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Embodiment in Violin Learning: Two Case Studies

Abstract: The acquisition of performance skills is the core of many studies that focus on the amount of exercise, motivation, mental strategies, and deliberate practice. At the same time, the embodied paradigm recently applied to music cognition advocates the role of the body in musical understanding.
The present study aims to describe the instrumental learning process whilst integrating a multimodal approach. The purpose of these case studies is to analyze individual learning processes to play a new melody on the violin when movements and graphic symbolization are integrated with the instruction for learning.
Microanalyses of video-recorded case studies are carried out. To analyze the structural changes between the three performances of two beginner violinists, specific kind of parameters are considered. The structural changes are analyzed using software for viewing, analyzing, and comparing audio data. Results show that the two students' performances gradually differentiated during the process as can be shown by detailed acoustic and corresponding musical features, as well as by correspondences with the children's graphic representation of their musical imagination. Such descriptions may improve our understanding of an individual child's strategies for building up a mental model of a melody by revealing analogies between physical and symbolic means.

Keywords: multimodality, embodied cognition, instrumental learning, graphical representation, visualization

Introduction

The acquisition of performance skills is the core of many studies. Some research has suggested a direct correlation between the amount of practice undertaken and the achieved ability (Sloboda et al. 1996). Still, recently other studies, while recognizing the importance of proper practice for children's musical progress, have identified other factors that could lead to an improvement of instrumental skills. These include quality of

children's practice (Barry and Hallam 2002), motivation, musicianship, mental strategy used (Hallam et al. 2012; McPherson 2002, 2005), and deliberate practice (Ericsson, 2014).

Recently, the pivotal role of an integrated approach in instrumental learning, involving multiple modalities, has been emphasized (Maerker Garner, 2009; Davidson, 2012; Fortuna, 2017). This includes the use of voice (singing before playing), bodily movement (interpreting key aspects of the piece with the body), and graphic notation (visually representing elements of the piece).

The main standpoint is that more modalities allow one to grasp in depth the musical aspects of the piece, fostering a clear mental image of the music to be played. Moving to describe the expressive characters of the piece allows a pre-conceptual and kinesthetic understanding of the musical elements, while, transcribing graphically the salient musical aspects may foster a mental image of the entire piece, thanks to the effort of re-thinking the structural features to be transcribed.

Although a growing number of authors and musicians advocate for the integration of a physical and graphical approach during the process of learning, nevertheless, the instrumental field tends not to consider these suggestions and remains anchored to a verbal teacher-pupil apprentice.

Accordingly, the purpose of this study is to analyze the individual learning processes to play a new melody on the violin when movements and graphic symbolization are integrated with the instruction for learning. The analysis will be carried out through two case studies of beginner violinists to gather an in-depth and comprehensive understanding of the phenomenon.

Background

Singing before playing allows children to embody the pitch, rhythm, and phrasing of the piece, and, subsequently, to be able to recognize the symbols of music notation (McPherson, et al., 2006). Instead of a mechanical recall of fingering for an instrument after reading, singing allows the students to imagine sounds before playing (Gordon, 2003; McPherson &Gabrielsson, 2002; McPherson, 2005). The importance of using the voice before playing and during the process of learning an instrument has also been emphasized by some renowned violin teachers such as Suzuki (1978), Havas (1961), Elliot (1974), and Schlacks (1981), as well as being suggested by musicians in the past (e.g., C.Ph.E. Bach, Chopin, Schumann). This has resulted in many recent methods for violin teaching and learning incorporating the use of singing

as a preparatory exercise to improve instrumental learning, e.g., Suzuki (1978), Zweig e Szilvay (1996). [Include a reference toward Truslit, concerning movement and shape in music, and experiments of conversions.]

Body movements as a means to enhance the expressive quality of instrumental playing were emphasized firstly by E. Jaques-Dalcroze (1921). According to the Dalcroze approach, body movements create a link between the ear and brain so that they are a means to embody musical features and improve performance expressivity.

