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Introducing Conceptual Simplification: How to Simplify Complexity when Analysing, Learning and Memorising Post-Tonal Piano Music

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Abstract. There is a gap in music performance, education and psychology in terms of memorisation training for post-tonal piano music. Despite the repertoire spanning over 100 years, pedagogues and professionals still lack effective tools for developing this skill. Existing research on this domain is mostly focused on observing practitioners' behaviours during practice, to understand how these prepare for a memorised performance of a selected repertoire. However, a systematic method for effective memorisation is not provided. This paper discusses a new method for analysis, learning and memorisation of post-tonal piano music, named Conceptual Simplification, which was developed, tested and formalised with my PhD thesis. This presents a novel implementation to musical memorisation building on certain areas of mathematics and computer science to improve human memory and musical performance. However, Conceptual Simplification does not require any previous scientific training to be successfully implemented and works for different learning styles and types of complexity. This method could also be adapted to other instrumentalists, singers and conductors; and musical genres; and presents enough flexibility for other practitioners to incorporate additional strategies, adapting it to their needs accordingly. Finally, Conceptual Simplification can also assist in preventing performance anxiety through greater confidence and reducing the potential for injuries that usually result from repeated practice. The method's systematic approach toward engaging conceptual memory and reasoning leads to more confident memorised performances, while needing less repetition during practice.

Keywords. analysis, learning, memorisation, method, post-tonal piano music.

1 Introduction

This paper discusses some of the main outcomes of my doctoral research at the Royal Birmingham Conservatoire, which focused on testing, extending and formalising Conceptual Simplification [1]. This is a new method for memorising post-tonal piano music that I developed over the years with my own experience as a pianist and

mathematician.

My interest in researching musical memory started when I was an undergraduate student in Barcelona. Back then, I was simultaneously pursuing a bachelors in piano performance and another in mathematics. Given that I had a very solid schedule, I needed to be very efficient in my practice. Therefore, I started experimenting with using mathematical strategies in my piano performance for practising, but especially for memorising. Later on, in my Master's thesis at the Royal College of Music in London, I organised and further developed this pool of strategies, under a first prototype of Conceptual Simplification [2]. However, beyond my interest and background, it is reasonable to use mathematical strategies for musical memory, because mathematics is one of the best tools for solving problems and for identifying patterns [3]. Moreover, that is what musicians do all the time: they are constantly trying to find patterns in the music and are also trying to solve different kinds of challenges [4]-[6]. Furthermore, given that post-tonal music presents less standard tonal patterns, because composers develop their own composition principles [6]-[7], mathematics can also help in simplifying the score, to better identify such new patterns [1].

2 Research Background

Existing research on musical memory is quite extensive, but it has mostly focused on observing how musicians practise and memorise, to determine whether some strategies are more efficient than others (e.g., [4], [8]-[12]). However, a systematic method on how to effectively memorise has not been proposed (e.g., [4], [8], [9], [13]), particularly for post-tonal music ([6], [10]-[12]). Additionally, most soloists, especially pianists, are required or expected to perform from memory during their studies and at professional level, but memorisation is not a topic frequently taught or discussed at conservatoires [14]. This is partly due to an existing gap in music performance, education and psychology in terms of how memorisation should be trained [15]-[17]. But also, because research findings do not always transfer or are pedagogically implemented at conservatoires ([14], [15], [17]). Consequently, memorisation is still a taboo with which performers struggle with, leaving musicians to find their own ways for achieving this goal (e.g., [10], [11], [13], [15]), which are not always effective under pressure or within tight deadlines ([8], [10], [12], [13]). Also, this is one of the main reasons why post-tonal music is likely to be performed from the score, since regular memorisation strategies (namely, using traditional harmony and standard patterns) are not always applicable ([6], [10]-[12]). Therefore, Conceptual Simplification, which is briefly discussed in this paper, aims to provide a systematic method for analysis, learning and memorisation.

