without warning your student, cover one bar with a small sticky note, and ask your student to play that section again. (Choose a measure you think they can play from memory.) Reassure him or her that this is not a test but a game, and they can remove the sticky note if they need to look at the music. I have tried this with a variety of skill levels after students have spent a few weeks on the piece, or sometimes, even after one reading of a new page. Gradually increase the number of stickers. You may let students look at the bars before you cover them. Taking away one sense enhances the other senses. Blocking out a few measures will force students to rely on their ears (audio memory), their fingers (kinesthetic memory) and their sense of structure (semantic memory). To observe and know whether the section had the same theme (covered) with a different

ending (not covered) is an example of semantic memory reinforcement. Students may be pleasantly surprised to find they actually knew more than they thought they did.

Many musicians check their audio memory by running through the piece in their head. Some pretend to play on a table or invisible keys, while others imagine the sounds without even moving a finger. This last stage is like playing in our virtual inner world. It feels real because the neurons in charge of those motions are activated although there is no motion. As the internal recording plays, we can find the exact spots where we cannot anticipate the next sound, where we physically feel hesitation, where we do not hear all the voices, or where the imagined motions are not precise. At that specific spot, was it a failure of our audio memory (I can't hear what's coming up next)? Was it a failure of our kinesthetic memory (I don't know where to move, or what fingers I used)? Or was it a failure of our visual memory (I can't see what is next)?

Here are a couple ideas for pianists to check their audio memory:

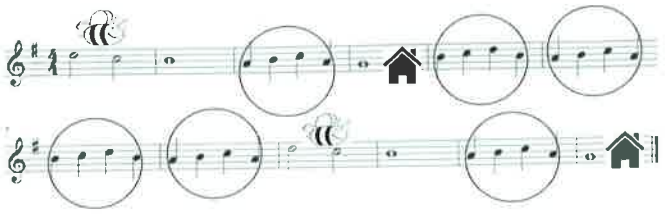
1) Try playing two or four phrases, then imagine the next two or four phrases. Do this for at least a page. Then try the reversed scenario, flipping the phrases that were played with those that were not.
2) If the piece has two voices, pianists can switch hands, playing what's written for the left hand with the right hand and vice versa, playing one voice with sound and singing or imagining the other one.

Recognizing Our Semantic Memory (Knowing "What")

Most students who major in music learn how to analyze a piece of music. Structure helps us understand expressions and the particular composer, but it is also a memory tool. Form analysis utilizes semantic memory. At the 2013 Music Teachers National Association conference, Rebecca Shockley and Melissa Colgin-Abeln presented "Mapping Music," a strategy for teaching and performance preparation. They presented ways to increase our self-assurance by connecting our semantic memory to our visual memory.

Their mapping method requires a thorough analysis of the piece. It forces the one making the map to reduce a musical piece to its minimal "notation" through several drafts. This new "notation" is for the learner to create. A romantic theme can be represented by a rose or a heart, a death theme by a skull or a cross. In this fashion, a score can be reduced to one page of scribbles.

As shown in the following simple example, one can use lines, letters and drawings to visually represent patterns or motifs. There are three different patterns in this excerpt.



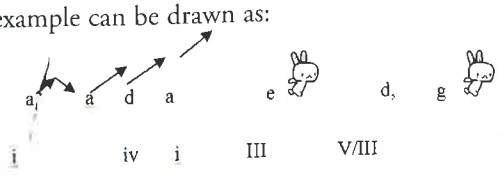
"Petite abeille bourdonne," arr. Bang Lang Do.

The theme of three descending notes can be represented by a bee. Three ascending notes with a return to the first note, let's call that a circle. We can name circles by the first note played (A circle or B circle in this case). The tonic note, we can call home. Thus this whole excerpt can be summarized as:

As long as the symbols are coming from our imagination, our recall of the piece can be sparked by a mere glance at one little page of doodles. More advanced musicians sometimes use Roman numerals or chord symbols and invent their own signs for cadences or variations of the same motif. It's similar to what we do when using cue cards for oral presentations. We reduce our speech to a few words; the more we work on our speech, the less we'll need to look at the cards. This is also a good way to teach songs to 3- or 4-year-olds before they learn how to read. Children love to come up with their own representations or drawings of patterns, but teachers need to guide them. Ideas need to match the motions of notes or fingers, harmonic structure, core notes such as tonic and dominant, keys pressed (matching intervals with steps, skips, hops, jumps and other vocabulary) and so on. Consistency through different pieces is the key to faster memorization. Here is an intermediate example:

Burgmüller Opus 100, No 2, Arabesque, edited by Adolf Ruthardt. (Leipzig: C.F. Peters, n.d.(ca.1903). Plate 8906. Reissue—Frankfurt: Edition Peters, n.d. after 1950). Public domain.