Through the body and all the senses, musicians can reinforce musical concepts kinesthetically and transfer force, rhythm, dynamics, and speed from whole-body movements to just specific parts of the body, and thereafter to the instrument. This embodied approach has been taken up recently by various authors (Juntunen & Hyvönen, 2004; Gault, 2005; Manifold, 2008; Abril, 2011; Davidson, 2005, 2012; Kerchner, 2014; Liao & Davidson, 2016; Nijs, 2017; Fortuna & Nijs, 2020) within the theoretical framework of Embodied Music Cognition (Leman, 2008, 2017).

Aligned with the vocal and kinesthetic modalities, recently, the use of spontaneous graphic notation has been investigated. Indeed, the effort to visually describe the expressive nuance of the piece graphically, may be considered a tool to enhance a mental reorganization of the piece and a way to create a personal structure of the piece based on the selected features.

The relationship between musical movement and shapes was investigated first by Alexander Truslit, in 1938, as reported by Repp (1993). In Truslit's experiments, some violinists improvised on a graphic drawing, and other participants drew a graphic score while listening to them. Interestingly, the similarities between both the graphic drawings suggest a relationship between the spatial movement evoked by the music and its pictorial rendering.

This symbolic aspect of musical experience — using or inventing notation — has been described by Davidson et al. (Davidson & Scripp, 1988; Davidson et al.,1988) in terms of "windows" into the children's musical cognition and as a way of externalizing their musical ideas. Invented notations were analyzed to understand children's music perception (Upitis, 1992; Bamberger, 1991; Barrett, 1997, 2002; Gromko, 1998). Recently, other studies investigated the intersection between music and drawing as a result of musical gesture (Mannone & Papageorgiu, 2020), and the cross-modal correspondence between music and visualization (Crnjanski & Tomaš, 2020).

The present study aims to investigate the role of invented notation, together with singing and body movement, during the learning process of a new piece with a musical instrument.

The activity of singing, moving, and visualizing the piece during the learning process seems to foster an aural and tactile mental representation of the music. Musical experiences and their transposition into movements and singing could be considered a means of intensifying these experiences and simultaneously expressing the person's musical ideas physically. In the same way, through the act of drawing, the children make a graphic symbolization of the features of the music they want to play.

Research questions

This study aims to shed light on the contribution of this multimodal integration on performance achievement and in so doing provide information to clarify how children could practice in more effective ways. Documenting a child's process of learning an instrumental piece could give the teachers suggestions on how to help children build a mental and embodied representation of the piece.

For this reason, the research aims to analyze step-by-step the changes in the learning process when the music visualization and embodiment are integrated into the instrumental lesson. This process is supported by instructing students to integrate activities such as singing, body movements, and drawing graphics. This can be defined as a multimodal approach. Three specific questions are addressed:

i) During the learning process may we observe any changes in the performances after the motor and symbolic activities?

i) If so, how could the changes between performances be described?

ii) What kind of relationship may be observed between graphic notation and performance?

When a child is asked to play a melody several times on the violin and receives verbal feedback, of course, we expect learning to take place and performances to improve. However, if the child is instructed to translate the melody into singing and movements, this may lead to focusing the attention on diverse aspects of the piece to be played, such as melodic contour, pulse, and phrasing, rather than just fingering or mindless repetition, while practicing. Moreover, the challenge of inventing a graphic analogy could foster the child to select some aspects of the piece she/he feels are more relevant. Accordingly, the research aims to observe any structural changes that may occur through these multimodal activities.

Methodology: Two case studies

To investigate the changes occurring with a multimodal approach to teaching and learning the violin in detail, two case studies were analyzed to observe the phenomenon in depth through observations, field notes, and audio-recorded data.

Two different case studies were examined, concerning children of different ages and with different expertise on the instrument, to observe whether and in which way a multimodal approach could lead to changes in the learning process according to the different developmental stages and level of instrumental mastery.

Participants

The study involved two participants, hereinafter indicated as A and B.

Participant A is a girl aged eight who had been attending one-to-one lessons in a private violin course. At the beginning of this study, she had been playing the violin for six months, and hence, was able to play just short pieces. Regarding instrumental skills, the younger student learned to use the first three fingers of the left hand in the first position of the violin. However, she is still insecure with intonation and maintaining the pulse and metre of pieces. She can play short pieces in G and D-major with separate bows.

