MEMORIZATION OF PIANO MUSIC AND PERFORMING FROM MEMORY

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Introduction

I became interested in the topic of memorization while taking a class with Professor Kielian-Gilbert when I was at Indiana University doing my doctoral course work. She used *Music and Memory: An Introduction* by Bob Snyder (2000) as our textbook. It was a new and fascinating topic for me, since I had no background in cognitive psychology at all. In this book, the author mainly focuses on the memorization process of music, which is routinely a part of the preparation for musicians whose goals include performing from memory. The class had helped me a lot with my personal practicing and teaching. It also motivated me to keep reading about this subject and look deeper into the process of performing from memory, and to try to find out how musicians use memory on stage and how to better prepare for performances. Many pianists suffer from the anxiety caused by fear of memory failure. Most self-help materials focus on how to memorize piano music and loop around a set of very basic practicing tips. They neither work for everyone nor does anyone explain why they work for some. Jennifer Mishra (2010) wrote a lengthy article discussing this exact issue in 2010. It has been at least one hundred years since the tradition of memorized piano recital was born, but only a few, like Roger Chaffin and Aaron Williamon, have attempted an understanding of the human psychology of music memorization.

In Chapter 1, this essay begins with a brief overview of the tradition, importance, and challenges of memorizing piano music, following by a summary in Chapter 2 of the types of memory involved as described in numerous piano self-help books and article on how to memorize and practice. Chapter 3 outlines several memory models that explain, in differing ways, the process of memorization and performing from memory. I conclude this Essay in Chapter 4 by presenting personal observations and offering new perspectives on the popular memorization and practice methods that have mysteriously been working for over a century.

Chapter 1: History, Importance and Challenge of Memorization

History of Memorization

It is a modern performance practice to play solo piano recitals from memory. Numerous books and articles have been written about memorization starting from the very beginning of the twentieth century. Many point toward Liszt and Clara Schumann (Walker 1977, 721; Aiello & Williamon 2002, 167), suggesting that they were the ones who established this tradition and set a high expectation for all the pianists to follow. Kenneth Hamilton's book (2008) tells the stories from the time of Liszt with more details. In the first half of nineteenth century, most recitals were not performed memorized, and always consisted of a mix of genres to keep the audience from getting bored, such as chamber music, or works with singers. Pianists frequently programed their own works and often ended the recital with improvisations on themes requested by the audience. Such improvisations were usually the highlights. Although the collaborative and the improvisatory parts of the recital were not memorized, Liszt would play his solo works without the scores here and there and it would gain ecstatic reaction and admiration from the audience. Clara Schumann also performed from memory often, encouraged by her father. Mendelssohn was another genius during that period who had the natural ability to memorize everything, even orchestral parts (Hamilton 2008, 75).

By the end of the nineteenth century, two phenomena helped created the tradition of playing solo recital from memory. The first was the decline of improvisation. The second was that, instead of playing their own compositions, the pianists started programing works that were composed in the past (Burkholder 1984, 77), and performing from memory was thought to demonstrate their seriousness and respect for the music (Hamilton 2008, 80). Pianists like Hans von Bülow, Anton Rubinstein, and Carl Tausig would play recitals from memory that were up to three hours long (Hamilton 2008, 58, 60). Although the recitals of today are rarely as long as

before, they nevertheless continue to incorporate the tradition of playing from memory, in recognition of the importance of doing so.

Importance of Memory

Besides having become embedded in the performance tradition, playing from memory for today's pianists is important for a few very practical reasons also. One of them is that pianists want to get rid of troublesome page turning (Rubinstein, 1950, 41; Aiello & Williamon 2002, 168; Cienniwa 2014, 5). Another reason is that they are too busy to look at the pages when a passage is very fast or technically demanding (Gordon 2004). Pianists also memorize to create more freedom and spontaneity at the keyboard (Hughes 1915, 595, 600; Gordon 1982, 14; Hamilton 2008, 74). Rubinstein thought that the more attention one gives to physical aspects of playing, the less attention he would be able to give on the emotional and interpretative values that are for both performer's and the audience's enjoyment. Performing music could be as personal as giving a speech, and playing from memory helps to create better communication with the audience. Like giving a speech reading off notes, performing with the scores would lose the feeling of reality (Rubinstein, 1950, 42; Gordon 2004). Another view to it would be when notes are assimilated before rather than while they are being played, the performer could put more meaning in it, like thinking about what to say before saying it (Newman 1984, 133). Rubin-Rabson (1950, 22) also made an analogy to theatrical performance, explaining how printed pages will create a barrier between the performers and the audience if the performers have to read from their script during the act. Alfred Cortot believed that memorization, in addition to facilitating better audience communication, was an integral part of learning and enlarged one's acquaintance with music (Chaffin, Imreh and Crawford 2002, 45). Both Gordon (2004) and Cienniwa (2014, 9) see memorization as an opportunity to do detailed analysis and gain a thorough understanding of the music. Although some pianists, like Murray Mclachlan, argue that performing with a score could be just as artistic (2015**,** 168), studies show that memorized performances were preferred by

the audience. In Aaron Williamon's experiment, he asked musicians and non-musicians to rate cellists performing Bach's preludes from the cello suites in different performance settings, without knowing whether the performer played from memory or not (1999). The result was that the musician group preferred memorized performances, and the non-musician group preferred performances without the visual of a music stand blocking the view. In addition, Waddell and Williamon's research (2017) showed that the quality of a music performance could be affected by the performer's facial expressions.

Although the piano stand does not block the vision of the pianist, pianists looking at the hands, looking through the lid opening, or closing their eyes to reflect concentration instead of looking at the score, could also add visual intensity to their performance.

Challenge of Memorization

Despite its importance, playing from memory causes anxiety to many pianists, from students to professionals, even the legendary ones. There are quite a few stories collected in Hamilton's book (2008, 74) of famous nineteenth century pianists whose memories failed while performing, and also comparable stories of modern pianists circulating among today's performing community. Except for those relatively few pianists who have already made their career playing from memory for over fifty years, pianists of today are expected live up to the standards set by the great ones. Although the recitals these days are not 3 hours long anymore, we face a slightly different memory challenge. The training at music schools and conservatories focuses much more on note accuracy and other details in scores, so there is a lot more information to memorize.

The music and entertainment market is currently extremely active, and the competition between diverse types of music is very intense. The audience is now very selective regarding concert choices (Cienniwa 2014, 10). For the audience members who have very little exposure to classical music, the first and maybe the only mistake that they might notice is if the music stops due to memory failure. The audience and the critics may often place too much emphasis on

memory slips due to their lack of appreciation on the performer's artistry (Viviano 1986). Because of the lack of understanding from the audience, pianists are very weary of public humiliation that can result from memory slips, to the point that some pianists even think that a memory slip could destroy one's career (Mclachlan 2015, 168). Although pianists that could not handle the pressure of playing from memory probably would have quit and chosen a different career earlier in life, for the ones that persevered, the fear often trumps the joy of performing.

Around the same time the tradition of memorized recital formed, self-help music memorization books and articles also started to appear. Frederick Shinn (1898), C. Fred Kenyon (1904), A. J. Goodrich (1906) and Edwin Hughes (1915) were among the earliest writers. They showed that memorization, although a natural talent for some, could be improved, and that when memorization is done correctly, hazards will become negligible (Rubinstein 1950**,** 43). Many students memorize with this method of doing rote repetition and "test the memory" afterwards, without properly understanding the music (Aiello & Williamon 2002, 176). Gordon (2004) thinks this incorrect way of memorizing creates insecurity and causes traumatic experiences. Memories of these experiences from childhood often linger for a long time (Wang 2013, loc 1047).

Chapter 2: Types of Memory

Distinct Types of Memory

An understanding of the tradition and importance of memorization to pianists would be incomplete without also understanding the types of memory that must be used to be successful. Most writing on the topic of musical memory for pianists addresses at four different types of memory – aural, visual, muscle, and intellectual memory (Kenyon 1904, loc 90; Hughes 1915, 597; Matthay 1926, 9; Magrath 1983b, 14; Aiello & Williamon 2002, 175; Wang 2013, loc 343; Cienniwa 2014, 16).

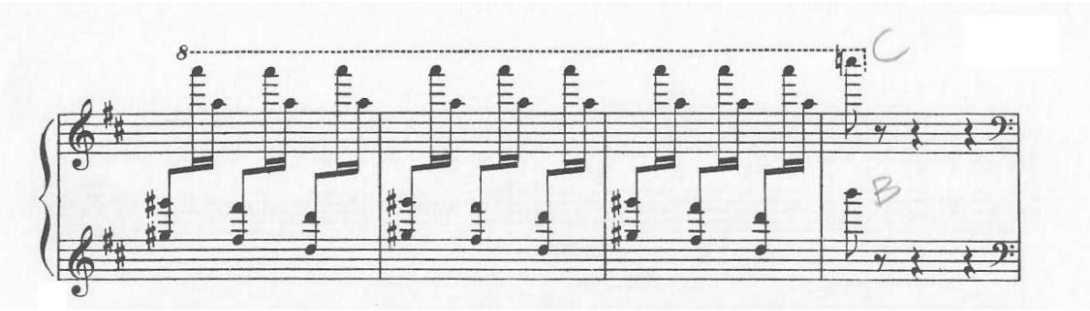
Aural Memory

Aural Memory in this context is the ability to remember and imagine sound before it happens. The earliest development of one's aural memory is from learning to speak as a child. Many children learned how to sing at an early age, starting with fragments of songs (Shinn 1898, 5). Musical aural memory often develops before a child even starts learning to play the piano, so it is a natural and intuitive type of memory. People who could hear the sound before it happens are able to conceptualize the sound before playing it (Gordon 2004). There are two types of situations when aural memory fails. The first type of aural memory failure is when a person is not capable of imagining the sound. The second type is hearing the sound in the head without the ability to translate the sound to fingers. The later one happens more often (Newman 1984, 133). Many teachers value Suzuki methods because of the early development of aural memory (Bricard & Woods 1978, 104; Wang, 2013**,** loc 170). In addition, Gordon (2004) argues that many pianists get away with not having good aural memory, compared to other instrumentalists or singers, because it is relatively easier to produce sound on the piano. Most instrumentalists need to make a bigger effort to anticipate the sound both mentally and physical before producing, instead of a

small finger movement on the keys where the pitches were predetermined. He also thinks that the continuity of a performance is guided by aural memory: sound first and everything else will follow (Gordon 2004).