The above example can be drawn as:



Can you guess what 🐰 means?

Recognizing Our Episodic Memory

In his book *Moonwalking with Einstein*, Joshua Foer talks about an anonymously authored Latin rhetoric textbook called *Rhetorica ad Herennium,* written around 86 BC, which features techniques to memorize lists of items. Most participants in the USA Memory Championships use the loci method. They choose a familiar space, such as a house they know very well, create multisensory images for each item on the list, put them in specific places in the house and use the same route for all lists. Creativity is the key word. For example, cheddar cheese could be remembered as one's front door draped in oozing melting orange cheese, complete with its pungent scent. According to memory champions, lewd, absurd or funny settings filled with scent, taste and sound will be retained longer than logical or common settings. Psychologists call this the Von Restorff Effect.

Many teachers are already adding emotional memory by creating meaningful stories, images or a narrative of emotions to accompany a piece. If the students can create their own story it will be more meaningful to them.

This kind of memory wherein students create is especially important because it keeps them engaged in active learning and makes a particular piece of music meaningful to them. Research has shown the more meaningful the learning, the more it is retained in our long-term memory.

Thus, to expand on Shockley and Colgin-Abeln's ideas, to reinforce our memory of a musical piece, we can associate our audio map to a visual map, a kinesthetic map and a structural map (semantic memory). But most crucial to developing musicianship and long-term memory is the association of all these memories to an episodic memory: a story-telling map or an emotional map.

For storytelling, these questions may help students imagine their own story: What is the main plot? What are the subplots? What is the motif for the protagonist, the hero or the narrator? For students who prefer to create their own film, we can ask them these questions: How fast are the scene changes? What are the angles of the camera or the particular effect of the lenses? For those who prefer structures: What emotional response do you get from a certain cadence, modulation, added ornamentation, added voice, a pedal or an ostinato? How would the story be different if some of the chords or voicing were changed, more ornaments were added, or a few intervals were made smaller?

Surprised feelings and "aha" moments can lodge an idea into our memory because our body will release serotonin and dopamine when we feel pleasure.[9] Involvement in musical activities activates areas of the brain known to be involved in emotion, reward and motivation.[10] We should take advantage of this fact. An effective way to create the "aha" moment for a student is to play the same phrase with a different cadence, voicing, ornaments or rhythm so that students can hear the other possibilities the composer could have chosen to write.

It would be wonderful if all teachers could share their creativity by posting online their particular stories or emotional maps of particular pieces (referring to measure numbers). Companies like Pixar and Google host informal safe spaces for employees to discuss or to review each other's works because it is in these interactions that sparks fly and new ideas are invented. Innovation and creativity come from collaboration as well as enough personal reflection time.

Notes

1. Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus and Giroux, 2011), 52.
2. Joshua Foer, *Moonwalking with Einstein—The Art and Science of Remembering Everything* (The Penguin Press, 2011), 52.
3. Ibid., 53.
4. Alvaro Pascual-Leone, Dang Nguyet, Leonardo G. Cohen, Joaquim P. Brasil-Neto, Angel Cammarota, & Mark Hallett "Modulation of muscle responses evoked by transcranial magnetic stimulation during the acquisition of new fine motor skills," *Journal of Neurophysiology* 74, (1995), 1037–1045.
5. Foer, Ibid, 145.
6. Kahneman, Ibid, 65.
7. Eckart Altenmueller, Gary E. McPherson, "Motor Learning and Instrumental Training," *Neurosciences in Music Pedagogy*, 5, (2008), 121–143.
8. Stefan Fischer, Matthias F. Nitschke, Uwe H. Melchert, Christian Erdmann, Jan Born, "Motor Memory Consolidation in Sleep Shapes More Effective Neural Representations," *Journal of Neuroscience* 25, no. 49, (2005), 11248–11255.
9. Hodges, Ibid, 12.
10. Ernst Mas-Herrero, Josep Marco-Pallares, Urbano Lorenzo Seva, Robert J. Zatorre, Antoni Rodriguez-Fornells, "Individual Differences in Music Rewards Experiences," *Music Perception,* 31, no. 2, (2013), 118–138.

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