Participant B is a twelve-year-old girl who has been studying the violin for two years in one-to-one lessons.

Concerning the mastery of the instrument, she has good tonal awareness and intonation, but she is only sometimes accurate in different tonalities in the first position. The child acquired a generally stable pulse but not overall rhythmic accuracy. She can use some elementary bowing techniques, such as separate bows, *legato,* and *staccato*.

Criteria for selecting the pieces

The musical pieces were chosen according to the skill levels of the two students and included many skills that both students have been developing at their stage of learning.

Participant A was given an easy arrangement for beginner players from the Concert No. 3 Op.8, RV 293 by Antonio Vivaldi, entitled *Autunno* (see Fig. 1).

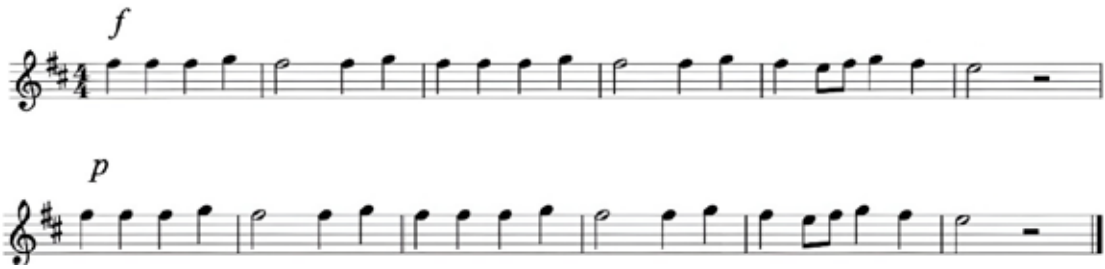

Figure 1. Excerpt of the arrangement from the Concert No. 3 Op. 8, RV 293 by Antonio Vivaldi, entitled *Autunno*

Participant B was invited to practice the Study 10 from the *100 Studies* Op. 32 Book 1 by HanzSitt (see Fig. 2).

Figure 2. Excerpt of the score of Study No. 10 from *100 Studies* Op. 32 Book 1 by Hanz Sitt

Tables 1 and 2 show the correspondence between the instrumental skills of both girls and the tasks required by the musical pieces. [use the dash: D-major, F-major in the table]

	Instrumental skills	Tasks of the pieces
Intonation-Pitch	Use of the first three fingers of the left hand in G and D major	First three fingers in the same string, diatonic intervals of 2nd in D major
Movements of the bow	Separate bows. Movements on the same string or between two strings.	All notes separately bowed on the same string
Musical phrases	Simple phrases repeated twice.	Two identical phrases of six bars, with different dynamics.
Rhythm	Note values (minims, crotchets and quavers)	Note values (minims, crotchets and one bar with two quavers).

Table 1. Sample table including the correspondence between the instrumental skills of Participant A and the tasks required by the pieces

	Instrumental skills	Tasks of the pieces
Rhythm	Note values (minims, crotchets, quavers, semiquavers, dotted rhythm)	Note values (semiquaver)
Intonation-Pitch	Use of four fingers of the left hand in 1st position. Plays tonalities with sharps and flats.	Four fingers in 1st position. Small and large intervals in tonality of F major
Movements of the bow	Separate bows, *legato* and *staccato*. Fast passages from one string to another	*Legato* and *staccato*. Fast passages between the strings.
Musical phrases	More complex phrases repeated with variations or modulations	Two phrases of eight bars repeated twice with little variations

Table 2. Sample table including the correspondence between the instrumental skills of Participant B and the tasks required by the pieces

Procedure

The study encompassed two main sessions organized as individual lessons of one hour. Each session focused on a multimodal design that lasted from 20 to 40 minutes; it was included within the activities usually carried out during an instrument lesson such as *arpeggio* scales, improvisation, and sight-reading.

The procedure used with both girls was as follows.

