Silent Reading and Aural Models in Pianists' Mental Practice

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ABSTRACT

This study addresses musicians' learning outcomes and subjective experiences in two common types of mental practice: silent score reading and score reading while listening to the music. The study incorporates expert ratings of performances before and after mental practice, questionnaire data concerning modal preferences, as well as semi-structured interviews. The results revealed individual differences in learning outcomes, attitudes toward the two types of mental practice, and the use of imagery. The participants' attitudes and strategies were variously affected by their ability to audiate newly encountered music, their possible preference for learning by ear, and their need to process the score at their own leisure. The results suggest that different types of mental practice might usefully serve various individual purposes in instrumental education.

I. INTRODUCTION

Mental practice, or imaginary practice, recently also called mental simulation, was once defined by Richardson (1967) as "the symbolic rehearsal of a physical activity in the absence of any gross muscular movement" (in Driskell, Copper & Moran 1994). In a meta-analysis of relevant literature, Driskell, Copper, and Moran (1994) found it important to distinguish between *mental practice*, in a strict sense of the term, and *mental preparation* in a broader sense, encompassing also various psyching-up techniques. Recently, van Meer and Theunissen (2009, 94) described *mental simulation* as "a technique by which the mind creates a mental representation of a preconceived idea or action with the intent to practice in order to enhance performance." Mental practice has proved to be effective both for cognitive and physical tasks, but greater efficacy has been found for tasks that included more cognitive elements (Driskell, Copper and Moran 1994; van Meer & Theunissen 2009). It is not to be understood as a substitute for actual physical practice with an instrument, but as an additional practice technique—more beneficial than no practice at all, albeit by itself less effective than physical practice. As a topic that was traditionally researched in the field of sports psychology, mental practice has grown over the years to be an interesting research area in many distinct fields, such as stroke rehabilitation, surgery education, and music. Common interests among the fields have been learning and enhancing performance.

The research on musicians' mental practice has concentrated mostly on learning, memorization, and instrument-related features. Already in an early study with pianists in the 1940s, overlearning by mental practice was found to be superior to overlearning by physical practice in a musical memorization task (Rubin-Rabson 1941). In several studies of musicians, the combination of mental and physical practice has shown benefits equal to those obtained by the same amount of physical practice alone (Ross 1985; Coffman, 1990; Theiler & Lippman 1995; Miksza 2005).

Musicians' mental practice might consist merely in thinking about playing the music in one's mind, but it could also incorporate activities such as reading a notated score and/or listening to a recording of the work. Comparing the use of an aural model with silent mental practice has shown some contradictory findings. Coffman (1990), in a study with pianists, found silent mental practice and mental practice with an aural model to be equally effective. Lim and Lippman (1991) researched mental practice with and without an aural model in memorization of piano music, and found mental practice together with heard music to be less effective than physical practice, but superior to silent score reading. In his study within elementary wind instrumentalists, Fortney (1992) found an aural model combined with score reading superior to silent practice, as well as to free physical practice conditions. Theiler and Lippman (1995) studied mental practice with guitarists and vocalists, and found an aural model to improve several dimensions of performance (especially with vocalists), suggesting that instrument related features might also play a role for the effectiveness of mental coding modalities. Also the level of expertise seems to affect practice outcomes and the need for sensory input: Palmer and Meyer (2000) found a stronger motor independence in mental plans for expert musicians than for novices. Cahn (2008), in a study on learning jazz chord progressions, found task difficulty to affect mental practice achievements and suggested that the superiority of physical to mental practice may hinge on task difficulty.

Aural skills have been found to be an important factor for memorization of music. Highben and Palmer (2004) found strong aural skills and auditory forms of mental practice to be beneficial for memorization. This suggests the need for studies comparing various mental practice conditions within individual performers. Bernardi, Schories, Jabusch, Colombo and Altenmüller (2013) studied individual differences in strategies of mental practice and found optimal memorization associated with pitch imagery and a more general habit for formal analysis. Recently, Bernardi, De Buglio, Trimarchi, Chielli, and Bricolo (2013) found mental practice to improve movement velocity, timing, and coordination in musical performance; movement velocity was improved by motor imagery during mental practice, but hindered by structural analysis of the music.