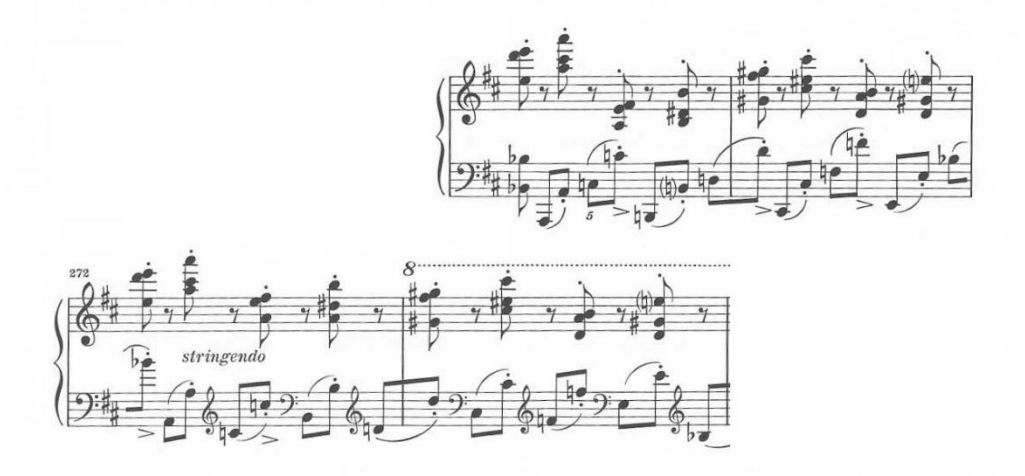
Visual Memory

There are two types of visual memory involved in piano playing. One is having visual memory of the score, and the other is to have visual memory of the keyboard. Some consider visual memory the least important one of all, using examples of successful blind pianists (Shinn 1898, 19). Though many pianists, including some famous ones, have photographic memory of the score and use it to their advantage, most people only have ordinary ability and they do not remember the details on the page, so it is recommended to invest time in developing other forms of memory instead of visual memory (Shinn 1898, 19; Newman 1984, 133). Visual memory of the score also does not withstand pressure (Gordon 1982**,** 16). It also takes too long to recall the image of the score, so it often causes performers to lose continuity during a performance (Gordon 2004). However, visual memory could be a useful tool during the initial phase of the learning process. The writing on the score could become one extra layer of visual memory association (Wang, 2013, loc 527). In Example 2.1 for instance, writing the names of the notes in the score would stick in the memory much better than the notes on ledger lines.



Example 2.1 Shostakovich Piano Concerto No. 1 Op. 35 Mov. IV, mm. 179-182

Many pianists also try to remember the image of hand positions or the shapes of their hand instead of individual notes while playing complicated or unusual chords to speed up the learning. Visual memory could also be useful when working on technical aspects of the playing. Anticipating and visualizing technical movements of hands could lead to more precision in the execution of difficult passages. Pianists could also visualize the physical movement that would produce the desired sound quality before playing (Wang 2013, loc 417). Shinn (1989, 21) brought up an interesting idea that the movement of the eyes looking at hands also could become a type of muscle memory with repetition. Example 2.2 is a passage I personally encountered while learning the Liszt B Minor Sonata. To land the jumps, I needed to remember the sequence of where to look on the keyboard in an exact order. With practice over time, my eyes would automatically go back and forth to find the spots where they should look since the passage goes by very fast.



Example 2.2 Liszt Sonata in B minor, mm. 270-273

Muscle Memory

Muscle memory is a sequence of reflex finger movements resulted from sufficient repetition (Shinn 1898, 10). Many consider muscle memory the most unreliable of all because it is highly susceptible to pressure and anxiety (Hughes 1915, 599; Matthay 1926, 10; Aiello & Williamon 2002, 175; Gordon 2004; Wang 2013, loc 170; Cienniwa 2014, 16). However, muscle

memory is crucial and rarely any performances can be done without muscle memory (Wang 2013, loc 381) Normal people simply do not have the brain power to recall every single physical decision made at the keyboard during performing, especially when the tempo is fast (Hughes 1915, 595; Aiello and Williamon 2002, 176). Using fingerings for example, without muscle memory, pianists would either have to remember every single fingering decision made previously or make up fingering on the spot. Therefore, it is impossible to get away performing without building muscle memory for a piece to be performed unless the piece consists only of patterns of previously learned muscle memory and existing in long term memory. Muscle memory of learned patterns could be stored and became part of the semantic memory, which is the reason why many students practice scales, arpeggios and numerous etudes. Stored patterns in long term memory speeds up learning and the memorization process (Shinn 1898, 11). Gordon (2004) thinks tactile memory, or memory of touch, is also unreliable because the keys could be sticky or wet at times, or lighter or heavier depending on the pianos (Gordon 1982**,** 16). However, tactile memory is still important. It has not been mentioned anywhere that tactile memory could help to increase accuracy. When the pianist is not looking at the hands, the hands could still find the position by touching the keys because the pianist remembers exactly how the keyboard feels at that position. It also happens very often that the fingers could feel the corners of the keys and make last minute adjustments for accuracy before playing the keys.

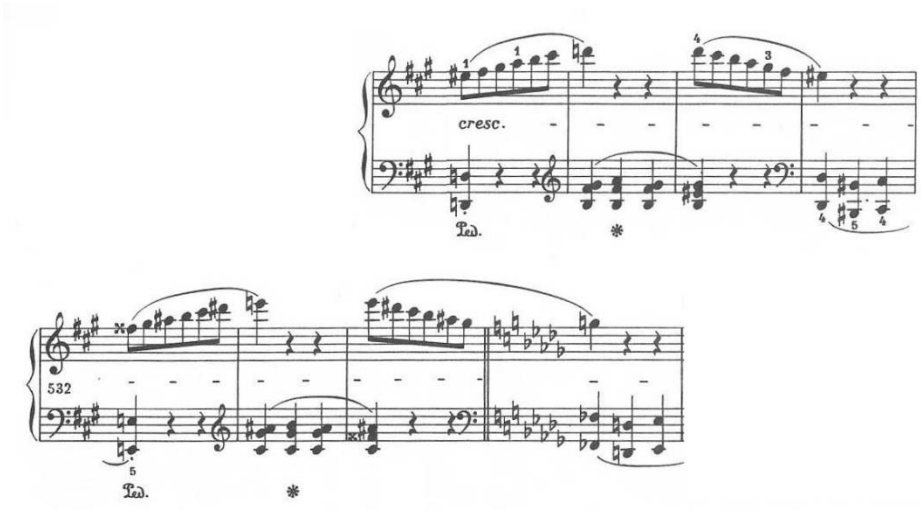
Intellectual Memory

Intellectual memory could be defined as the ability to make association to new memory using musical analysis. Intellectual memory is agreed among many great pianists to be the most important type of musical memory (Kenyon 1904, loc 175; Gordon 1982, 16; Chaffin, Imreh and Crawford 2002, 35; Gordon 2004). Intellectual memory helps build multiple layers of association to the same piece of information, so when one association lapses others could provide cues instead (Winslow 1949**,** 16; Magrath 1983a, 17). Intellectual memory provides a structure to the

first three types of memory. In Goodrich's book (1906), the only mention of the other three types of memory was in the introduction. The rest of book is entirely composed of analyzing various aspects of music. It caught my attention that, on the cover of the book, the printed title is "Guide to Memorize Music," but in the inside, on top of every page, the book seems to be called, "Guide to Practical Musicianship." Either way, Goodrich thinks that using his methods saves time when memorizing, and the more thorough one's musical understanding of a section or piece to be memorized, the more secure the memory. The following sections are several of the important topics on intellectual memory included in Goodrich's and Shinn's books.

1. Motivic Sequence

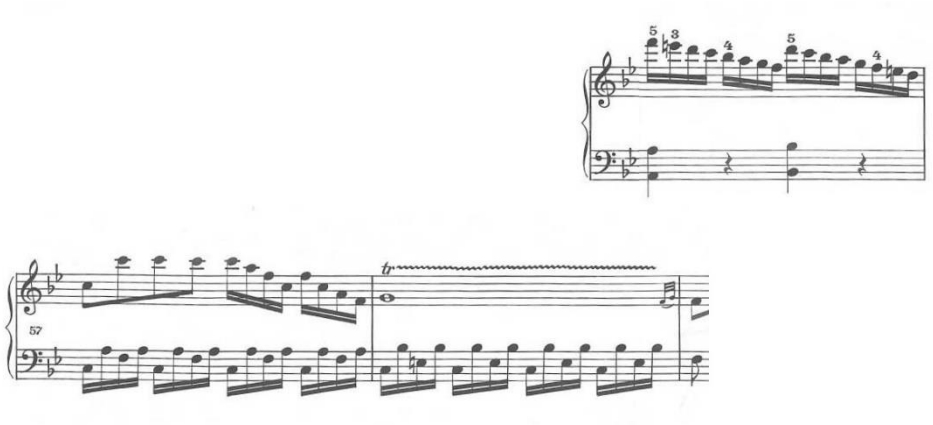
Many compositions use motivic sequences. Goodrich (1906) had the idea that if the pianist understood all major and minor keys, he or she should be ready to play the same sequence in different keys. Shinn (1898) also included this method in his book, and used a passage from Chopin's second scherzo as an example (Example 2.3).



Example 2.3 Chopin Scherzo No. 2 Op. 31, mm. 528-535

2. Harmonic Progressions

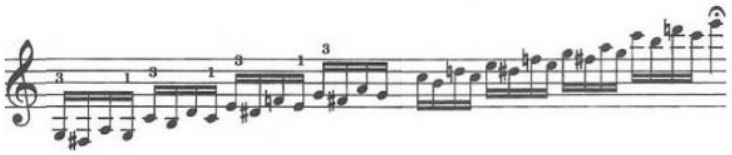
Many compositions, especially those from the classical period, frequently use the standard T-S-D-T (I-IV-V-I) progressions. Goodrich suggests that the structure and the design should be immediately recognized. This passage from Mozart's Sonata K.333 would be a perfect example (Example 2.4). Any pianist who is familiar with Mozart's composition style should be able to memorize this passage with ease because of the frequency Mozart uses similar patterns at section closings.