Lesson 1.

Both the girls, in each one-to-one lesson, were invited to learn a new piece on the violin. The teacher/researcher after playing the pieces invited each student to learn the piece by singing. Afterward, the students were asked to explore and practice the piece at home for only 20 minutes, just the day before the following lesson.

Lesson 2.

Phase a. *First Performance*

At the beginning of the lesson, each of the two girls was asked to practice for three times the first two phrases of the piece she was assigned.

Phase b. *Singing and body movements*

The girls were invited to sing their piece (even just mentally singing) and simultaneously to describe, through their body movements, the pulse, accents, and expressive features of the piece such as the dynamics, the breathing, *rallentado*, etc. The students were free to use the part of the body they preferred, such as stamping the feet, versus clapping or moving their arms as holding a scarf in the air to describe the melodic contour, dynamic, and articulation.

The activities followed the suggestions of Dalcroze, which encourages the sensory experience of musical features through body movements.

Phase c. *Second performance*

The children were asked to perform the piece on the violin again (three rehearsals).

Phase d. *Invented notation*

In the following step, each girl was asked to draw her graphic notation by memory, without any score, to visualize her image of the piece, what she felt was important for her, and what she experienced with her body movement in the previous phase.

Phase e. *Third performance*

Finally, the two girls were asked to perform the piece again, taking into account her graphic notation (three rehearsals).

Each step was audio-recorded. In addition, before each performance, the children were allowed to practice the excerpt three times to better focus on the performance and avoid attention problems due to the transition from one activity to another.

Analyses

Musical features analyzed

To analyze the structural changes between the three performances the following parameters were considered:

(i) Pulse, metre, and rhythm;

(ii) Intonation – pitch;

(iii) Phrasing and comparison with the graphic notation of the piece.

Analytic tools

The structural changes (time and pitches) were analyzed using *Sonic Visualiser* software (2015) for viewing, analyzing, and comparing audio data. This software was selected to acquire objective and analytical data on the different performances, ensuring the validity of the observation.

Analytic data plan

Audio Analysis		
Parameters	*Analysis tools*	*Detailed analysis aims*
Pitch	Histogram of the frequencies	Observation if the pitches gradually approach to the target melody
Pulse and rhythm	Spectrogram	Analysis of the regularity of the pulse and accuracy of the rhythm patterns
Meter	Spectrogram	Analysis of the strong beats or downbeat
Phrasing	Spectrogram and melodic spectrogram	Analysis of the accents, dynamic, stressed beats, and use of either lengthening or shortening the duration
Visual - Audio Analysis		
Children graphic notations	Features of the graphic marks	Correspondences between graphic notation and performance

Table 3. Sample table shows the links between aims, parameters, and analysis tools

Results

The results of the analyses concerned the third rehearsal of Phase *a* (first performance), Phase *b* (second performance), and Phase *e* (third performance) of Participants A and B.

Participant A

(i) Pulse, metre, and rhythm

First performance.

The spectrogram in Figure 3 shows the length of each note of the Phase *a* (first performance) assigned to Participant A, where the black lines in the spectrogram represent the onset of each note.

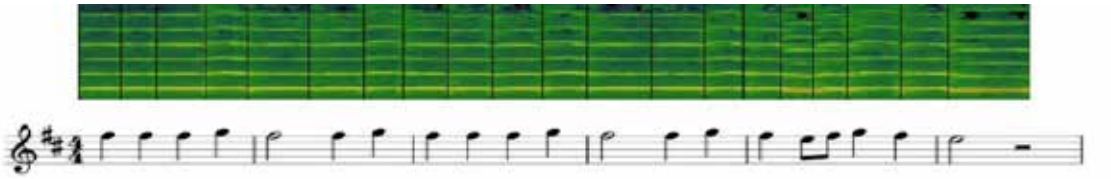

Figure 3. Top: The Spectrogram of the participant's first performance; down: the corresponding score

As it can be seen from the spectrogram, the length of each note does not correspond to the rhythmic patterns of the score. Indeed, there is a lack of differentiation between the values of the crotchets and minimis; i.e., the minimis have almost the same duration as the crotchets notes, see segments 5-6; 12-13.

