

Exploring effective memorisation methods for advanced pianists——A systematic literature review

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Abstract: Pianists' performance sometimes last at least fifty minutes and produce more than a thousand notes per minute, so the memory demands of pianists are extremely high during piano performance, a core feature of a soloist's professional competence is the ability to play without the score in concert. Performers play from memory can show their professional ability and a pianist can perform better only if he or she has excelled in memorizing the score. In order to improve pupils' ability in memory, this literature review focuses on exploring effective memorisation methods for advanced pianists in content-addressable, performance cues, motor, visual, and auditory aspects.

1. Introduction

It is common for musicians to perform pieces from memory. The circumstances of musicians playing with sheet music include: 1) recitation performances are accustomed to concert performances by soloists; 2) near-perfect performances of famous works are expected by audiences in the Western art-music tradition; and 3) rock, folk and pop musicians always perform without the repertoires[1]. There are several practical strong points for musicians performing without sheet music: 1) the physical aspects of the performance can be monitored by the musicians, such as looking at other ensemble members, hands; 2) pianists do not need to share the platform with page-turner at the concert; and 3) the performers do not have to turn pages. Performers can prevent lots of trouble from playing without pieces on stage. Effective communication among all participants is involved because the audience's visual feedback is received and then reacted by the musicians, it makes the performance really interactive. Playing from memory can promote communication and interaction with the audience. In today's society, a core feature of a soloist's professional competence is the ability to play without the score in concert [2]. Performers play from memory can show their professional ability.

Pianists' performance sometimes last at least fifty minutes and produce more than a thousand notes per minute, so the memory demands of pianists are extremely high during piano performance. In the process of performance, pianists have to memorise a lot of notes, especially for advanced pupils. Moreover, some elementary pupils memorise sheet music mainly by observing the teachers' demonstration. Therefore, the research object of this literature review is advanced pupils. In order to improve pupils' ability in memory, this literature review focuses on exploring effective memorisation methods for advanced pianists in content-addressable, performance cues, motor, visual, and auditory aspects. These five strategies in different aspects help pupils memorise music in a more targeted and

step-by-step manner.

2. Content-addressable memory

The memory of what is about to happen is implied by each of these memories, and this is the form of an associative chain that is formed spontaneously when learning a new score [3]. A major disadvantage of associative chains is each point of the chain must be reached from the beginning. This is often catastrophic for the players who are in the middle of performance since they must start awkwardly from the beginning and concern about failing in the same place again. Therefore, musicians tend to use content-addressable memory instead of associative chain.

Performers are required to offer more effort to develop content-addressable memory (i.e. reliable memory) as the associative chain is only the first step. The difference between the content-addressable storage and association chains is the former involves descriptive knowledge, which is language-based, conscious, and explicit. In the memory function, the memory is restored by the content-addressable memory in the event of interruption of the performance and association chain because a safety net is provided by the content addressability. Using content-addressable memory, numerous starting points will be created to give performers a safe way of alternatives, thus, the problem regarding going back to the beginning and starting over can be effectively resolved. Piano teachers can teach their pupils to make different starting points so that it can build pupils' content-addressable memory. Additionally, performers need to develop a strategy to distinguish the parts, if they are relatively similar, as much as possible. One of the effective ways of performing without sheet music this is to add clear landmarks, especially in where the channel diverges[4]. Piano teachers can teach their pupils to create clear landmarks in the score so that it can improve their content-addressable memory.

3. Performance cues

Markings in the mental of a piece of music in working memory are kept by competent players during performance, which are performance cues. Repertoire is organized into four distinct categories of systematic and in-depth performance cues: a) expressive cues are associated with extra-musical sensations, such as images, atmospheres and emotions conceived and perceived by the interpreters; b) contours, rhythms and dynamics of musical gestures are guaranteed to be relevant to interpretive cues; c) structural cues are associated with aspects of formal structure, such as musical boundaries, design, part endings and changes in tempo, like punctuation in written texts; d) certain technical aspects are related to basic cues, such as basic mechanics, breathing, body posture and fingering resolution[5]. Teachers can make the plan about memorisation schemes by four different categories of performance cues to enhance their pupils' memory systematically.

Additionally, performers organise the performance cues in a hierarchical way. The balance of the overall structure of the work and the emotional expression are guided by performance cues[6]. A safety net is gained by the performance cues to avoid accidental serial cues because performance cues can be accessed not only directly by address but also via serial cues. Accidental serial cues mean that they are out of order. For example, when performers want to play a piece without sheet music starting from the second theme, a memory cue should be set for this position. The starting fingerings and chords of the second theme on the repertoire are observed by the performers and then played. The next time performers play from memory, they only need to think about the starting fingerings and chords to find performance cue. Anything a classical pianist might consider concentrating is triggered by performance cues[7]. Performance cues are very useful for pianists to perform without the score. A piece of information is retrieved by many associative cues, when the pianist correctly retains and encodes this piece of information. Therefore, performance cues are very convenient for players.