Individual differences may, according to van Meer and Theunissen (2009), affect the successfulness of mental practice. The present study was developed to shed light on individual differences in and behind skillful pianists' mental practice of new repertoire. We focused on two common mental practice conditions: silent score reading and score reading combined with an aural model of the music.

II. METHOD

A. Participants

The participants were 23 skilled piano students (incl. 22 piano majors) at three Finnish conservatories or universities, with a mean age of 25.3 years (*SD* = 3.6), and and average of 15.0 years of active piano playing (*SD* = 5.4). 17 of them were females. All of the participants had taken "instrumental examination D" in classical piano performance, often understood as an admission requirement for university-level instrumental studies in the country. The participants had participated in professional music studies for an average of 4.5 years (*SD* = 2.6). They reported spending 15.8 hours a week in active music-making (*SD* = 11.2), and 14.5 hours in reading music notation (*SD* = 10.2), on average.

B. Musical materials

Two lesser-known piano pieces by the Lithuanian composer Jurgis Gaižauskas (1922–2009) were selected as musical materials for the study. The two target pieces, *Pute vejas* and *Oi mergele tu jaunoji*, both taken from the same suite of folk songs for the piano, were of comparable length, sharing a roughly similar linear two-voice texture, *andante* character, and broadly modal, but "modern" characteristics in the pitch structure. All written information and all dynamic markings were removed from the scores in order to match the amount of information available. (For better comparability in terms of musical and notational complexity, we further took the liberty to implement one clef change in *Pute vejas* as well as two time signature changes in *Oi mergele tu jaunoji*, from which we also removed a briefly appearing middle voice.)

C. Procedure

The participants were tested individually by a research assistant who also collected their eye-movements during the musical tasks (to be analyzed in a later publication). The participant was seated at a Roland FP-7 electric piano, with a computer screen behind the keyboard for displaying the written music and the instructions. After getting used to the setup, the participant was asked to sight-read one of the target pieces that appeared on the screen. A suggested tempo (the same as used for the corresponding aural model) was given with a few metronome clicks after which the participant performed the piece *prima vista*. Following this initial sight-reading performance, there was a mental practice period of 2'55'', followed by another performance of the same target piece. Finally, this progression of *prima vista* performance—mental practice—*seconda vista* performance was repeated for the second target piece, but now with a different set of instructions for the mental practice phase. All of the performances were recorded using Logic Pro X 10.2 software.

The participants were randomly assigned to four groups of a 2 x 2 design in which roughly equal numbers of them were given each of Gaižauskas' pieces as the first target piece (followed by the other one), and in which roughly equal numbers of participants also began the session with one of two mental practice conditions. In the *aural model* condition, the participants spent the practice time by reading the score displayed on the screen while listening to an aural model of the music (an expressively "flat" performance played by Sibelius 7 software), repeated for three times without a pause. In the *silent reading* condition, the participants spent the same amount of time studying the score in silence.

In accordance with our interest in strategic choices in musicians' freely conceived mental practice routines (cf. Bernardi et al. 2013), the only restriction imposed on mental practice was that the participants were not allowed to touch the keyboard during either of the practice phases. Hence, in particular, such motoric strategies as finger tapping or even "playing in the lap" were *not* discouraged. In general, how "mental practice" would be understood was left open in the instructions.

After the performances, semi-structured interviews were conducted in order to elucidate the relative benefits of the two conditions, and to shed light on potential individual differences in the use of aural imagery. During the interview, the participants were asked to compare the two conditions, explaining their potential preference for one of them. In addition, they were asked whether and to what extent they had been able to "hear the music in their heads."

After the interviews we administered a Finnish version of VARK (7.8) questionnaire of learning styles (Fleming 2012), which distinguishes between visual, auditive, reading/writing, and kinesthetic modal preferences (© Copyright Version 7.8 [2014] held by VARK Learn Limited, Christchurch, New Zealand).

D. Data analysis

The technical level of performance before and after mental practice was estimated by calculating pitch errors and rhythmic errors. The total sum of pitch errors (incorrectly played notes, extra notes and missing notes) was proportioned to the total number of notes in each piece. Each quarter-note beat that included a rhythmic error was counted as one rhythmic error. The sum of rhythmically incorrect beats was proportioned to the total number of beats in each piece.