Second performance, after singing and moving.

As it can be observed from the spectrogram of Figure 4, there is a correct relationship in length between the two-crotchet notes and minimis.

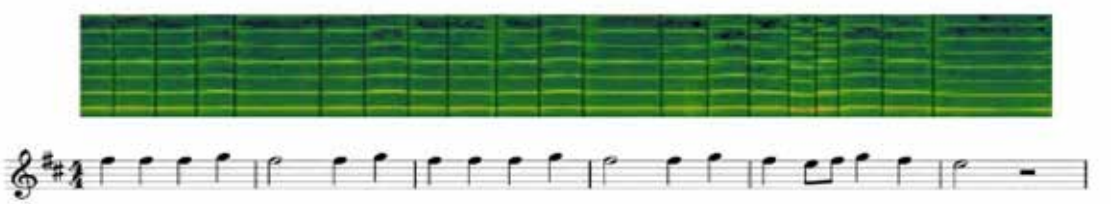

Figure 4. Top: spectrogram of the second performance of Participant A; down: the corresponding score

Third performance, after inventing a notation
By comparing Figures 4 and 5 below, the performance shows a stable regularity in timing.

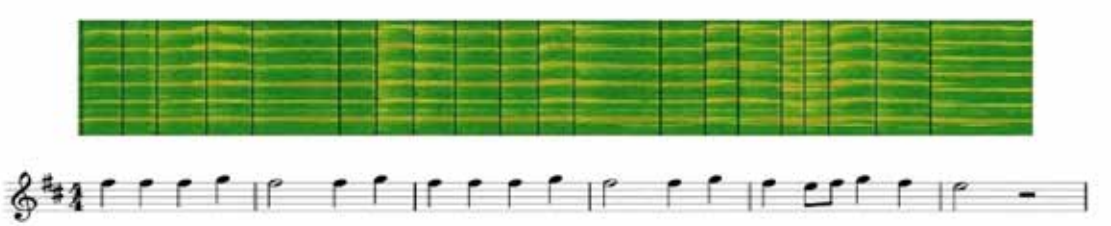

Figure 5. Top: spectrogram of the third performance of Participant A; down: the corresponding score

(ii) Pitch/Intonation

Comparison between the three performances.

Each pitch of the excerpt is shown on the horizontal axis and the frequencies in Herz on the vertical axis (Figure 6). The blue columns show the calculation of pitch, calibrated based on A 440 Hz. Green columns show the frequencies of the first performance, yellow columns show the frequencies of the second performance, and red columns show the frequencies of the third performance.