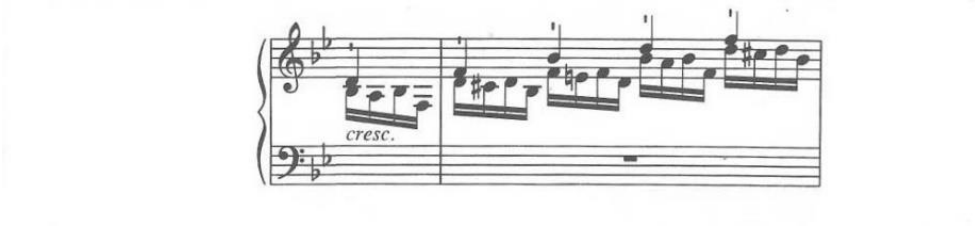
Example 2.4 Mozart Piano Sonata K. 333 Mov. I, mm. 56-58

3. Non-Chord Tones Figuration

Figurations founded upon adjacent notes or non-chord tones could be easily memorized when they are accurately analyzed. Example 2.5 from the first movement of Beethoven Sonata Op. 2 No. 3 is constructed of adjacent notes embedded in the frame of a c major arpeggio. The opening of Beethoven Sonata Op. 22 (Example 2.6) and this passage from Mendelssohn's first piano concerto (Example 2.7) are of similar concept.



Example 2.5 Beethoven Piano Sonata Op. 2 No. 3 Mov. I, mm. 232

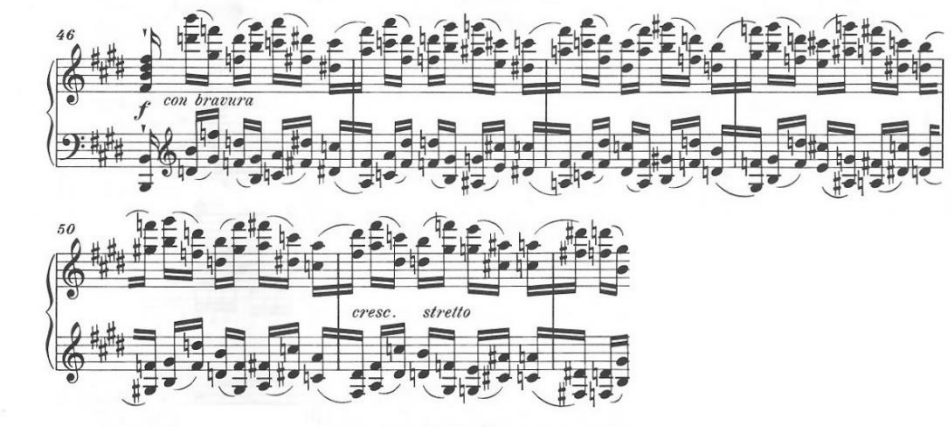


Example 2.6 Beethoven Piano Sonata Op. 22 Mov. I, mm. 3

Example 2.7 Mendelssohn Piano Concerto No. 1 Op. 25 Mov. I, mm 10

4. Chromatic Progression

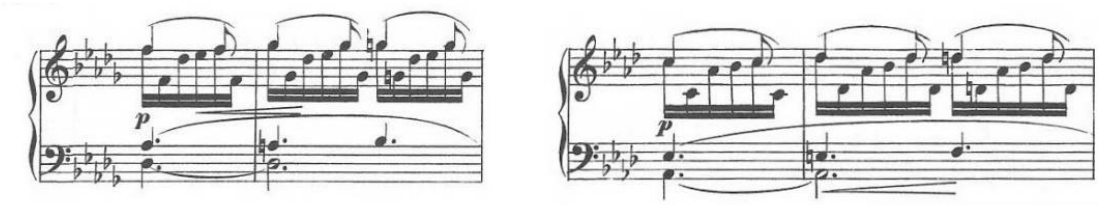
Goodrich thinks pianists that understand all major and minor keys should be able to fluently reproduce patterns that chromatically descend or ascend. Example 2.8 from Chopin Etude Op. 10 No. 3 shows a progression chromatically descending on two different levels.



Example 2.8 Chopin Etude Op. 10 No. 3, mm. 46-61

5. Relationship between Key and Structure

Shinn highlights key relationships between sections of the same theme. This relationship exists in almost every single composition of sonata form. Example 2.9 from Schumann's Aufschwung shows the two sections in D-flat Major and A-flat Major accordingly.



Example 2.9 Schumann Aufschwung from Phantasiestücke Op. 12, mm. 16-17, 122-123

Goodrich also suggests the use of many transposition exercises, something jazz musicians practice very often, to focus on the relationship between notes instead of the notes themselves. It could also improve one's aural memory. Although the level of music theory used in Goodrich's and Shinn's books is relatively basic, an important theme is apparent is both. A performer's

awareness of the music theory used in the composition process of a given piece provides tremendous advantages when memorizing that piece over exercises such as mindless repetition.

Mapping Music: For Faster Learning and Secure Memory **by Rebecca Shockley**

Shockley (1997) wrote a very interesting book on memorization, also with an emphasis on music theory. Her method includes two steps. The first is to study the score away from the piano, and the second is to draw a graph including aspects of music like melody, phrasing, rhythm, harmony, repetition, contrast, etc. At first glance, the graphs may seem like some sort of visual memory aid, but the act of creating them is what actually helps establish intellectual memory. Looking at Shockley's examples you could see some characteristics of each composition that stand out from the rest. For example, the shape of a melody line, the important notes, contrast between high and low registers, key changes, structure and form, special notation, dynamics, etc. Playing off the map may not be very practical because the lines in the graphs that represent the melodies are very general, and it is impossible to transform into lines the musical notes that usually convey many details like pitch, rhythm, their meanings and beyond. There are simply too many intricate musical elements to be reflected in a simple graph. For example, a graph could show contour but not the exact interval also. It could show harmonies but not the spacing of a chord. Articulation is not very specific. Range is also very limited. Adding all the extra information as text onto the map, like harmonies, important notes, accents, or dynamics, would make the map look too complicated. Also, her maps only show two lines, one for each hand. Any piece with complicated a texture would be impossible to draw.

The limitations of graphing may explain why this method is more for beginner and intermediate level students. However, when the graph is used on only one aspect of music, it could be a very useful tool. Figure 2.2 was produced based on the five phrases in Figure 2.1. In this graph, Shockley used it to compare the variations between a set of parallel phrases from Chopin B Major Nocturne Op.9 No. 3. It is a clear and powerful picture of the subtle differences

between the phrases, and the graph makes it very easy to remember. It could also be an easy image to visualize even during performing. Even though this method has limitations, it is a very good method to encourage students to discover more details in the score and to observe patterns. Drawing maps could be time consuming, but the process of studying the score and developing deeper understanding of music is definitely more rewarding than the map itself.

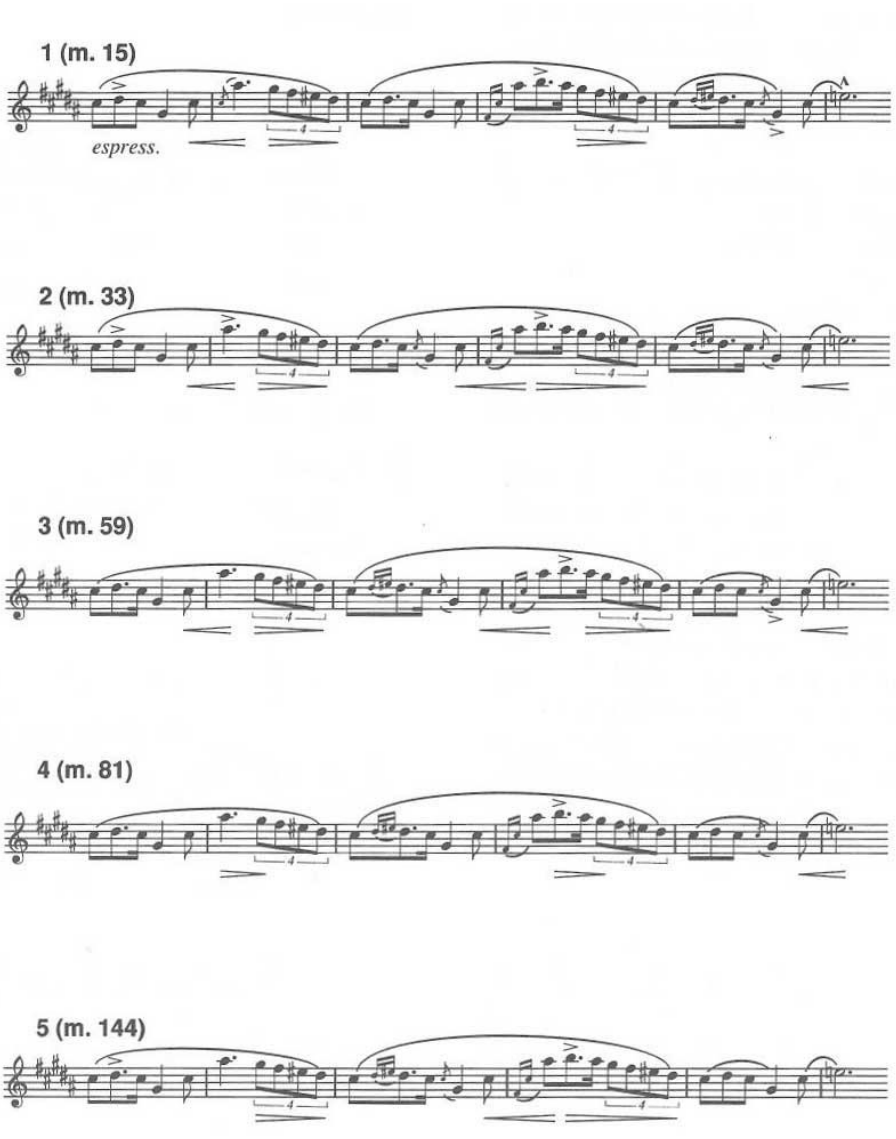


Figure 2.1 Parallel Phrases from Chopin Nocturne Op. 9 No. 3

(Shockley 1997, 84)