Learning outcomes were assessed by an expert panel of four skilled pianists and piano pedagogues. The panelists evaluated the improvement during mental practice by comparing the performances before and after mental practice on 7-point scales (between –3 and 3) in terms of technical fluency, expressive interpretation, structuring of the phrases and structuring of the overall form.

III. RESULTS

In the following, we will first introduce our general quantitative results, and then proceed to the more specific qualitative findings concerning individual differences and preferences.

E. Learning outcomes and effects of modal preferences

Table 1 presents the learning outcomes—the average changes in expert ratings between the two performances, and the corresponding changes in error scores. In terms of the expert panel ratings, no significant benefits were found between the silent condition and the aural model condition.

However, a comparison between the pitch errors made in the two performances of each target piece revealed a significant difference between the silent and audio conditions. In the silent condition, mental practice diminished the amount of pitch errors made by 9.9 percentage points, which was significantly better than in the aural model condition.

Table 1. Learning outcomes in the silent and aural model conditions.

		silent	aural	Difference
Improvement	technical fluency	.75	.70	t(22) = .280 p = .782
	expressive interpretation	.96	.93	t(22) = .124, p = .902
	structuring of the phrases	1.05	.89	t(22) = .753 p = .459
	structuring of the overall form	.92	.90	t(22) = .131 p = .897
pitch errors		–9.9	–3.4	t(22) = –2.17 p = .041
rhythmic errors		–3.4	–3.1	t(22) = –.105 p = .917

The improvement scores, as given by the expert judges, were found to be significantly correlated with scores from the VARK questionnaire for modality preferences especially for the silent condition. In the silent condition (see Table 2), the scores for the kinesthetic and auditive dimensions were significantly correlated with the learning outcomes assessed by the expert panel. In particular, kinesthetic VARK scores found significant correlations with the scores for improvement in expressive interpretation, improvement in the structuring of the phrases, and improvement in structuring of the overall form. In addition, the auditive VARK scores were correlated with the improvement in expressive interpretation.

Table 2. Silent condition: Pearson correlations between learning outcomes and modality preferences

		VARK kinesthetic	VARK auditive
Improvement	technical fluency	.371	–.241
	expressive interpretation	.596**	.540**
	structuring of the phrases	.567**	.163
	structuring of the overall form	.506*	.248
pitch errors		–.362	.260
rhythmic errors		–.317	.124

** p < .01, * p<.05

In the aural model condition, the only significant correlation was found between the visual VARK dimension and the improvement in structuring of the overall form (r = .464, p < .05).

F. Musicians' experience of the aural model condition

Above, we saw that the silent reading and the aural model conditions were equally efficient in facilitating the musicians' learning processes on the group level. Of course, this does not rule out the possibility that individual musicians might find one of these conditions as more suitable, useful, or motivating for themselves. In this and the following section, we will give an overview of the most prevalent kinds of argument that the participants used in the interviews after the experiment to account for their experience of the advantages and disadvantages of the two conditions.

One of the most important benefits of the aural model, as experienced by the participants, was that such a model could offer them a "better general impression of the piece" (Eva; similarly Ella, Anna-Liisa, Anja, Sissi, Tomi, Hilma, Tia). Hearing the music would help the musician "discern everything more clearly" (Tomi), or "perceive and internalize the music better" (Ella; similarly Hilma). Heard sound might, indeed, be felt as a kind of glue between the visual and the kinesthetic:

> The aural model kind of helped to connect the visual score and the melody to doing it with your hands. There were so many aspects that were linked together. (Ella.)

The participants who stated their preference for the aural model typically explained this by their *inability to clearly hear music directly in their minds* on the first encounter (Tomi, Eva, Ella, Sissi, Ville, Anja, Anna-Liisa, Sanna, Anu). Indeed, Tomi suggests that such inability might be due to the very use of audio recordings in practicing:

> I grasp the idea of the music more effectively when I listen to a recording. My inner ear is not that developed—probably because I have not practiced it. Maybe I could develop it if I left out the recordings. (Tomi.)

The aural model, then, was found helpful for "confirm[ing] the right pitches" (Esko; similarly Tomi, Anu, Hilma), and for detecting possible mistakes in the previous *prima vista* performance (Milla). Some of the participants reported "being more self-confident" after hearing the music (Tia; similarly Tomi, Mari).