3 Methodology

The doctoral thesis *Conceptual Simplification: an Empirical Investigation of a New Method for Analysis, Learning and Memorisation of Post-Tonal Piano Music* (2023) presents the findings of testing Conceptual Simplification with other pianists and myself, with a substantial body of repertoire [1]. For this purpose, I completed:

- A couple of Self-Case Studies with myself as practitioner.
- Interviews with professional performers specialised in post-tonal music.
- Studies with recruited participants, who mostly consisted of advanced piano students.

The main outcome of this research was a three-stage method, as shall be later detailed. However, first it should be explained the main philosophy behind how Conceptual Simplification operates.

4 Understanding Mathematical Thinking

Given this problem below, there are different ways in which this could be approached:

$$1 + 2 + 3 + \cdots + 100 = ? \qquad (1)$$

In a straightforward manner, this sum could be solved by adding one term after the other, until reaching the result. Despite this eventually leading to solving the problem, it is not the most efficient procedure. Alternatively, a pattern could be sought within this sum, noticing that by successively grouping in pairs the biggest and lowest terms, these always total 101:

(2)

$$1 + 100 = 101$$
$$2 + 99 = 101$$
$$3 + 98 = 101$$
$$4 + 97 = 101$$
$$\ldots$$

Hence, the original problem simplifies into adding 50 times 101, which is the same as multiplying 50 by 101 [18]. However, this is not only an effective strategy for solving the problem faster: the time initially spent analysing the problem permits developing a deeper understanding of it, leading to higher proficiency in solving similar problems in the future. Consequently, the original problem can be generalised for all positive integers n:

$$1 + 2 + 3 + \cdots + n = \frac{n}{2}(n + 1) \quad (3)$$

Furthermore, by understanding the problem's underlying patterns and finding an effective problem-solving strategy, there is no need to memorise the formula as such. This can be forgotten and deduced when needed, by reconstructing the original steps. Accordingly, only one key idea must be remembered: how the terms of this sum are to be paired.

5 Main Issues on Current Memorisation Strategies

It may be puzzling how human memory can relate to mathematics, but this example illustrates the main concern in how musicians approach a new piece: analysis, learning and memorisation are typically regarded as linear problems. On the one hand, less experienced musicians (i.e., novices) tend to memorise through mindless repetition [15], exclusively relying on Sensory Learning Styles: i.e., kinaesthetic memory, aural memory and visual memory [16]. Therefore, memorisation results from repeated practice ([5], [15]). On the other hand, expert musicians follow a more analytical approach that engages conceptual memory and implements problem-solving strategies for achieving certain goals (e.g., [12]). Hence, in contrast with novices, experts effectively use their knowledge of tonal patterns to encode music and memorise by triggering these familiar entities (e.g., [13], [16]).

Nevertheless, when experts deal with post-tonal music's unfamiliar languages, this approach becomes more challenging and time-consuming (e.g., [10]), since composition principles do not necessarily concur, making it harder to develop common codes [6], [7]. Within this context, these practitioners can lose some of their advantage in respect to novices, at being exposed to an unknown framework with less evident ways to proceed [6], [10], [11]. Thus, a frequent strategy used is fitting the music within a tonal framework, if possible, to restore some familiarity (e.g., [10], [12]). However, this process is slow and difficult: patterns are not explicit as in tonal music, but content is reinterpreted according to these, significantly increasing the time investment that an equivalent tonal context would require [10]-[12]. Furthermore, the more challenging a musical work is, the higher the tendency in linearly segmenting it in smaller units than usual. Therefore, practice becomes mostly ruled by a linear understanding of the music, according to the structure identified, leading to a time-consuming approach: the smaller these are, the more time needed (e.g., [10]). This is why Conceptual Simplification reduces complexity differently, allowing to work with bigger chunks [1].