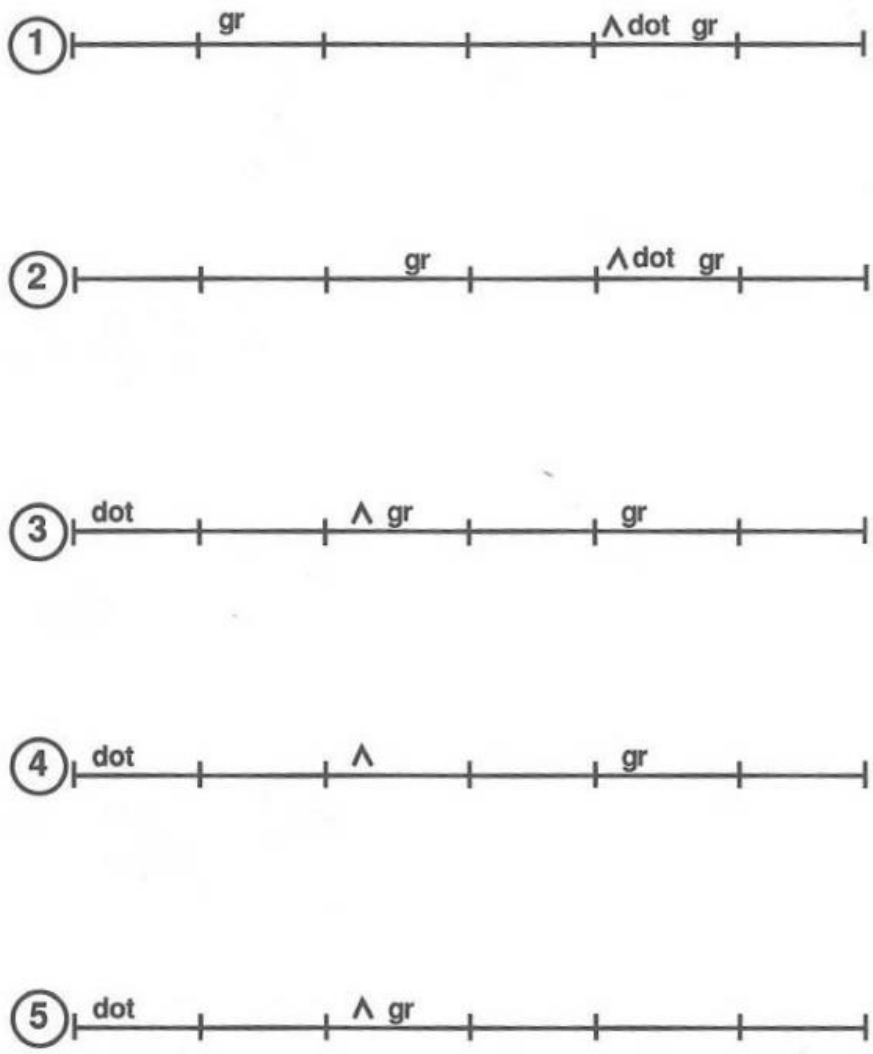


Figure 2.2 Graph of Parallel Phrases from Chopin Nocturne Op. 9 No. 3

(Shockley 1997, 85)

Chapter 3: Memory Models

Process of Memory

"Memory is the faculty of the mind by which information is encoded, stored and retrieved." – *Wikipedia*

Memory is "the power or process of reproducing or recalling what has been learned and retained especially through associative mechanisms." *–Merriam-Webster*

Memorize is "to commit to memory." *–Merriam-Webster*

"Memorization is the process of committing something to memory." *–Wikipedia*

The process of memorization and performing from memory cannot be explained by any one memory model. Rather, multiple models in varying ways all play a part for every pianist, and no single model alone will work if a pianist wants to succeed. Understanding how memory works will make this point clear.

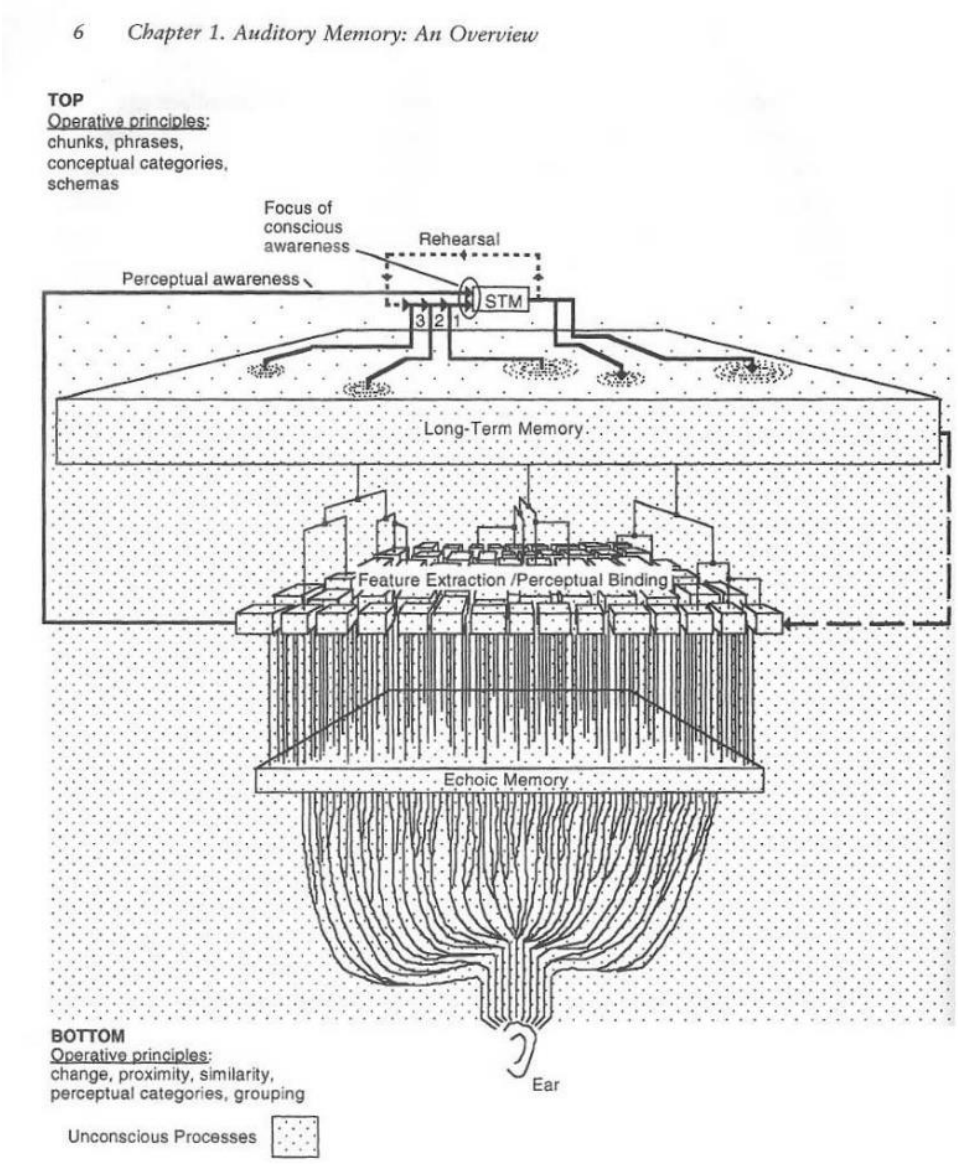


Figure 3.1 Snyder's Memory Model

Snyder (2000)

Snyder's Memory Model

So how does memory work? There are many recent memory models developed during the past half a century. Most of them evolved from models generated in the 1960s based on this

sequence: processing sensory memory, storing in short term memory (STM), and encoding into long term memory (LTM) (Baddeley, Eysenck, and Anderson, 2009, 6).

Bob Snyder (2000) built a memory model (Figure 3.1) specifically for auditory memory of music. This bottom up process starts with sensory memory that contains auditory information, which he refers to as echoic memory. After the sound waves were perceived by the inner ear, the information is transformed into nerve impulses to form echoic memory, which could be a pitched event in the context of music. Echoic memory then undergoes the process of perceptual binding to be combined with multiple echoic memory units into a more coherent auditory event. For instance, the motive of a phrase. Snyder has mentioned two types of perceptual binding: proximity, events that happen close in time, and similarity, events that sound similar. These events then enter STM, which is often part of the working memory system. There are two types of processes that constantly happen in working memory. The first type is chunking. Due to limited capacity of working memory, information needs to be grouped into manageable chunks to be processed. The chunks are grouped using patterns that already exist in one's knowledge retrieved from LTM. An example of chunking in music could be grouping motives into a phrase, or grouping chords into a harmonic progression. The second type of processes that constantly run in working memory is rehearsal, especially when learning is involved. Through rehearsals the information could be stored as new knowledge into LTM with enough repetition.

Although Snyder's model was designed based on auditory memory, this model could also explain the bottom up encoding of muscle memory and visual memory during the process of memorizing piano music. For example, muscle memory could start with the sensation of moving one finger at a time, maybe the thumb, at sensory memory level. Grouping it with the next movement of index finger and middle finger would create a fingering group 123 event in STM. Combining a fingering 123 group with a 1234 group using the retrieved "finger movement of a scale" pattern from LTM, the new information is now recognized as muscle memory of a scale. As for visual memory, it could start with separate images looking at thumb on the key C, middle

finger on E, fifth finger on G. Then the combination of the three could be grouped into the image of a right hand C major chord on the keyboard in STM. Connecting the image of the C major chord to a D major to a G major chord, LTM is going to categorize it as a visual image sequence of a S-D-T progression. Visualizing the chords on the keyboard is always a very helpful tool to memorize and understand voice leading.

The process of memorizing using intellectual memory is exactly the process of chunking. The music theory knowledge is retrieved to organize the new notes pianists try to memorize and to encode them into recognized patterns and structures. Snyder included a lot of detailed information on the process of encoding on many different levels. From the smallest unit, a motive, to the largest ones, form and structure, many of the concepts are closely related to music theory. However, he did not discuss how memory works during performing, which is a process of retrieving and executing the encoded information. Similarly, most of the self-help memory books also provide a lot of information on how to memorize, but there are very few that include deeper discussion on how pianists use memory during performing to successfully complete a performance. The typical advice given on what to do while performing is "to concentrate" (Hughes 1915, 596; Magrath 1983a, 18), but what exactly to concentrate on?

There has been very little research done on musical memory beyond the point of encoding because performing is a lot more complicated than memory recall tests run in a controlled situation. Jennifer Mishra (2005) tried to come up with a model for the entire process of performing from memorization to the performance, but she failed to explain the gap between having memorized the music and being capable of performing the music from memory on stage. Not a professional pianist herself, Mishra (84) calls the preparation stage before performing the "over-learning" phase, and she did not explain why performers continue to practice after memorizing a piece. However, she did describe an important concept which occurs during the "over-learning" phase – automation. Although she characterized it as "stereotyped" and

"inflexible" repetition that involves "no conscious control," the automation step is very important during the process of performance preparation, and it will be discussed below.