As the music develops, the performance cues appear effortlessly in the performers' mind since the

performance cues are repeatedly focused on the process of practice and guaranteed by the performers to be an important part of the performance. During the practice, musicians concentrate the performance cues can enhance memorisation skill. The essential points of key phrases and difficult fingerings are considered by the pianists during the performance so that these points and related motor responses are automatically brought to the mind of the pianists. This is the interpretive and basic performance cues[8]. The subjects of Chaffin and Imreh's study were only one person, which may have influenced the results of the experiments. Nevertheless, comparing these two studies, it could be found that performers who want to improve their memory skill have to focus on performance cues during the practice, so these performance cues can be developed in performers' mind effortlessly.

Before the most reliable cues are marked in the score, the performers must analyse the music to ensure that the important information becomes reliable cues so that the memory of these cues can be strengthened every time when players practise the pieces unconsciously. It is the method to find reliable cues in repertoire and how to reinforce the performance cues during practice. The accuracy of the memory cues is tested by letting pupils start from different places, teachers always use the strategy of condensed performance to make their pupils play all the performance cues, each phrase and each part is played in sequence by their pupils. Piano teachers can teach their pupils to associate complete phrases based on performance cues, a process that develops pupils' performance cues. After the pupils are familiar with the performance cues of the pieces, teachers can try the following advanced methods. Teachers mainly use the method of imagination to teach advanced pupils. For instance, the music being played is carefully imagined by them, when teachers clap their hands to indicate the change, the actual playing state is played by them immediately. When students' memory cues become more fluent, teachers can find more difficult places for students to complete the transition between imaginary music and actual performance. The purpose of the teacher's applause is to remind the pupils to complete the transition between imaginary music and actual performance. Piano teachers can try these avenues to enhance their pupils' memory in performance cues.

4. Motor memory

The significant features of motor memory are unconscious and invisible, which is the most significant character. Although musicians know they can play the particular works, they can only show their musical knowledge when they actually perform them. This makes performers feel anxious and may cause them to over-practise. Therefore, piano teachers should be aware that motor memory may not be suitable for every pupil, especially pupils who are not good at emotion management. Motor memory operates in the way that the next action is reminded by previous one in the series. This is due to the clearest part of the chain of relationships in memory is provided by motor memory. The sound should be produced by the performer's physical movement on an acoustic instrument, although music or notes can be mentally rehearsed by the performers in analysing the score and listening to recording of the composition. Motor memory plays a significant role in memorising the sheet music. Well-crafted motion sequences and practised motion programs are included in motor memory, and the desired result is produced by these motion sequences by controlling the surrounding environment in the most efficient method. Effective motor memory helps pianists to perform without the pieces. In addition to rhythm, harmony, tone, form and structure, musical theory is covered by meaningful motor memory related to piano performance, how musical instruments work is also widely understood by motor memory, and how fingers handle and interact with the keyboard. Motor memory involves not only basic music knowledge but also how the piano works. Piano teachers can try to incorporate knowledge of the piano and music theory into the lessons. The development of the network that controls finger movement is caused by associative memory of similar motor movements, the planning of finger movement, neural firing and involvement of other alternative directions, such

as episodic memory, emotion. Furthermore, the ordeal is constantly burdened by the performer's memory load, starting with the first practice. Pianists improve their motor memory in their first attempt of pieces. During this process, pupils' memory may not be able to be loaded, piano teachers can assign the recited content according to the level of pupils.