6 Conceptual Simplification's Paradigm

On a larger scale, Conceptual Simplification uses a series of paradigms from computer science for algorithm optimisation. On a smaller scale, the method's pool of strategies is informed by mathematical thinking and based on problem-solving techniques that are frequently used in number theory, geometry and group theory. Discussing these is out of the scope of this paper, but further details can be found in my doctoral thesis cited earlier [1]. Still, it is worth reviewing the reasons for relating human memory to algorithms, since humans and computers think differently and excel at different tasks ([3], [5], [19]).

Computers have limited memory resources and need to complete tasks within a reasonable time [19]. Similarly, musicians have a limited working memory capacity, and finite time for practising conditioned by deadlines ([4], [13]). Therefore, Conceptual Simplification's main principle is the following:

What essential information do I need to memorise to remember this music?

Accordingly, the method identifies and encodes the least amount of information needed to learn and memorise effectively. It also seeks ways of triggering, deducing or reconstructing the content of a passage, through a series of conceptual clues or instructions. That is translating into music the same procedure used for solving the mathematical problem discussed earlier. All this is possible, because Conceptual Simplification proceeds by slicing into layers of complexity a musical score, to scaffold learning and memorisation. Consequently, the practitioner is always comfortable with the amount of difficulty involved, without tackling more information than can be successfully managed or internalised [1].

7 Conceptual Simplification's Overview

In general terms, Conceptual Simplification comprises three main steps:

1) The first step of the method is a *Triage*, which is an initial stage to become acquainted with the music and identify what strategies could be useful for facing the challenges presented.

2) The second step is *Simplifying Layers of Complexity*, which proceeds to slicing complexity by layers, while dealing with bigger chunks that are easy enough to

approach. This process is done preferably mentally using the piano, but it can be written down too, if that's more helpful.

3) Finally, the third step is *Conceptual Encoding*, which is like the reverse process of Simplifying Layers of Complexity. Basically, Conceptual Encoding consists in restoring layers of complexity once a certain modified version of the musical work has been successfully internalised.

8 Triage

As anticipated, the Triage consists in developing a first impression of the music, while identifying its main challenges and how these can be best tackled with the available pool of strategies. This purpose is achieved by implementing several mental and physical strategies as listed below. But, as the literature has consistently highlighted, it is very important to spend some time at the beginning before solving a problem, to understand its nature and logic (e.g., [4]), which is exactly what was done earlier with the mathematical problem (1)-(3). Hence, the proposed strategies for this purpose are:

(1) Score Overview
(2) Listening to recordings
(3) Sight-reading (as opposed to sight-playing)
(4) Decision making on fingerings and hand arrangements
(5) Formal analysis
(6) Assessment of main challenges
(7) Decision making on potential effective strategies

9 Simplifying Layers of Complexity

After becoming acquainted with the piece, the method proceeds to slice complexity, by identifying and removing those elements that are an obstacle for learning or memorisation. The set of information that is removed each time with this procedure is a *layer of complexity*. For this purpose, the simplifying strategies are classified according to four main elements, which are: pitch, harmony, rhythm and context.

(1) **Pitch:** pitch, octaves.
(2) **Harmony:** voicing, chords, hands.
(3) **Rhythm:** rhythm, repetition, tempo.
(4) **Context:** extended techniques, structure, preceding structure.

10 Conceptual Encoding

Once a certain version of the music is successfully learned and memorised, the method proceeds to restore a layer of complexity, to make it slightly more difficult. Hence, Conceptual Encoding consists in encoding and practising the resulting patterns each time, using the following strategies:

(1) **Pitch:** interval conceptualisation.
(2) **Harmony:** chord conceptualisation.
(3) **Rhythm:** *solkattu* vocalisation and clapping, rhythm conceptualisation.
(4) **Context:** pattern, switches and dynamics conceptualisation.

After providing an overview of the three stages of Conceptual Simplification [1], I proceed to discuss its implementation on David Lang's *Cage* (score to be retrieved from [20]).