Memory for Skills

Ericsson and Chase's memory model for acquired skills could explain the entire process of memorization and performing (Ericsson, 1985; Ericsson and Kintsch 1995; Haberlandt's 1999, 125). The model contains three main steps: The first step is to learn and store knowledge into LTM using a pre-existing semantic memory structures. This step coincides with the chunking and encoding process that Snyder discussed: using knowledge in the LTM to process new information. This is the step for pianists to use knowledge of music theory and other previously learned patterns to memorize music. The second step is to develop an effective retrieval structure to make sure that the information could be retrieved with retrieval cues; the cues need to be linked to target information during encoding. The final step is to practice speeding up both the encoding and retrieval operations of LTM. The last steps are crucial in the process of preparing for performances. Without an effective retrieval structure, memorizing the amount of music that compose an hour-long recital would be a daunting task. The speed of encoding and retrieval is also a key. Without speedy encoding, it would take too much time to for a pianist to memorize the number of notes required to play at a professional level. The retrieval speed is also absolutely critical when the performer wants to play without stopping, especially when the music is challenging in terms of speed and technical complexity.

Automation

The process of automation better explains the second and third steps in Ericsson and Chase's model.

Automatic action is a process that can be carried out while the conscious mind is free to engage in other parallel activities (Ellis and Cohen 2008, 155). The opposite of an automatic

process is a controlled process, and it requires attention (Shiffrin and Dumais 1981, 111). The following is a list of some of the more relevant characteristics of automatic processes described by Shiffrin and Dumais (121-124) and how it relates to music:

1. Automatic processes do not utilize general processing capacity and they free space up for controlled processes (Shiffrin and Dumais 1981, 121). During a performance, if the performer could automate the entire process of generating and playing notes using developed aural and muscle memory, he could be free from worrying about the physical execution of playing the piano. Instead of reading the score or thinking about which notes to play, the performer could concentrate on the emotional or other artistic aspects of music and be more free and spontaneous, and be "in the moment."

2. All interesting processes consist of both automatic and controlled components (Shiffrin and Dumais 1981, 116). Many processes start as controlled process initially, but the sequence runs automatically (Shiffrin and Dumais 1981, 121). The process could also go in and out of control when it is monitored. Automatic processes often need intermittent attention at critical points (Ellis and Cohen 2008, 155). For example, making sure the muscles do not automatically take you back to the exposition right before going into the second theme of the recapitulation of a sonata. It could also be a situation during performing when muscle memory fails, the conscious mind would take over and keep the fingers going, cover up the mistake, and set it back on automation again. There could also be a controlled process assigned to monitor the same task as the automated one to produce awareness (Shiffrin and Dumais 1981, 124). For example, even though producing good quality tone from the piano could be an automatic process, active listening could monitor the tone created at any moment and generate feedback and see if adjustment is needed.

3. Automatic processes run to completion unless interfered with (Shiffrin and Dumais 1981, 121). Probably all pianists have had the experience playing automatically while thinking about what to eat for lunch at some point. A similar situation would be the familiar-to-many sensation of not remembering how one drove home sometimes.

4. Automatic processes usually start with a simple cue, though it is often not a simple task (Shiffrin and Dumais 1981, 123). The Cue in musical memory could be the first measure of a movement, or maybe the very end of the phrase before.

5. Controlled processes do not improve with practice while automatic processes improve dramatically with practice (Shiffrin and Dumais 1981, 122). However, with repetition and habit, automatic processes could not be easily modified while controlled processes remain flexible. The need for change in a well-established routine is liable to produce errors (Ellis and Cohen 2008, 155). Any experienced pianist would know the risk of changing fingering right before a performance.

6. It is hard to start in the middle of an automatic process (Shiffrin and Dumais 1981, 122); this is the reason why it is often very hard to start in the middle of a phrase, even while playing with music.

7. Controlled processes have to run in sequence because of the limited processing resource, but there could be multiple automatic processes running at the same time (Shiffrin and Dumais 1981, 123). This could be key to preventing memory failure. If there can only be one process in focus and it has to run in sequence, it means that the mind can only focus on one thing at a time during performing, although pianists have to perform many activities simultaneously. How does one

know *when* to do *what* during a performance? Discussion on prospective memory and planning in the next paragraphs might lead to the answers to this question.

Too many decisions need to be made during a successful performance. Every single note needs a decision on which note to play, which finger to use, how long to hold it, how loudly to play it, what sound quality to produce, and, depending on how the note fits into the phrase, how the phrase fits into the section, and how the section fits into the movement. At the same time, pianists constantly have to adjust to the unfamiliar pianos that they are playing on, in addition to fighting numerous distractions from the environment. As Chiu (2006) mentioned in his DVD, "playing the piano is such a complex activity. We can't possibly consciously do all the things that are necessary... we can only set up reflexes, things that happen over period of time automatically… All of these things happening in parallel – thoughts, feelings, physical motions."

Although automation is a must, it is not enough to get through an entire performance or recital and let it all happen as an automatic process. Nobody wants to play like a robot. It probably happens to some young beginner students who only need to perform a short and fast piece, but the higher the level of playing, the less likely for any performer to rely only on automation. A big part of performing still depends on controlled processes, which only happen in a sequence.

Prospective Memory and Planning

Prospective memory involves forming an intention, deciding on the action, and create a cue that calls for future action, as opposed to retrospective memory, which is the recall of stored knowledge (Ellis and Cohen 2008, 141; Baddeley, Eysenck, and Anderson, 2009, 343). However, prospective memory also includes retrospective memory – remembering *what* to do. Prospective memory is a self-generated process that does not necessarily involve learning since the knowledge required has already being encoded. (Ellis and Cohen 2008, 142) Giving a

performance must involve prospective memory on various levels. Such levels might include remembering to play all the pieces included in the recital in the correct order, remembering to play all the movements in a large work, remembering to take a repeat, remembering to play one motive twice, remembering to voice a melody, or even remembering to use a certain fingering at a particular spot. There are two types of prospective memory (Ellis and Cohen 2008, 144). Depending on the types of the cue, it could be time based, like remembering to make a phone call at 7pm, or event based, remembering to give the gift to Carol when you see her. Prospective memory during performing should be mostly event based, with cues planted along the progression of the piece. Common prospective memory failures during a performance, often called slips of action, could include the several of following situations. 1. When the cue is forgotten, the performer will blank out on what to do next. 2. When the goal is switched, the performer will connect to the wrong passage. 3. When there are repetition errors the performer would forget whether a repeat has been taken or not. Slips of action occur predominantly with highly practiced and over-learned routine activities with little conscious monitoring (Ellis and Cohen 2008, 154).

Planning is "predetermination of a course of action aimed at achieving some goal" (Hayes-Roth and Hayes-Roth 1979, 27)**.** It is what guides prospective memory. The when-planning is extremely important in music. It could involve making a conscious decision on which processes are going to be automatic and which ones are going to be controlled during a performance. Major mistakes could happen either way. When the mind starts to control an automatic process, the automated action could be interrupted; when the mind forgets to control a process, slips of action could happen. Planning could also mean designing the sequence of controlled processes that will stay in consciousness, like a flow chart of what the mind should be concentrating on. For example, the performer could decide phrase by phrase what to focus on. Or the performer could be listening to the melody while supporting the phrasing with the bass, focusing on the rhythm and the moment, or focusing on how one chord melts into the next. These

challenges are analogous to planning activities for a day to maximize productivity: wake up at 7am; shower and breakfast; 9:30am bus; go to class; stop by the library; lunch with a friend; and the list continues. It is important to have a plan or some activities could be forgotten. Just like the order of activities in any given day can be planned prior to the day they actually occur, one can also practice going through your musical plan on the piano for a future performance as many time as you wish.

Prospective memory is subject to distraction, or other processes that compete for the process resources (Ellis and Cohen 2008, 144). Interruption could seriously impact prospective memory (Baddeley, Eysenck, and Anderson, 2009, 348). Pianists are often startled by their own mistakes and start having memory slips. Task completion is also affected by emotions (Ellis and Cohen 2008, 144; Baddeley, Eysenck, and Anderson, 2009, 344). Studies also show that emotions and personality traits could both affect the performance of prospective memory, which could explain why nervousness affects performing.

Chaffin's Observation

Chaffin (Chaffin, Imreh and Crawford 2002) used a memory model similar to Ericsson and Chase's model for acquired skills to observe Pianist Gabriela Imreh learning to perform the third movement of Bach's Italian Concerto.

Imreh used three similar steps (198-201). In the first step, she used meaningful encoding and memorized the third movement using chords, scales, arpeggios, phrasing, and harmonic progression to encode the new information as variations of all of the above. Chaffin's observation shows Imreh going through the piece using chunking technique, though she found it challenging to memorize because of the rich variety of patterns used by Bach that required non-standard fingering. In the second step, Imreh used a well-learned retrieval structure. She broke the piece into sections, which served as a natural retrieval structure, and she established the beginnings of each section as performance cues. Chaffin created a graph showing the hierarchical retrieval

scheme of the movement used by Imreh (199) (Figure 3.2). However, the graph did not reflect the sequential property of the music.

