# The musician's first instrument

## Towards a sensory approach of music pedagogy

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**DOI :** https ://doi.org/10.17184/eac.9629

**Abstract:** Whereas integration of corporal experience into musical pedagogy is developing in many countries, in France an intellectual approach is still common practice allowing one to perform studies with naïve populations. To shed light on how body awareness and perception contribute to root kinesthetic imagery and build the instrumental technique, we present a qualitative study with young pianists enrolled in a French Conservatory. Our work reveals that the degree of body-awareness is linked to age and that verbalization on the use of their bodies constitutes a sensory awakening, leads to refining their proprioception and to better understanding the mind-body-sound interaction.

**Keywords:** music cognition – bodily awareness – aural feed-back – verbalization – piano pedagogy

**Le premier instrument du musicien : Vers une approche sensorielle de la pédagogie musicale**

**Résumé :** Alors que l'intégration de l'expérience corporelle en pédagogie musicale se développe dans de nombreux pays, en France une approche intellectuelle demeure pratique courante permettant d'étudier des populations naïves. Afin de mettre en lumière comment la perception et la prise de conscience corporelles contribuent à construire l'imagerie kinesthésique et la technique instrumentale, nous présentons une étude qualitative auprès de jeunes pianistes inscrits dans un conservatoire français. Ce travail révèle que le degré de conscience corporelle est lié à l'âge et que la verbalisation sur l'utilisation du corps constitue un éveil sensoriel, conduit à affiner leur proprioception et à mieux comprendre l'interaction corps-esprit-son.

**Mots-clés :** cognition musicale – conscience corporelle – verbalisation – feed-back auditif – pédagogie pianistique

## 1 Introduction

The body is at the centre of musical practice and constitutes the musician's first instrument. However, the musician is too often unaware of how her body works while playing since this is not always taught in formal education. Beyond being required to physically play an instrument, the body is pivotal in musical practice because it is involved in all the cognitive processes of musical expression : executive functions,

emotion, perception (Friberg/Sundberg 1999 ; Levitin/Tirovolas 2009). Notably, very important contributions on the embodied perspective (Bermudez 2005 ; Clark 1997 ; Damasio 1999 ; Varela et alii 2012) state that the body has a crucial significance in how and what we think and feel and that mind, body, and world mutually interact and influence one another (Gallagher 2006 ; Karlikow 2025). More specifically, the embodied perspective of music cognition has established the central role of body movement in musical-meaning formation processes (Cox 2011 ; Godøy/Leman 2010 ; Leman 2008). From a quite different standpoint, here we approach the central role of the body in music practice from a pedagogical perspective and within the framework of French music conservatoires. Even if nowadays it is extremely rare that someone openly assert that mind and body are two independent entities, the long-lived dichotomy between the body and the mind have been drawing the attention of authors from the 1970s (Hanna 1976 ; Holdstock 1979), seems to persist in our culture, in particular in France where this study has been undertaken.

## 2 Context

A sound body of research supports the indivisible connections between physical body and action, sensation, perception, thought (e.g., remembering, imaging, conceptualizing) and affect (e.g., emotion, and "vitality affects") (Damasio 2010 ; Sheets-Johnstone 2010 ; Stern 2010). Despite scientific evidence, the body-mind duality remains a reality in the field of music education and, to a lesser extent among music performers (Pennetier 1998). In our opinion, this conception remains very present among Western classical musicians and in particular, in the context of conservatories that train future professionals.

Indeed, the belief that mind (understood as intelligence or even soul) is nobler or superior to body is widely spread in artistic environments, in particular as far as musical expression is concerned. Art would be a work of the mind, a product of inspiration, the value of which would be undermined by the requirement of physical labour. This preconception also originates from European 19th classical piano tradition, which progressively created the image of extremely gifted concert artists capable of the greatest feats somehow beyond the abilities of the layman. Other important aspect supporting this dichotomic conception which reveals neglection of the body in music education contexts, is that musicians' health problems related to practice are often minimized if not denied. Alongside to this phenomenon is the lack of bodily education in order to install healthy habits among students.

For instance, in the municipal conservatoires of Paris (the largest conservatoire in Europe constituted by a network of 17 sites), courses focusing on the body and its role in musical practice are virtually non-existent (Direction des Affaires Culturelles 2019). To date, for the whole network of 28,000 students, only one department is specifically dedicated to supporting the artistic performance of student musicians, dancers, and actors : the *Bien-être, santé et prévention* department of the Conservatoire de Rayonnement Régional (CRR). Established by William Bensimon in September 2023, its mission is to assist students in addressing psychological challenges (such as anxiety and stage fright) and physical issues (including muscle fatigue, musculoskeletal di-

Published in : PINEDA, Ester ; FÖLLMI, Beat (dir.), *Musique et transmission à la lumière des sciences cognitives*, Editions des archives contemporaines, ISBN : 9782813005748, doi : 10.17184/eac.9782813005748

sorders, tendinitis, etc.) related to their artistic practice. Outside this department, this gap is sporadically addressed either through isolated initiatives by individual teachers—who have become aware of the importance of preventing issues related to intensive practice—or through the support of two expert counsellors in Functional Movement Analysis (AFMD), who are available to provide professional assistance upon request.