It was especially in connection with the aural model that the participants also mentioned reflecting on *expressive aspects of performance*. Hearing the melody was found to invite such reflections more than the silent condition did (Sissi, Ella, Anna-Liisa, Eva, Esko). Heard sound might be experienced to free some additional resources for thinking about the dynamics (Ella, Anna-Liisa), or to "remind of the articulation" (Eva). Important elements to be emphasized such as slurs would "come forth better" while listening, "reminding [the player] of performing them" (Eva). Occasionally, the details perceived with the support of the heard music might be devoted more prolonged visual attention, even while the music was progressing onward:

> [With the aural model] I was thinking about interpretational things, how I would play it. […] For example, when I heard some passage, I thought: hey, I could play like this and this. […] When the theme came for the second time, I stopped and thought to myself how it might be played differently than in the beginning. (Sissi.)

The heard audio version may also have been used as such as a guiding model for expressive performance (Eva, Anna):

> I noticed that in the latter piece I took quite a lot from the heard aural image, so that I found a more vertical treatment to the piece. (Eva.)

More often, however, the deadpan computer performance seems to have been treated critically, "encouraging a more musical performance" in exchange (Tomi). Interestingly, some of these participants reported "fighting in my mind with the computer" (Kaisa; similarly Hilma), or comparing the heard sound with a better imaginary version (Esko, Ella). Esko, who confessed "not thinking much about the interpretation" in the silent condition, did so with the audio condition:

> I was maybe comparing my interpretation to what I was hearing. […] For example, some notes are supposed to be a little bit less in volume than others. In such instances, I noticed that the computer is just playing it [in] the same volume, and I was comparing it to some ideal interpretation.

Even though the aural condition often complemented participants' weaker audiation skills, some participants with strong audiation skills might also prefer the aural condition as a tool for *learning music by ear*. Marika and Mari both reported having perfect or near-perfect pitch, but confessed to be slow music readers, and hence they valued the auditory model. Mari calls herself an "auditive learner," and recounts:

> With a new piece, hearing it helps me a lot […] Maybe it's because as a musician one of my weaknesses is handling the rhythms. (Mari.)

Learning by ear was a characteristic approach to new repertoire for Mari, who actually scored highest of all participants on the VARK auditive modality scale. She mentioned "reading the score being challenging since childhood." This is how she described her exceptional memory for music as a combination of absolute pitch and visual imagery:

> In general, being with the score has always been such that I play a lot without it—like from the memory and by ear […] because I can play a lot based just on an auditory image, so that I don't need a score […] [The memorizing] is very easy for me. Often just hearing it once will allow me to play it [...] Of course, I immediately hear the key and how it begins, and I can locate where I'm at [in the music]. […] It happens somehow automatically. In my opinion I don't consciously think much of anything—rather, I just listen, and then I'm like: "a-ha: this is how it goes," and then I go and play it […] I can't explain it very well. […] I kind of hear, and I see—I can very well imagine fingers on the keyboard: "a-ha, that's the way it goes here, and now it does this." (Mari.)

The participants also pointed out some disadvantages with the aural model. Chief among them was a tendency to *inhibit slower and more detailed processing* of passages that would have required extra time for analysis or simulated practice (Mai, Tuomas, Anna, Matti, Susanna). Tuomas found the aural model "superficial," and thus experienced it as challenging for himself to "balance between" listening to the model and focusing on musical detail (Tuomas). Mai who wanted to "look at the notes at their places at my own leisure" simply found the tempo too fast and was "frustrated by it": as she said, "my brain just could not keep up that speed" (Mai).

Some participants found the mere presence of heard sound *distracting* to mental practice (Tuomas, Sami, Kaisa). Tuomas seemed to conceive of the "practicing" element in mental practice as something separate from either reading the score or listening to the music, and found it "too much" to combine all of these aspects:

> I hardly did much practicing with the music playing in the background—I could not concentrate. I could have done that too, but it would have equaled doing like three things at the same time: looking at the score, physically practicing and listening to the music. (Tuomas.)