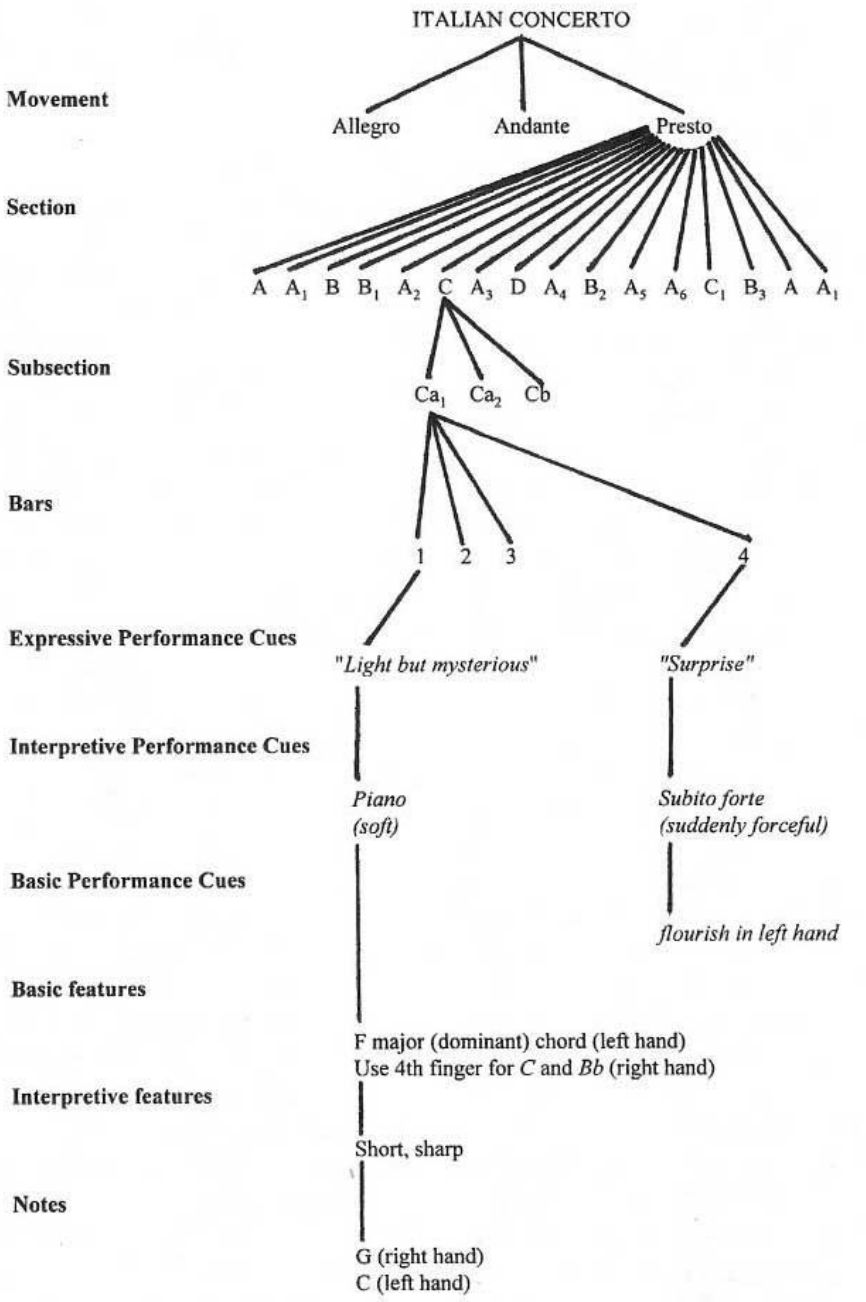


Figure 3.2 Chaffin's Hierarchical Retrieval Scheme of Italian Concerto Mov. III (Chaffin, Imreh and Crawford, 2006)

During the third step Imreh developed rapid retrieval from LTM. After memorizing the notes, Imreh practiced to speed up her playing. Chaffin suggested that retrieval during performing is muscle or auditory. If mistakes happen, intellectual memory will kick in, though retrieval from LTM is slower than slower than muscle memory (199). Chaffin and Imreh called the cues to the processes "performances cue," defined as "conceptual representation of music that is linked to the corresponding muscle response" (201).

According to what Chaffin learned during his observation, pianists should be attending to performance cues at the right moment. As Imreh's practice progressed, the speed increased and the number of performance cues dropped and they eventually became "expressive cues" (216). The process of automation frees up the processing resource and allows the performer to focus on the emotional aspect of music. Perhaps the expressive cues are what the piano teachers mean when they tell student to "just focus on the music."

During the learning process Imreh made an important comment: "It was a matter of learning exactly what I needed to be thinking of as I played, and at exactly what point" (216). This could be when prospective memory and planning become useful. However, Chaffin did not go further with the idea of creating expressive cues or how to program them partially due to running out of practicing sessions to observing the rest of the preparation leading up to the performance.

In Chaffin's latest publication with his colleagues (Chaffin, Logan and Begosh 2009) that was related to his original research, he included a few new concepts that were missing in his original paper. He added the idea of associate chains which reflects the sequential property of music (353). He contrasted associate chains to content-addressable memory, which were the performance cues. He also suggested that the two types of memory work together. When the association chains fail, the content-addressable memory would serve as a safety net. He also provided a new memory graph that combined these two types of memory (Figure 3.3). He also defined a new type of memory: linguistic memory – "the mental instructions that experienced

performers use to remind themselves what to do at key points in a performance" (357). Linguistic memory is similar to prospective memory in the way it can be rehearsed mentally. However, he did not include any discussion on the concept of planning.

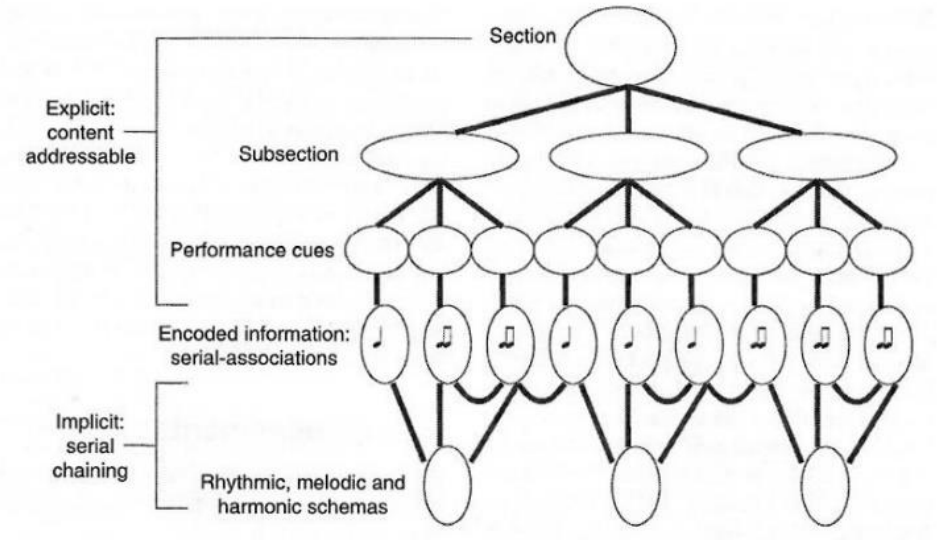


Figure 3.3 Chaffin's Updated Graph

The memory is just not secure enough when performing on stage without an aggressive and well-rehearsed plan for the performance using the concept of prospective memory and planning, unless the performer prefers to let it all happen and use recovery methods when necessary. The sequence of control processes requires so much attention that it will keep the conscious mind occupied, and thus free the performer from the distraction caused by environmental factors and from nervousness and anxiety.

Chapter 4: Memorization Methods

The process of memorization as highlighted in this essay is complex and cannot be explained by any one model. Likewise, memorization methods that have been popular for about one hundred years for pianists are involved and differ in usefulness and scope.

Study the Score

The ability to process music analytically is agreed to be the number one key to memorization by many great pianists such as Bella Davidovish, Jörg Demus, Alicia de Larrocha, Leon Fleisher, Friedman, Ignaz Friedman, Heinrich Gebhard, Percy Aldridge Grainger, Myra Hess, Lili Kraus, Rudolph Ganz, Moriz Rosenthal (Chaffin, Imreh and Crawford 2002, 48, 54, 56). Many of them recommend studying the scores in detail. This method was also recommended in many musical memory self-help books (Cooke 1948, 61; Winslow 1949, 16; Aiello & Williamon 2002, 176; Cienniwa 2014, 7). However, people who are too general with their observation and lack the ability for detailed study usually do not have reliable memory (Wang 2013**,** loc 417). Segalowitz's experiment (Segalowitz et al. 2001) reflected the importance of elaboration, or depth of processing, and concluded that memory was most successful when the music was remembered in terms of its musical essence**.** In addition, generate effect – the concept that ideas are more likely to be remembered when the association is generated by the subjects themselves – also applies to intellectual memory. It is even more effective than elaboration (Anderson 1994, 205). Therefore, if the pianists take advantage of the generate effect and discover the information from the scores on their own, they will have more successful retrievals.

Mental Practice

Mental practice is the process of practicing away from the piano. Some musicians find mental practice to be not very helpful. Rubin-Rabson found no significant advantage with mental