Under general pedagogical guidelines of the Ministry of Culture (Ministère de la Culture 2023), most of the conservatories in France offer programs of music, dance and drama. Musicians use body movements to play instruments with rhythmic synchronization and to embody musical expression. Although, motor skills and rhythmic synchronization are as crucial for musicians as for dancers (Gilbert 2015), the curriculum for musicians in Paris Conservatoires does not include any somatic approach to develop motor skills required for precise timing and execution. The body (soma) seems to be only considered when some physical problem appears with extended practice (e.g. related to wrong posture habits). Concretely, in France few conservatories offer mechanisms for evaluating, monitoring and coping with problems related to musical practice outside the two high conservatories of Paris and Lyon. In our view, this clearly reveals the lack of an integrative body-mind vision.

From a neuropsychological point of view, as pointed out by Olsson and Nyberg, there is no clear-cut separation between what the brain does when we do actual physical training as compared with when we are only thinking about it (i.e. doing mental rehearsal). In both cases, several brain areas are activated but mental rehearsal highly depends on our previous motor experiences (for neuroscience studies related to music production see, e.g., Bangert/Altenmüller 2003 ; Damasio 2010 ; Kamiyama et alii 2010 ; Katahira et alii 2008 ; Maidhof et alii 2009). Mental rehearsal is one of the very useful aspects that musicians are taught to diversify their practice ; it can be defined as thinking about music (visualizing the score, aural memory and movement) without physically playing the instrument. As the same areas of the brain are activated when hearing internally and producing music, mental practice is an effective means to improve later performance, especially when cognitive aspects of the movement task prevail (Driskell et alii 1994). To become familiar with this particular kind of rehearsal, mindful practice needs to be addressed. Bodily awareness can be considered as a key work towards mindful practice.

Scientific evidence indicates that mindful practice and body awareness have an impact on healthy musical practice. Mindfulness, defined as a form of non-judgmental present-focused attention (Driskell, Copper, and Moran 1994) has motivated a growing body of scientific research showing the positive effects of mindfulness on cognition (Jha et alii 2007) physiology (Carlson et alii 2007 ; R. J. Davidson et alii 2003) and psychological well-being (Chiesa/Serretti 2009 ; Keng et alii 2011). Present-focused attention enables awareness of sensations, imagination and emotions that emerges to the mind without judgement (Baer 2003 ; Bishop et alii 2004). Even though, integration of mindfulness into music education institutions is still sparse even if some conservatoires offer somatic education approaches like the Alexander Technique, Eu-

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tony, Feldenkrais Method etc. In general, contributions from neuroeducation research have poor penetration in arts teaching and learning environments.

Unlike sports performers that benefit of highly supportive environments, musicians receive extremely little attention in terms of health and well-being. Physical and mental demands of both populations, however, are comparable. Instrumental teaching, which aims to lead to an accomplished, healthy and fulfilled practice, has many facets and can be approached from different interesting aspects such as comfort, strength, fluidity, expression, etc. We chose to delimit our exploration to the degree of bodily self-awareness and acuity that young pianists with different ages and years of practice may have. With no intention to produce results with statistical significance, we followed a phenomenological approach with semi-guided interviews with pianists aged 8 to 22 from the Conservatoire Jean-Philippe Rameau in Paris. The students were asked to play a simple exercise (a scale) twice, before and after a first interview. Our purpose was to collect their testimony on the perception of their bodies while playing and on their degree of body awareness (such as parts of the body involved in sound production, posture, breath, etc.). Our observations on this naïve sample, support the importance of bodily awareness on sound quality, suggest a clear relation between student maturity and self-awareness, and clearly indicate the need to include somatic approaches in musical education.

## 3 Materials and methods

Our underlying premise is that we learn from our personal experiences and this becomes an informed and insightful basis for musical practice. The experiential dimension of bodily awareness has raised great interest within the phenomenological tradition (Husserl 2015 ; Merleau-Ponty 1996). Husserl proposed that phenomenology should focus on the conscious experiences of an individual as any understanding of the world comes from the first-person perspective. The path tracing Phenomenology of Perception work of Merleau-Ponty has elicited important contributions in the field of body perception. (Gallagher 2006 ; Gallagher/Zahavi n.d. ; Hanna/Thompson 2003 ; Henry 2011 ; Legrand 2011).

Within this phenomenological framework, our approach implements Vermersch explicitation interviews that favour free and associative verbalization, focusing on an exhaustive description of experiences. Open-ended questions are an appropriate means to foster a progressive understanding of the participants own cognitive processes, which can be defined as metacognition or the "knowledge or cognition about cognitive phenomena" (Flavell 1979). We used open how-questions (for instance, how are you feeling physically while playing the scale ?) to guide the participants towards bodily perceptions. In terms of controlling sound production, we argue that the pianist should be able to establish a causal link between two events : the action and the sound resulting from this action. In other words, to "control" sound production in the sense of "having a goal" (Moors 2016) corresponds to an action that matches a desired sound quality result (dynamics, timber, etc.).