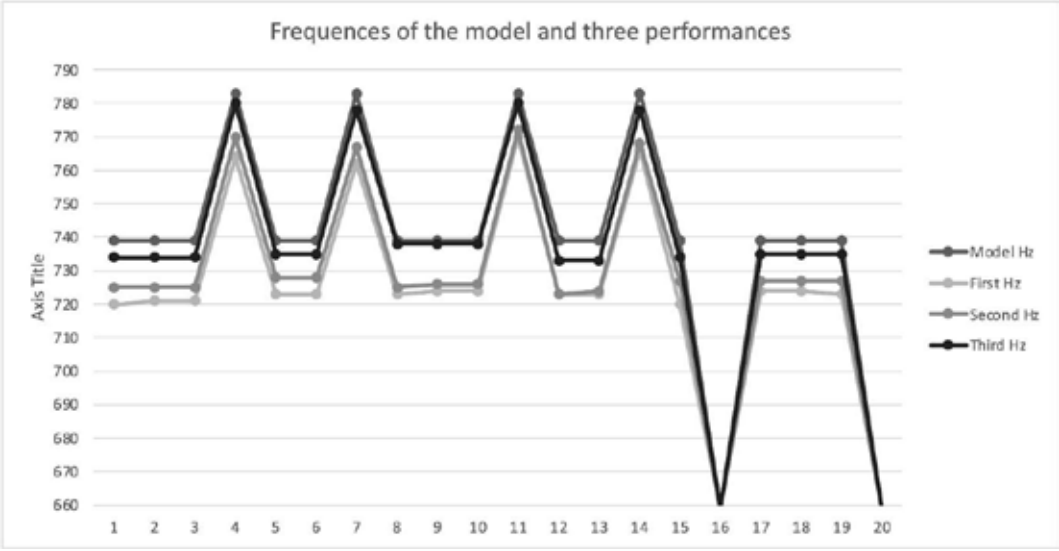

Figure 6. Frequency histogram

From the histogram of Figure 6, it can be observed that the intonation of pitches gradually approached the target melody and reached a correct intonation, mainly in the third performance (after the activity of invented notation).

(iii)*Phrasing and comparison with the graphic notation of the piece*

The graphic notations of the piece seem to focus mainly on three aspects of the music:

- melodic contour is represented with continuous lines;
- stressed pitches are highlighted with strong marks;
- **t**he dynamic of the two phrases (i.e., *forte* and *piano*) are described through different pressures of the mark.

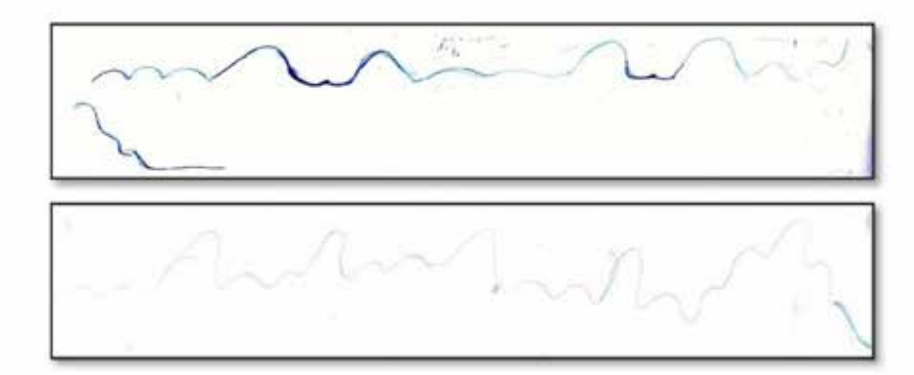

Figure 7. Top: drawing of the first phrase as *forte*; down: the second phrase as *piano*

Participant B

(i)*Pulse, rhythm, and metre*

Figure 11 shows that Participant B performs a steady pulse from the first performance, the same for the repeated rhythm throughout the fragment. Accordingly, this task was not further analyzed in subsequent performances.

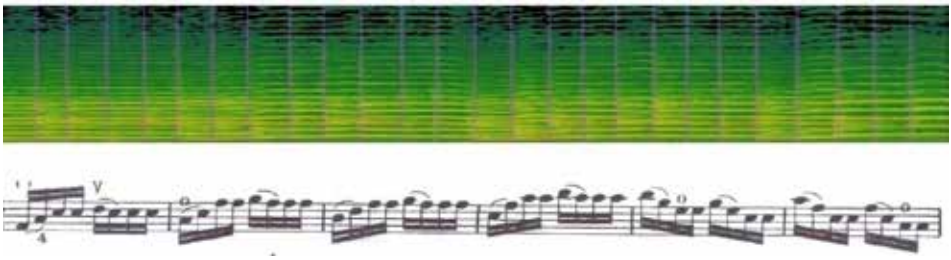

Figure 8. Spectrogram of the first performance of Participant B and the corresponding score

(ii) Pitch/Intonation

There was no detectable difference in pitch between the performances. The audio analysis showed a stable and correct intonation since the first performance.

(iii)*Phrasing and comparison with the graphic notation of the piece*

The third performance shows a clear differentiation between strong and weak beats, obtained through more pressure and amount of length with the bowing.

Interestingly, the same features can be seen in the invented notation drawn by Participant B, shown in Figure 9. In addition, it is noteworthy to highlight the similarity of this figure with the neumatic notation used in Gregorian chant of gestural origin.