The building of long-term memory is developed by further practice with the same material in the form of schemas, which are built on the basis of existing schemas, and then detailed attributions of the performers' current long-term memory is created by some stage in the hierarchy of the existing schemata. The new pattern is produced by music without basic characteristics and performers who lack previous musical theory. Pianists repeat the same practice task can trigger schematised long-term memory. The line movement between the hands, the movement, extension and placement of the hands and fingering are memorised by the performer at the subconscious level in a kinematic aesthetic way through a lot of repetition, which is making a piece of music into your fingers[9]. When the pianist repeats the practice, the memory of the hand movements is improved. In order for a sustainable connection to be established between the parts through repetition, the smaller parts should be continuously practised by the pianists in the process of memorising the music. The amount not to exceed the working memory capacity is limited by the part itself, it is 7 ± 2 . Fortunately, this limit is always present in a lot of phrases. To illustrate, pupils can divide the phrase into five to nine bars, and then it is easier for them to memorise. When performers use repetition exercises to improve muscle memory, it is better for them to divide the score into lots of small pieces to practise. Furthermore, when longer pieces are memorised by pianists in parts, they should not wait for one part to be perfected before starting the other, which makes the latter part prone to accidents[10]. The works should be performed as synchronously as possible using motor memory to reduce the chance of accidents. Short snippets are needed by musicians to play difficult phrases. The whole works and segments are hard to relate to since the flow of music is disrupted by the musicians breaking the music into such small parts. Nevertheless, motor memory always relies on musical coherence. So, Mishra reported that it is difficult for performers to organise fragmented segments in motor memory. Teachers can guide their pupils to regularly divide phrases into smaller pieces. As a result, pianists have to find their suitable strategies when using this method. The pupil has to re-memorise and add to the memorised part the next day, no matter how brief. The reason is that muscle memory is contracted without exercising. Once students have memorised the piece, they may still forget when they stop memorising and only practise with the sheet music, even if it is practised every day. Pupils ought to memorise the works every day to prevent motor memory from disappearing.

The pianist should properly consolidate the motor programs that have been practised for designated music before they enter the long-term memory portion that contains procedural memory. Then the pianist only needs to make a slight adjustment rather than perform other operations. To illustration, some details such as the interpretation of the accuracy of phrases, pronunciation and timing are added to the schema that the pianist already has maintaining practice. After the movement program is entered into long-term memory, the players ought to focus on the details of the repertoires. The pianists' hands are in place when they are sitting in front of the piano because the key signature is determined by the pianists before the performance. Thinking about the key signature before the performance is beneficial with musicians' motor memory. At the same time, piano teachers can teach music theory in the lessons. For example, teachers can explain the relationship between the various scales and the sharps and flats. The fingers used to control the movements of the piano are transferred by the musician's auditory imagery or auditory cues, such as memorised sounds and music, and visual imagery or visual cues, such as memorised scores or scores since the first note is planned carefully by musician. In order to switch visual memory and listening memory into motor memory, it is better for pianists to know the first note. The performance is affected by the pianist feeling the pain of muscle and the memory is disturbed by the pain of muscle taking up a lot of mental workspace. So

how the smallest amount of muscle activity produces the best results is concentrated by the pianist, which makes the musical performance easy for the pianists to play, a process in which new motor memories are consciously monitored and constructed. When the musicians perform in the wrong position for a long time, they may feel muscle pain. Therefore, in the process of cultivating muscle memory, performers should not neglect to think about optimal muscle activity for perfect musical performance.

5. Visual memory

Visual memory is one of the most effective memory strategies for performers. The memory fragment of a piece of music can be supported by the visual memory of the interactive hands on the piano and score. Not only the score memory but also the hands on the piano are visual memory. In the early stages of memorisation, musicians concentrate the visual memory of the sheet music primarily, but in the later stages of memory, they tend to focus more on the visual memory of their hands on the musical instrument. However, in this study, Chaffin observed that performers used different visual memory methods at different stages. A great deal of information can be contained in the performer's visual memory, familiar material can always be processed more efficiently and faster because of the conceptual categorisation in long-term memory. Performers can use visual memory to remember more information.

Players' memory is based on new work from annotated sources during the process of practice and learning. Piano teachers can teach their pupils use the notation to improve their visual memory. A pretty useful avenue to aid in memory error recovery or avoid memory errors is that the notes are known to the player where they are on the page during performance. Piano teachers can teach their pupils to remember the place of the notes in the sheet music. Repertoire is marked with colored pens or pencils to emphasize visual information memory. Piano teachers can help their pupils to taking notes on scores with different colored pens. During the performance, trivial memories play an important role. If the performer is playing with as orchestra, some basic things develop the visual memory, such as the special movements of the leader, the downbeat of the conductor. Some trivial visual fragments can promote visual memory. Writing and reading notes are included as other aids in improving visual memory[11]. Pupils can use some auxiliary strategies to enhance visual memory.

6. Auditory memory

Many performers' memory skills are developed by listening and imitating by what they hear instead of learning score. Clarity, dynamics, and surface rhythms are recalled by auditory memory and intensified in pitch. Moreover, the pianist's memory is dominated by auditory memory because music is essentially a variety of sounds. What do they expect to play in the next few seconds, to know if they are playing the right notes, these are two specific targets completed by the pianists using auditory memory[12]. Aural memory is helpful for pianists to perform without the repertoires. Each new piece of music we hear helps to remember specific pieces of music that we have experienced and already know. Performers use the music they hear to create memories for a particular piece of music. The memory of more sounds is triggered by sounds through association, and it is the relationship between memory and music that is implicated by the performer's consciously planned effort to memorise sounds in succession. Musicians consciously use sounds to enhance their hearing memory.