Interestingly, some of the participants even claimed that hearing the aural model actually *prevented them from mentally listening* to the music (Tuomas, Anna, Mai, Susanna). Susanna actually tried to ignore the aural model, concentrating instead on visual and kinesthetic strategies:

> I had to go like: "Okay, close your ears and concentrate on the score." I was kind of able to exclude [the aural model] reasonably well, but […] because I also wanted to hear it in my mind—to get an aural picture of it, but then I was forced just to look at the score, and think about how it would feel on the keyboard. It was disturbing not to be able to listen to it in my head. (Susanna.)

G. Musicians' experience of the silent condition

The most often reported benefit of the silent condition was the possibility it offered for *processing the score at one's leisure* (Anu, Anna, Matti, Susanna, Tuomas, Mai, Mari, Tia). In a word, this condition gave the musician "more time to practice in one's mind" (Anu). Compared to the aural model condition, more varied reading processes were reported here. These ranged from simply reading through the music (Anu, Esko, Ella, Sanna, Anna, Mai), through more segmented (Tuomas, Susanna) and comparative reading processes (Susanna, Esko, Matti) to "unsystematic" (Anja), or "squinting" (Tomi) approaches.

The silent condition was found helpful in aiding *detailed analytical study* of important or difficult passages (Susanna, Tuomas, Anna, Milla). Susanna, who in this condition received the highest expert judgments across the board, enjoyed the condition, as it enabled her to quickly scan the score for difficulties and to concentrate on them:

> With the silent [condition], I was able to focus my concentration—like "Okay, this is easy, easy, that is a difficult one, difficult one, that's a difficult one." And then, to concentrate on those. To go through them many times. (Susanna.)

Another potential benefit of silent mental practice is that, for some musicians, it might actually *facilitate audiating the music*. One indicator for playing the music in one's mind, as opposed to analytical scrutiny, might be tapping to the silently imagined music (as described by Tia and Hilma). Without support from heard music, enacting the music kinesthetically might be experienced as a helpful approach:

> I was moving my fingers quite a lot. I moved them actually more than with the music playing [in the aural model]. It was somehow even more important to get the feeling image with it. (Tia.)

Many of the participants who expressed preference for the silent condition reported having easily heard the musical score in their minds (Anna, Esko, Susanna, Kaisa, Sami, Milla)—a skill commonly referred to as *audiation* (Gordon 1984). Anna who described getting the music "more carefully in my head" in the silent condition, noted that playing the music in her mind helped her "pretty much with everything," also helping her to relax. Descriptions of audiation in the silent condition involved such phrases as "beautiful melody" (Esko) or "getting the atmosphere" (Anna), suggesting that at least some participants were able to grasp the silently audiated materials as aesthetically rich *music*.

Whereas the aural condition was above noted to evoke thoughts concerning music's expressive aspects, the silent condition sometimes seemed to render "thinking about the interpretation more difficult" (Ella, similarly Sissi). At least these two participants were among the ones who also admitted not having been able to audiate the music clearly.

In cases where audiating the pitch content of the piece was found to be challenging, it could also be replaced with audiating the rhythms (Sanna, Matti). This could be understood as a kind of silent singing:

> I could not somehow sight read it by singing in my head. I didn't want to spend time in searching for the pitches or the pitch intervals. Maybe I was thinking more about the rhythm. […] I was singing it in my head even though it was just the rhythms at this point. In this piece, I did not [think about] the melody. [Sanna demonstrates by playing on the lap and singing in a whispery tone:] Dii-dii-dii. Somehow I was in that pulse. (Sanna.)

Some participants found the silent condition "useless" (Tomi) and were even pondering "when it is going to end" (Anu). The disadvantages of the silent condition were very often related to the participant's inability to clearly listen to the music in one's mind (Ella, Eva, Sanna, Sissi). Ella mentioned feeling a certain "insecurity" when she "did not know if it's precisely correct."

IV. CONCLUSION

The present study addressed the role of individual differences in musicians' mental practice of new musical material, meaning score-based practice away from the musical instrument. Two different mental practice conditions—silent mental practice and mental practice while listening to the music—were compared through expert ratings of achieved improvement as well as through interviews of the participants.