Figure 9. Invented notation of the first two phrases of the piece, drawn by Participant B

The drawing shows marks, differentiated in intensity and length, as follows (Fig. 10):

1. the long lines describe the two semiquavers notes *legato*, and the short ones describe the two semiquavers notes *staccato (short bowing);*

2. The long and stressed marks describe differences in dynamics, which may correspond to the different lengths of her bowing.

Figure 10 shows the correspondences between lines, score, and intensity of the sounds of an excerpt.

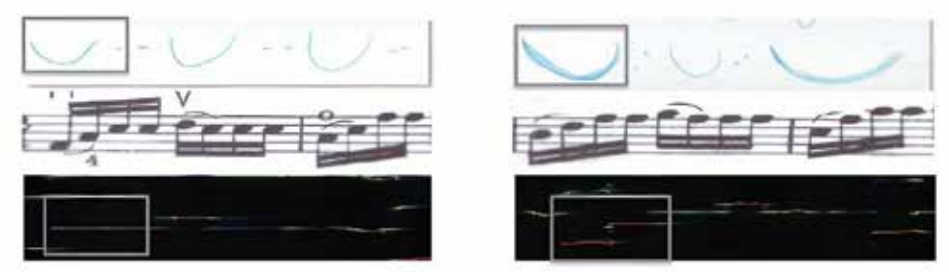

Figure 10. Correspondence between lines drawn, score, and spectrogram

Discussion

This paper presented a detailed analysis of specific steps in the melody learning processes of two children. The two case studies aimed to investigate changes in the learning process to perform a new violin piece by incorporating singing, movement, and graphical representation of the perceived melody.

The results of Participant A show an enhancement in timing from the first to the second performance after the involvement of body movement. Arguably, the process of transferring the music into movement may have enhanced the development of her psychomotor awareness of pulse, metre, and rhythmic patterns associated with the melody. The timing improvement may be explained through the physical experience and the kinesthetic memory of musical concepts that were subsequently applied to instrumental performance (Sheets-Johnstone, 2011). In the same way, the improvement of the intonation with the violin could be linked to the invention of a new notation of the piece's melodic contour (Fig. 6).

The transposition of the salient cues of the piece into a graphic score may have enhanced a deeper mental image of the auditory elements, leading to a more accurate performance of pitches and articulation of the piece. The symbols the student used in her drawings are characterized by *legato* lines and curved shapes. Remarkably, this specific articulation in her graphic representation mirrored her arm gestures and body movements during the performance. These results seem to confirm the statement of Werner and Kaplan (1963), which states that the symbols are closely connected to the body and its sensorimotor patterns.

In the case study involving the beginner violinist (participant A), notable changes were predominantly observed in the technical aspects of playing, encompassing intonation, pulse, rhythm, and articulation, i.e., *legato.*

Conversely, the case study with the more experienced student (participant B) revealed a different nature of performance changes. Noteworthy distinctions were not identified concerning pulse, metre, rhythm, or intonation; rather, the most significant changes emerged in her phrasing.

An examination of the violin learning steps indicated that the more experienced student (Participant B) tended to focus her improvements on aspects such as breathing, dynamics of the melody, accents, and phrasing. Figure 10 visually represents her phrasing, illustrating her effort to integrate accentuated notes of the melody, either by lengthening or shortening their duration, into a cohesive melodic phrase. Such an emphasis on phrasing as an overarching unit is also highlighted in her invented graphic notation.

The Participant's learning process appears to be inherently technically proficient, particularly in intonation and timing. This proficiency may have allowed her to concentrate her attention on phrasing as the overarching and integrating movement.

The graphic representations created by both girls exhibit distinct similarities to their personal instrumental performances. In addressing the primary question regarding the nature of individual progress, it can be argued that the two students establish analogies between physical and symbolic representations through these activities. It is relevant to point out that these similarities seem to confirm the pioneeristic Truslit's studies about the correlation between musical movement, gestures and shape (Truslit, 1938, see also Leman, 2007).