11 How to Implement Conceptual Simplification?

Implementing Conceptual Simplification to a musical work produces versions of reduced complexity by removing layers of information to enhance understanding. Once that amount of difficulty is assimilated, it can be slightly increased by restoring removed layers [1]. The piece *Cage* by American composer David Lang (b.1957) is a clear example of one extreme of complexity that involves uniformity and self-referencing (score to be retrieved from [20]). Thus, the main difficulty of this piece is switches, which are places that look similar, but resolve differently, and can be a real challenge for memory [13].

As an example, focusing on bars 1-30 of this piece, four elements need to be tackled: uniformity, hand coordination, independent melodies and changes of register. These are respectively identified as four layers of complexity, namely: repetition, rhythm, hands and octaves. Hence, these shall be temporarily removed and restored.
To implement Conceptual Simplification to this passage, the method starts by identifying what information is essential: here, repetition and rhythm have an ornamental role. Therefore, these are removed, obtaining two independent melodies. Then, two further layers of complexity are identified: combining both hands and playing the notes in different octaves. Hence, both hands are examined independently. Also, by removing the octaves, it is easier to see the underlying pitch-sequence of each hand. However, these might have not been spotted, if memorising this piece by repetition or by how it sounds ([5], [15]-[17]). In this latter case, possibly leading to a less confident performance, due to the piece's uniformity and self-referencing ([1],

[10], [13]). Once this is clear and memorised, the layers of hands and rhythm are restored, focusing now on learning how both hands interact within the middle register of the piano.

After this, the rhythm is removed, to learn each hand's pattern in the original octaves. Then, the same process is repeated: the combination of both hands and the rhythm is restored, but this time in the original octaves. Finally, once this is clear, it is simply a matter of adding the repetition to internalise the original excerpt. Consequently, this excerpt can be confidently learned and memorised, despite being misleading due to switches ([10], [13]). Thus, it is just a matter of repeating this same process as many times as needed.

Therefore, implementing Conceptual Simplification does not imply ignoring how the piece sounds, looks or feels in the physical sense: using a conceptual approach allows to organise the rest of senses and memory resources more effectively. This way, memorisation does not exclusively rely on the Sensory Learning Styles [16], but regard these as complementary [1]. Also, repetition is still used as an overlearning strategy: despite using Conceptual Simplification, mental and physical run-throughs will be needed. However, these will be much more effective, probably needing less repetition to achieve the same result.

12 Conclusion

As a summary, the main goals of Conceptual Simplification are:

1) Scaffolding analysis, learning and memorisation into different progressive stages, to prompt always being comfortable with the amount of difficulty to deal with, not taking more information that can be successfully processed at once [21]. Also, even if the final goal is not performing from memory, this method is also very effective for preparing a confident performance from the score.

2) Once confident with a certain amount of difficulty, this is slightly increased by adding a new layer of complexity. Thus, working by layers enhances the understanding of the piece.

3) For difficult pieces, such an approach could lead to more fluent and convincing performances. Particularly, for post-tonal music, this could make a difference to audiences that are less familiar or eager of this repertoire.

4) Internalising music by scaffolding complexity instead of through repetition can help in preventing performance anxiety and injuries ([5], [13]). This procedure could also be adapted to the needs of other instrumentalists, besides pianists.

However, so far, this method has only been tested with a limited number of practitioners and repertoire [1]-[2]. Since musicians have different learning styles, I designed Conceptual Simplification in a way that is flexible enough for other practitioners to include further strategies, according to their needs [1]. But it is not certain that such an approach will work for everyone. Still, Conceptual Simplification:

1) Provides a new method for analysis, learning and memorisation.

2) Simplifies complexity, not necessarily proceeding in a linear way.

3) The method is flexible, and each strategy can be used on its own, or in combination with others, without needing previous expertise on a certain musical genre or composer.

Presents a novel implementation to musical memorisation, building on certain areas of mathematics and computer science to improve human memory and musical performance [1]. However, it does not require any previous scientific training to be successfully implemented and works for different learning styles and types of complexity.

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