The two conditions did not differ in their overall benefits, as judged by the expert panelists. However, the learning outcomes in the silent condition were associated with kinesthetic and auditive tendencies, as assessed by a test of modality preferences. In the silent condition, the expert panel scores for improvement in expressive interpretation, structuring of the phrases, and structuring of the overall form were significantly correlated with a kinesthetic tendency; this was not the case for improvement in technical fluency. These results resonate with previous findings suggesting that mental practice might be more efficient for cognitive than for motor tasks (see Driskell & al. 1994; van Meer & Theunissen 2009). Now, as found by Kessler, Rubinstein, Ginsborg, and Henik (2008), a cued manual motor imagery is often present during music reading. We suggest that when processing the score in silence, individuals with stronger kinesthetic tendencies might more fluently have been able to translate cognized musical elements into embodied action.

In the silent condition, the connection between auditive tendencies and improvement in expressive interpretation probably cannot be accounted for by conscious planning of expressivity: in this condition, only very few of the pianists reported such planning during the silent practice. One potential explanation for the connection between auditive tendencies and expressive improvement could simply be that an "auditive musician" is better able to expressively respond to her/his own playing in the course of performance. An alternative explanation would be the use of audiation strategies during mental practice. Namely, in the silent condition, the four participants who improved their expressive performance the most reported singing or listening to the music in their minds during silent practice; none of the four participants with least improvement in expressivity reported clearly hearing the music. Having internalized the piece through inner audiation, the musician not only memorizes the piece better (Highben & Palmer 2004; Bernardi & al. 2013), but also gains more freedom to even improvise a cogent expressive interpretation in the actual performance.

In the aural model condition, the expert panel scores for improvement in structuring of the overall form were associated with a visual tendency. Many musicians experienced that the aural model offered them a better general impression of the piece. We suggest that the aural model may have helped especially musicians with visual tendencies to connect the visual score and the heard music to project a more structured understanding of the overall form.

As revealed by the interviews, musicians' ability to hear newly encountered music in their minds affects their attitudes towards types of mental practice. Silent mental practice may often be found useful by musicians with developed audiation skills. When audiation skills are more modest, listening to a recording may be found necessary for grasping a more holistic impression of the piece. However, listening to an aural model may also be useful for musicians with preference to "learn by ear," irrespective of their level of audiation skills. However, the habit of using recordings to speed up the learning process in the beginning stages of learning new music may turn out to be an impediment to the development of stronger skills in score reading and audiation.

Of the two mental practice conditions considered, it was especially the aural model condition that evoked thoughts about expressive interpretation—paradoxically, despite the expressively flat computer rendering used here for the aural models. While some of the musicians accepted the performance on the recording as a guiding model, others would, conversely, be inspired to their own expressive performances in opposition to the deadpan version heard. Aural models may surely be used as sources of inspiration for expressive interpretation. Nevertheless, they may sometimes guide performers too much, preventing them from creating an expressive interpretation of their own—which was noted by some pianists as a negative side of using recordings in early stages of learning.

The aural model, despite giving support, may also disturb the cognitive processing by preventing the musician from processing the piece in a slower and more detailed manner. Some of our participants also reported that the aural model prevented them from audiating the music by themselves. Silent score reading gives more freedom to process at one's own leisure, to concentrate, to focus on critical passages, and to engage in structural analysis. It can be seen as a more ideal type of mental practice, particularly in situations that require more in-depth, detailed processing of the music. It is, perhaps, a more ideal activity for developing skills like audiation, reflective score analysis or imagined physical action.

In silent mental practice situations, musicians are not exclusively dependent on their ability to audiate. If one's ability to silently "listen" to the music from the score is weaker, the skills lacking in aural imagery may be compensated for by audiating only the rhythms or leaning on kinesthetic strategies such as tapping in rhythm. Despite individual weaknesses, there is always something a musician can do. The challenge is to find the most appropriate strategies for different individuals and situations.

In our experience, instrumental educators do often advise their students in mental practice, but judging from the characteristically individual attitudes of the musicians in our study, it is a real possibility that not all of the methods suit everybody. Our findings converge with previous research in emphasizing the importance of audiation for mental practice, but perhaps meaningful programs of mental practice could also be developed along other lines—for instance, by building on an individual's kinesthetic tendencies. Our study tentatively suggests that individuals' kinesthetic tendencies may play a bigger role in the silent processing of music than heretofore acknowledged.

ACKNOWLEDGMENTS

This research was supported by the project *Reading Music: Eye Movements and the Development of Expertise*, funded by the Finnish Academy (project nr. 275929).

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