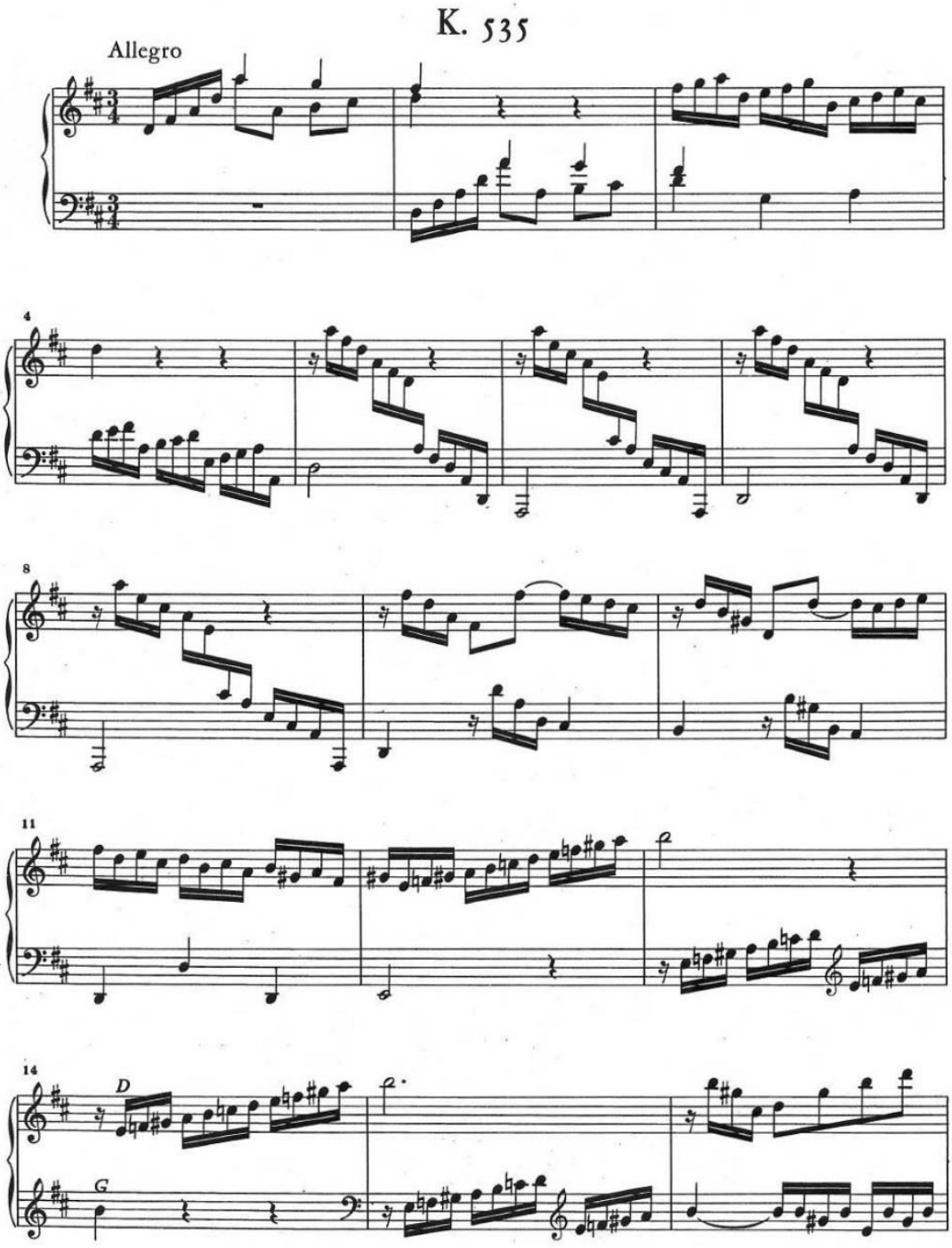
practice during her research (1937, 343). Ross found that mental practice is useful for college trombonists if it is interspersed with physical practice; the group that had mental practice alone with no physical practice did not improve significantly over the control group who did not practice (1985). However, mental practice is recommended by many great pianists and educators including John Browning, Bella Davidovich, David Bar-Illan, Victor Seroff, Frederic Chiu, and Horowitz (Kenyon 1904, loc 90; Leimer-Gieseking 1932, 48; Magrath 1983b, 14; Viviano 1986; Shockley 1997, 4; Chaffin, Imreh and Crawford 2002, 44, 52, 57; Chiu 2006; Wehrli and Wehrli 2007, 44; Cienniwa 2014, 36; Dumais 2015, 29). This technique is said to help securing memory.

Mental practice removes some of the automated physical movements to allow the mind to focus on rehearsing controlled processes and creates several advantages. First, the mental practice of a performance could be a good way to practice the planning of a piece. Since only the controlled processes are left, the pianist is forced to focus on the continuity of the control process sequence. The sequence will stop any time when distraction makes the mind wonder away. That is also why many think that mental practice could help to better develop the ability to concentrate during performing (Matthay 1926, 10; Hughes 1915, 601; Bricard and Woods 1978, 106; Newman 1984, 137; Cienniwa 2014, 37).

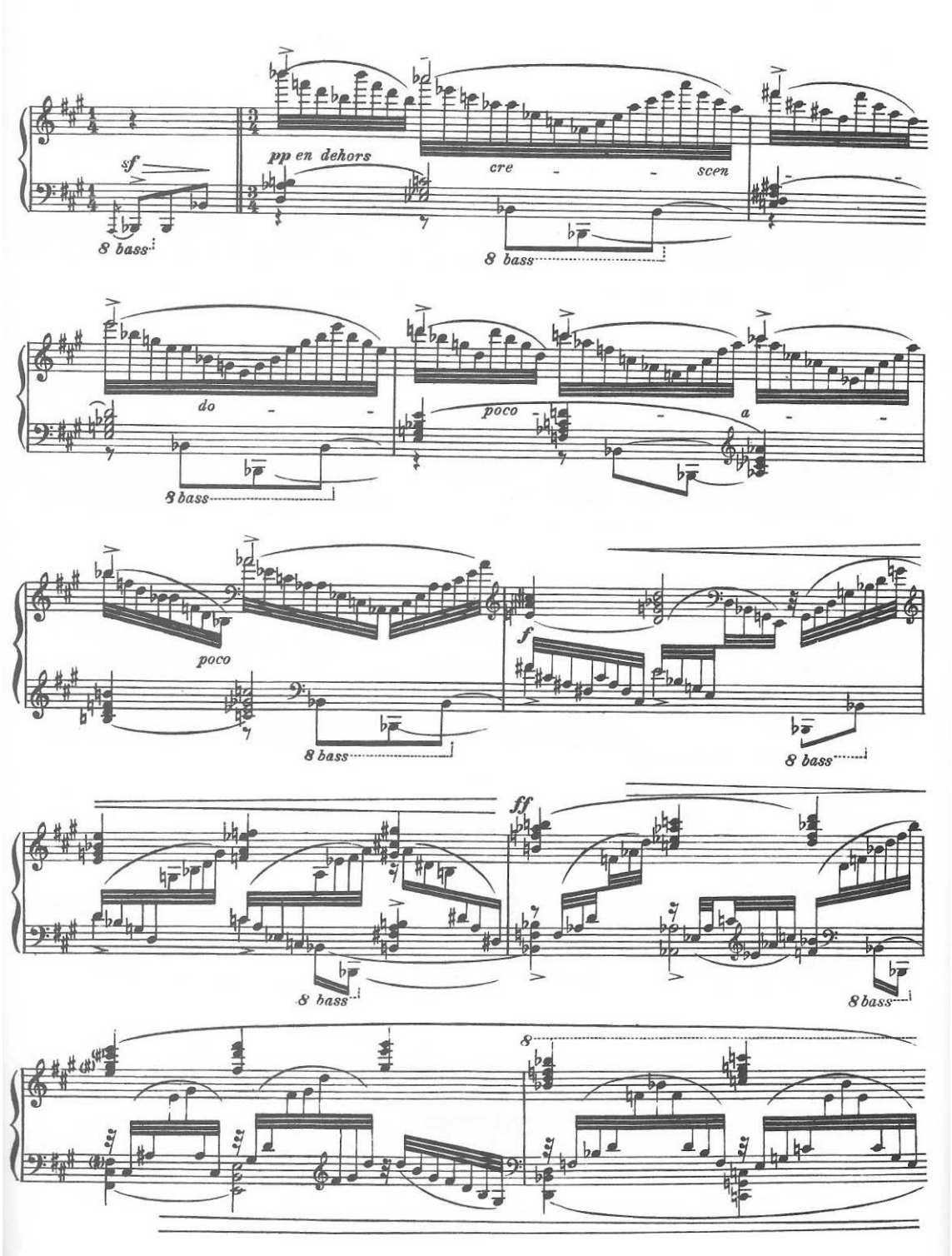
This intersection of memory and concentration is important to understand. Many musicians are unaware that their concentration is inadequately developed, rather than their memory. (Bricard and Woods 1978, 104, 106) Second, during mental practice, the performer could be focusing on the controlled processes, which often involve emotional and interpretative decisions, like the expressive cues used in Chaffin's and Imreh's experiment (Chaffin, Imreh and Crawford 2002). A pianist could have a chance to be free and creative without being tied down physically. Finally, mental practice also improves aural skills, which is the basis of auditory memory. Many suggest imagining the sound and to sing it out loud (Kenyon 1904, loc 439; Magrath 1983b, 14; Aiello & Williamon 2002, 178; Wehrli and Wehrli 2007, 42; Mclachlan 2015, 169; Dumais 2015, 33). They also stress the importance of aural skill training (Kenyon

1904, loc 401; Aiello & Williamon 2002, 177). Wang shares her experience with how her teacher helped her develop the skills since she was very young (Wang 2013, loc 1135).

Frederic Chiu (2006) designed his Deeper Piano Studies focusing on the awareness of thoughts while practicing away from the piano. In his documentary DVD, he gave the five participating pianists a Scarlatti sonata (Example 4.1) to learn away from the piano for two days and perform it without having physically practiced it on the piano. Each participant noticed the form, patterns, and all the details in the score. Although one of the pianists commented that when he tried to perform, his fingers felt like rubber from not having had a chance to play the piece physically beforehand, he nonetheless acquired good understanding of the piece. Chiu believes that practicing away from the piano makes the memorization clearer. However, learning to play a piece without physically playing the piano has limitations on the complexity of music one can process. Imagine learning this page from Miroirs by Ravel without using a piano (Example 4.2). It would be very difficult to imagine all the physical movement required to play the arpeggios and jumps. Many do not have the aural capability to learn a complex piece either. Nonetheless, mental practice still has its value when used at the right stage of the learning process depending on the purpose and each individual's ability.



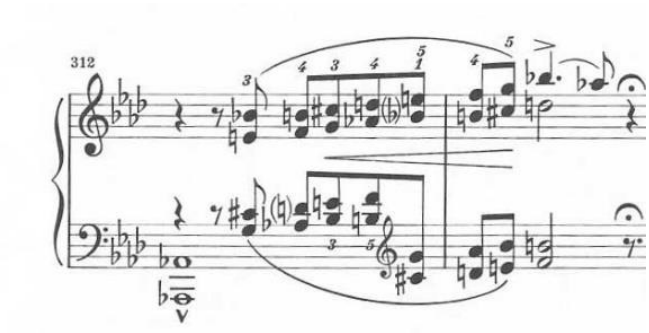
Example 4.1 Scarlatti Sonata K. 535, mm. 1-16



Example 4.2 Ravel Une barque sur l'océan from Miroirs, mm. 28-37

Repetition

Repetition is necessary when developing automatic processes like muscle memory (Viviano 1986; Wang 2013, loc 940). The formation of automatic processes needs sufficient time so it is important to take that into consideration when making a practice plan (Mclachlan 2015, 170). Pianists should always review and reinforce what was practiced during the previous session (Bolton 2015, 66). STM fades away in time unless some effort is made to retain it by rehearsing until the memory is consolidated by forming structural and chemical change in a neuron (Tallarico 1974, 4). This passage from the Liszt Sonata (Example 4.3) is one example where I relied on repetition to develop automation of muscle and visual memory of playing this passage. Although I understood the underlying theory – parallel diminished seventh chords moving up an octatonic scale – I could not conceptualize it from LTM fast enough. Without automation, I would not be able to play this passage up to tempo.