Two distinct strategies emerge: the younger participant (participant A) focuses on pitch and rhythm, while the older participant (participant B) directs greater attention to larger units of phrases and to musical expression. The results align with existing literature on the role of body movements in assimilating musical parameters. Both children transfer characteristics felt in their body movements to their instruments while playing. Arguably, the diverse musical features highlighted by the two participants may stem from differences in instrument mastery and musical knowledge. Technical proficiency with the bow, for instance, could facilitate or constrain the expression of a musical idea grounded in embodied experiences.

According to the existing literature, graphic notation is a valuable tool for accessing the students' musical cognition and hierarchical organization of different parameters. Indeed, the effort to transfer the musical idea to a graphic domain may have led the students to select and clarify the features of the piece they felt more relevant. In addition, graphic representation may constitute a viable tool in instrumental lessons, offering the teacher a visual image of the musical idea of her/his student.

Arguably, the pieces' diverse symbolizations could stimulate further research into the hierarchical representation that students develop as a mental visualization of the features of the musical pieces they perform.

Limitations and further development

Many interacting factors may influence the effects of practice, such as teaching style, motivation, self-esteem, different musical knowledge, and high or low individual concentration levels (Hallam et al. 2012). Accordingly, the present preliminary study cannot be generalized and would deserve to be broadened by participants' comments, in terms of motivation, active involvement, and flow.

Nevertheless, summarizing the major results of the two case studies, an integrated and multimodal approach in instrumental learning may give insight for further exploration. These processes could be examined in even greater detail, for

instance, concerning a broader hierarchical organization of melodies. An alternative paradigm might involve comparing larger groups of children learning to play the violin, with or without integrated instructions involving the body and symbolization. In this research, the case studies aimed to offer the advantage of preserving the complexity of phenomena during the process of learning.

Conclusion

Learning to play an instrument is a holistic process that engages the entire individual, encompassing body and imagination. The process of learning described in this study unfolds through a multimodal approach, utilizing one's singing voice, body movements, and individually crafted graphic symbolization of sounds. These symbols are influenced by sensorimotor awareness and mental images of various elements of the piece, including pitch, pulse, movements, and phrasing. It is crucial to acknowledge that this mental and physical practice, along with the diverse transpositions, focuses on synesthetic and kinematic sensations of the sounds.

The findings of this study align with existing literature on embodied learning, underscoring the significance of integrating movements and voice in the learning process. However, this study also highlights the importance of the personal creation of graphic notation as a means to incorporate a symbolic, multisensory approach during instrumental lessons. This approach emphasizes the personalized and creative aspect of representing musical elements, further enriching the learning experience for the musician.

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Otelovljenje u učenju violine: dve studije slučaja

Apstrakt: Sticanje izvođačkih veština nalazi se u fokusu mnogih studija koje istražuju motivaciju za vežbanje, mentalne strategije i svesnu praksu. Istovremeno, otelovljenje paradigme otelovljenje, nedavno primenjena na muzičku kogniciju, zagovara ulogu tela u razumevanju muzike.
Ovaj rad ima za cilj da opiše proces učenja instrumenta integrisanjem multimodalnog pristupa. Svrha ovih studija slučaja je analiziranje individualnih procesa učenja sviranja nove melodije na violini, gde se pokreti i grafička simbolizacija integrišu sa instrukcijama za učenje. Sprovodi se mikroanaliza video-zabeleženih studija slučaja. Za analizu strukturnih promena između tri izvođenja dva početnika na violini, razmatraju se specifični parametri. Strukturne promene analiziraju se pomoću softvera za pregledavanje, analiziranje i upoređivanje audio podataka. Rezultati pokazuju da su se izvođenja dva studenta postupno razlikovala tokom procesa, što se može pokazati detaljnim akustičkim i odgovarajućim muzičkim karakteristikama, kao i korespondencija masa grafičkim prikazom njihove muzičke mašte. Takvi opis i mogu unaprediti naše razumevanje strategija pojedinca za izgradnju mentalnog modela melodije otkrivanjem analogija između fizičkih i simboličkih sredstava.

Ključne reči: multimodalnost, otelovljenje, učenje instrumenta, grafička reprezentacija, vizualizacija