Students' auditory memory skills ought to be cultivated by teachers at every opportunity since this is not only the most musical but also the most natural avenue to remember. It is better for teachers to develop pupils' listening memory. Piano teachers must be more interested in ear training lessons than pupils because this lesson is significant for the general musical well-being and auditory memory

development of each piano pupil. Piano teacher can let pupils take part in more ear training activities to enhance their auditory memory. Although this is a study from nearly a hundred years ago, in today's society, many piano teachers still use ear training exercises to improve their pupils' musical skills. In order for students to cultivate their memory and recall memory, it is important for pupils to begin to find their own musical voices firstly. Auditory tasks are included in learning methods and teaching that promote cognitive-psychological skills needed to develop hearing, such as echo or call-and-response songs and singing games, making rhythmic clapping games, talking and listening to music[13]. Apart from this, engagement of the ear is stimulated by singing or humming along with the recording, the musical ear is engaged by the students singing the pieces and then enters the learning process and reinforces the memory, with or without the soundtrack. There are some ways based on strategies of auditory teaching to enhance memory skills. Additionally, the relationship between the physical layout of the keyboard and the sound is learned by playing the response and calling games on the piano and by rote memorisation, different piano sounds ought to be tried, such as staccato, legato, soft, loud, high, low. These more practical techniques allow students to practise and explore on the piano . There are some listening exercises on the piano can facilitate pupils' auditory memory. In order to avoid the bad idea that music can only be played by learning in front of lines and dots on the page from students, the teachers should play the piano with the pupils from memory, in the case of not being able to perform by ears. Teachers can try to play without the sheet music since they are role models for pupils.

7. Conclusion

Musicians play without sheet music is a very common form of performance. Apart from this, performing without the pieces has a lot of advantages, such as avoiding lots of trouble on stage, improving communication and interaction with the audience, showing performers' professional ability. In the process of performance, pianists have to memorise many notes. In order to enhance pupils' skills in memorisation, this literature review concentrates exploring effective memory methods for piano teaching in content-addressable, performance cues, motor, visual, and auditory aspects. These five strategies in different aspects help pupils memorise music in a more targeted and step-by-step manner.

To begin with the content-addressable memory, pianists tend to use content-addressable memory instead of associative chain since associative chain has some fatal weaknesses. Additionally, piano teachers can teach their pupils to make different starting points and create clear landmarks in the score so that it can improve pupils' content-addressable memory. Secondly, it is the performance cues. Teachers can make the plan about memorisation schemes by four different categories of performance cues to enhance their pupils' memory systematically: expressive cues, interpretive cues, structural cues and basic cues. When pianists concentrate the performance cues during the practice, which are came to pianists' mind effortlessly. Piano teachers can test their pupils' memory cues in the lesson. As an illustration, teachers can let their pupils play all the performance cues in order. After the pupils are familiar with the performance cues of the pieces, teachers can allow their students to switch between imaginary music and actual performance at any time. Thirdly, it is the motor memory. Motor memory may be not suitable for every pupil. Motor memory involves not only basic music knowledge but also how the piano works. So, piano teachers can try to incorporate knowledge of the piano and music theory into the lessons. Moreover, Pianists cultivate their motor memory in their first practice, and then piano teachers can assign the recited content according to the level of pupils. Apart from this, when the pianist repeats the practice, the memory of the hand movements is improved. In this regard, musicians have to memorise the works every day to prevent motor memory from disappearing. Moreover, after the movement program is entered into long-term memory, the players ought to focus

on the details of the repertoires. Furthermore, thinking about the key signature, the first note and optimal muscle activity is beneficial with pianists' motor memory. Nonetheless, the argument that whether the pianist should divide the pieces into some smaller segments is thought to depend on the pianist's own needs. Next, it is the visual memory, not only the score memory but also the hands on the piano are visual memory. Additionally, pianists used different visual memory methods at different stages. Moreover, piano teacher can teach some strategies about visual memory to their pupils: using the notation, memorising the place of the notes in the repertoires, taking notes on pieces with different colored pens, some trivial visual fragments and using some auxiliary strategies. Finally, it is the auditory memory. Piano teachers can use some listening exercises to enhance pupils' auditory memory: echo or call-and-response songs and singing games, making rhythmic clapping games, talking and listening to music, singing or humming along with the recording, playing the response and calling games on the piano and trying different piano sounds. To summarise, some effective content-addressable, performance cues, motor, visual and auditory avenues can improve memorisation skill in piano teaching.

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