Example 4.3 Liszt Sonata B minor, mm. 312

Practice Without Mistakes and with Consistent Fingering

In addition to doing the repetition necessary to reinforce and create automation, especially for muscle memory, it is very important to avoid making mistakes and create false impressions from the very beginning (Matthay 1926, 7; Leimer-Gieseking 1932, 47; Rubinstein 1950, 60). Messy practice habits create problems and limit progress (Wang 2013 loc 561, 574). Although it is unlikely to be perfectly consistent, automation could still be developed. According

to Schneider and Shiffrin (1977), as long as the repetition is correct more than half of the time, it will offer improvement. However, in the experiment, the authors found that it takes 2400 reversal repetitions to undo a learned habit and get it up to the level of 1500 repetitions, which is a totally of 3900 repetitions. So, the price to fix a mistake doubles.

During the Deeper Piano Studies, Frederic Chiu (2006) suggested that a pianist should think more about how to improve before the next iteration, instead of relying on rote repetition. He also suggested not to associate anxiety with a difficult passage. For instance, in anticipating a passage as difficult on repetition, it could become habitual and create unnecessary anxiety during performance. One very common bad habit among pianists is stuttering. Stutter happens when the pianist is not conscious of rhythm and fluidity; both are very important elements of music and should never be ignored (Wang 2013, loc 719). Another good habit it to always use consistent fingering, and when there are wrong notes, to make sure to find the cause (Matthay 1926, 14; Newman 1984, 98, 134). It is also important not to memorize misreading, which would have been avoided if the score was studied carefully (Wehrli and Wehrli 2007, 43; Mclachlan 2015, 171). Duke, Simmons and Cash (2009) performed research on the relationship between practice behavior and retention of performance skills. Although memorization was not required during the recall test, the pianist definitely needed enough muscle memory to perform the excerpt from Shostakovich's first piano concerto. They found good practicing habits of those who learned faster that was lacking in those ranked lower: the faster learners preempted errors by stopping in anticipation of mistakes, with a first trial at the new tempo that was nearly always accurate, with no persistent errors early in practice, repeating until the error was corrected, and addressing errors immediately.

Distributed Practice

It's also very important to distribute practice. Repeating something too many times in a short period could create boredom or fatigue (Winslow 1949, 16). It could even cause injuries

when repeating a physically demanding passage. Many studies show consolidation of memory overnight and that performance accuracy is enhanced by sleep-based memory consolidation (Allen 2013; Simmons 2017) In addition, there could be interference when practicing similar tasks since they compete for the same neural resources (Allen 2013), so it is also important to not memorize too much of similar material in one day.

Practice in Sections/Sequence

Pianists should practice a piece in sections and not always start from the beginning (Magrath 1983a, 17; Aiello & Williamon 2002, 178; Chaffin, Imreh and Crawford 2002, 56; Wehrli and Wehrli 2007, 41; Holmberg 2012, 36; Wang 2013, loc 819; Cienniwa 2014, 26; Shefski 2014 loc 181; Dumais 2015, 32). Beginnings of sections could always serve as a secondary starting point in the case of memory failure (Bolton 2015**,** 63). In Williamon and Egner's research (2004), they found that structural bars were identified faster than non-structure bars, and that therefore, memory is more secure when using structural bars to create retrieval cues.

Record Yourself and Play on an Unfamiliar Piano.

Recording oneself not only gives pianists a chance to listen to themselves subjectively, it also adds some amount of stress to performance during recording (Magrath 1983a, 18; Magrath 1983b, 16). The added stress and playing on a different piano each change the context of the recall, making it unfamiliar; those basic factors are among several that commonly affect pianists during performances. Haberlandt (1999, 85) quoted four different experiments comparing recalls in the same context vs recalls in an altered context – different environment (land or sea), different mood (happy or sad), whether under drug influence (drugged or sober) and different association (rhyme or semantic). Recalls were best when the environment context matched. When pianists perform outside of their practice rooms, in a concert hall for example, the space is different

(acoustic, lighting, temperature), an audience is present, the mood is different, and the piano is also different. Mishra and Backlin's research (2007) shows that recall is negatively affected when done on a different instrument. Therefore, practicing performing in a different environment or for others helps with identifying the passages that are insecurely memorized and susceptible to external influences (Hughes 1915, 602; Magrath 1983a, 18; Cienniwa 2014, 7, 52, 68; Dumais 2015, 28). Bolton (2015, 69) suggests playing on a keyboard at a friend's house!

Practice Imagining the Page!

The Wehrlis are some of the very few that actually suggest practicing visual memory of the page and trying to imagine what you see on the page line by line (Wehrli and Wehrli 2007, 42).

Hands Separate

Although many teachers recommend to practice hands separate, there was not enough information found on this topic to decide whether practicing hands separate has any demonstrable, consistent effect (positive or negative) on memorization. For example, Rubin-Rason found positive and negative transference after conducting her experiment (Rubin-Rabson 1939, 342). On the other hand, Ernest Hutcheson never bothered to memorize hand separately (Chaffin, Imreh and Crawford 2002, 55), while the others suggest memorizing hands separate (Magrath 1983b, 14; Aiello & Williamon 2002, 178; Wehrlis 2007, 43; Bolton 2015, 65, 68), or use it as a way to test the memory. One thing to consider is that in theory it could potentially take two times longer to practice hands separate for any given piece. The bigger concern should be that by practicing hands separate, the hand practicing alone becomes the controlled process. However, when putting the hands back together, there could not be two controlled processes. Therefore, practicing hands separate could potentially destroy the automation that has been previously established. Instead of focusing on one hand at a time, the coordination between the

two hands should be guiding the controlled processes to monitor both hands at the same time. Nonetheless, practicing hands separate still has its value. For example, focusing on the accompanying hand alone could always help the pianist to understand the horizontal association of notes while memorizing.

Start Memorizing Early and Practice Memorization

Many great pianists, including Leschetizky, suggest starting memorization early and to learn notes and memorization at the same time (Hughes 1915, 595; Magrath 1983b, 16; Chaffin, Imreh and Crawford 2002, 54, 55, 57; Hamilton 2008, 74; Wang 2013, loc 417; Shefski 2014 loc 181). Newman thinks if the pianist waits too long to memorize, it would equal relearning the piece (Newman 1984, 135). Memory skills need to be developed and practiced. Shockley (1997, 1) thinks it is better to start memorizing as a beginner and systematically apply knowledge of musical pattern, and it would also make playing more enjoyable. Memorization should be practiced every day (Newman 1984, 136; Bolton 2015, 64; Mclachlan 2015, 169), instead of right before the concert Gordon (2004).

Mclachlan developed a fifteen (15) step routine for memorization that pianists are instructed must be followed in strict turn, starting with lying on the floor while relaxing and then progressing through steps such as singing and playing the main melodic thread in the passage simultaneously, playing through the piece at dynamics of *ppp* with no pedal, writing out the fingering of each note away from the piano, copying the music note-for-note onto manuscript paper, lying down again but singing this time, and then on the final step playing the passage while recording oneself, followed by listening to the recording and noting any areas that went wrong… and then repeating the *entire* process for the spots that went wrong.

Roughly calculated, a one minute passage would require more than one hour of time if a pianist were to use this method, not to mention that if errors are made during any step, repeating the *entire* process will take another hour. It also looks like the mistakes are unavoidable: only one

step in the process involves the pianist actually practicing hands together on the keyboard, in *ppp*, which means absolutely no hands-coordinated muscle memory was developed during the entire process. Preparing a recital-length program using this method would be a complex task.

People have different Approach

Wang (2013, loc 1614) collected conversations with many professional musicians including non-pianists on the topic of memorization, and everyone has their own way of memorizing music (Hughes 1915, 597; Aiello & Williamon 2002, 178). It is very important for each pianist to figure out what works and what does not. Blindly following a set of practicing methods without understanding what the goal is and why it works could result in significant wasting of time during practicing. The best thing for pianists to do is to always observe their own practicing and be mindful of their progress. Learning from experience could help creating a set of efficient memorization strategies tailored to individual needs.

Expert Memory

Expert Memory, compared to general memory, is characterized as having more depth, interrelatedness, details, and more cohesiveness, though the complexity is sometimes implicit and hard to describe (Cohen 2008, 220). Many consider expert memory to be a natural talent, but some argue that it is not a talent because the memory is only at the expert level specific to their expertise and always requirs a lot of practice. There is no short cut to acquiring a large amount of knowledge in any expertise besides engaging in an extensive period of study. With the large amount of knowledge, the experts use the knowledge to establish their own acquiring mechanism. Using organization and chunking skills and their experience to filter out irrelevant information, the experts are able to retain information faster than novices. Nothing comes easy without the famous 10,000 of practice. At the beginning of my study, more attention was given to the memorization process of music, and it demonstrated similarity to the memorization process in

other area of expertise especially in terms of how information is encoded. However, considering the concept of prospective memory, it becomes clear that both chess and sports lack the continuity in retrieval processes that is crucial to any successful musical performance. Instead of a planned sequence of actions, the retrieval in chess and sports is often prompted by a participant's interaction with his or her opponent.

Dance is probably the most similar to music in terms of continuity and the application of prospective memory. There are quite a few articles online where dancers share their experience on how to memorize dance choreography faster. The strategies for learning choreography are very similar to music. For example, to learn choreography in chunks, to set a schedule for repetition, and to repeat in your mind as well as your body (Miss P, 2017). The concept of "marking a choreography" is similar to mental practice, and it is said to have positive effect when memorizing choreography (Warburton et al. 2013). However, like music, there is also very little information on how memory is used during a performance of a dance choreography and how the choreography is retrieved from LTM continuously while performing. It could be a good topic for future cognitive psychology research in both Music and Dance.

Conclusion

The tradition of playing from memory has been a challenge for pianists since the end of the nineteenth century. Although pianists and educators have been using different practice methods to conquer this challenge, many continue to struggle with performance anxiety caused by fear of memory failure. In order to improve memorization, it is very important for pianists to have a better understanding of the psychological processes surrounding how memory works. Most of the resources on this subject focus on the process of memorizing music. While many memory models and theories were developed during the past fifty years, very few of them explain the memory retrieval process during performing. However, I certainly hope that more psychologists will invest their time in studying the retrieval process and how it relates to the concept of prospective memory and planning. In the meantime, pianists should always think about their goals while they are practicing, so they can memorize music or prepare for performances more efficiently. With a better understanding of these practice methods and their purposes, pianists should be able to choose exercises that are better suited to their practice routines than rote repetition to maximize benefits and improvement. Lastly, I encourage everyone who reads this paper to be creative with their practicing and design their own memorization methods.

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