Data was collected in single sessions through interviews with semi-guided questions on a basic technical exercise, a scale. Scales are one of the first steps in piano learning

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and common exercises providing the fundamentals to understand Western tonal music. With other technical exercises, scales provide a basis to develop a grounded technique. The objective was to collect students' testimony on their basic technical exercise while playing the scales and on their degree of body awareness (such as parts of the body participating in sound production, posture, breath, etc.) before and after an interview.

### 3.1 Participants

Ten young pianists aged 8 to 22 with 2 to 10 years of piano practice, all of them enrolled in the official curriculum of the Jean-Philippe Rameau Conservatoire in Paris (JPRCP). Their training includes music theory, ear training, instrumental tuition and ensemble. Eight of the ten participants started formal music education at the Conservatoire Jean-Philippe Rameau (JPRCP) at the age of 8. Some of them had previous lessons with a private teacher or a member of their family. The other two (20 and 22 years old) joined the JPRCP after having studied in other French conservatories. Years of practice are closely related to the age of the students (see Table 1).

### 3.2 Music materials

Music material consists of a scale, played from memory, in a key chosen by the student. The chosen scale (Figures : Music Material) was part of the daily exercises of the student, therefore it should be an already learned scale that doesn't require particular focus nor motor efforts from the students. It is more convenient to use scales (Jabusch et alii 2004) than a piece of music where expression is needed. This principle has also been used to study the effects of the Alexander technique on piano playing, more precisely to quantify the difference in musical skill before and after an Alexander technique lesson (Fletcher 2005 ; Bennett/Morris 2006 ; Williamson et alii 2017). In our study, the scale is played with both hands, ascending and descending by parallel movement, spanning 2 to 4 octaves depending on the piano level of the student. Transforming a scale into an easy sensory exercise should favour the sense of involvement, as it does not need too much control thus allowing the musician to focus on sensation. The interviews aim at shedding light on (i) the degree of awareness of the students on what they are doing (ii) what the students make use of to play the exercise, as well as to (iii) awaken bodily perception and heighten awareness with a semi-guided questionnaire.

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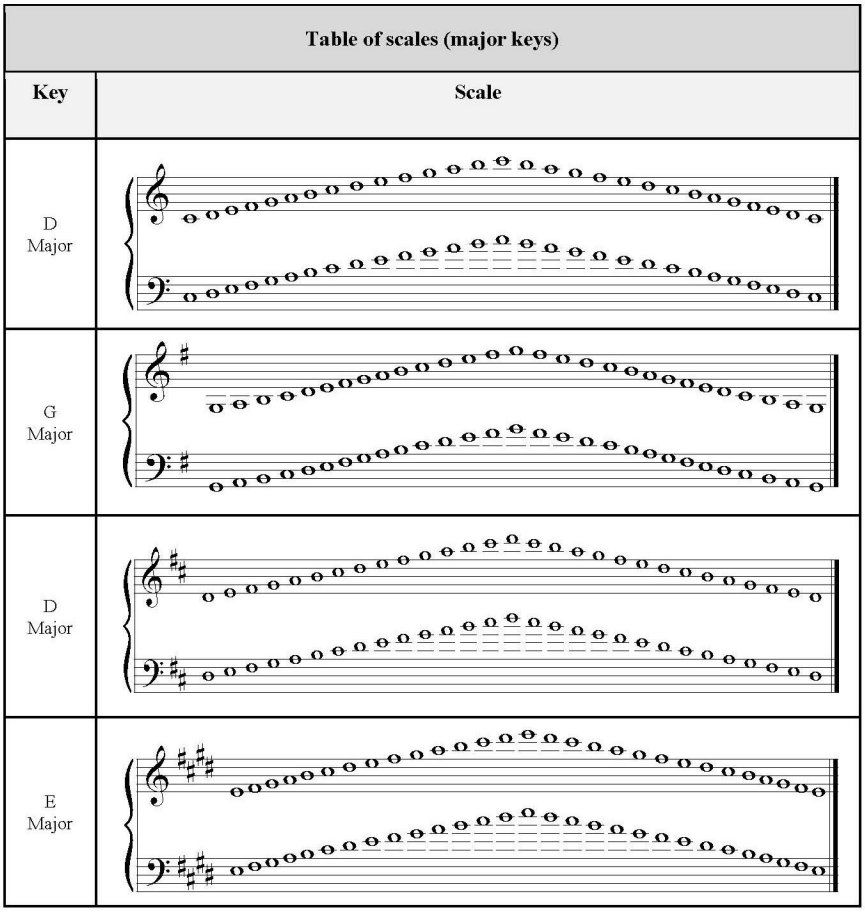
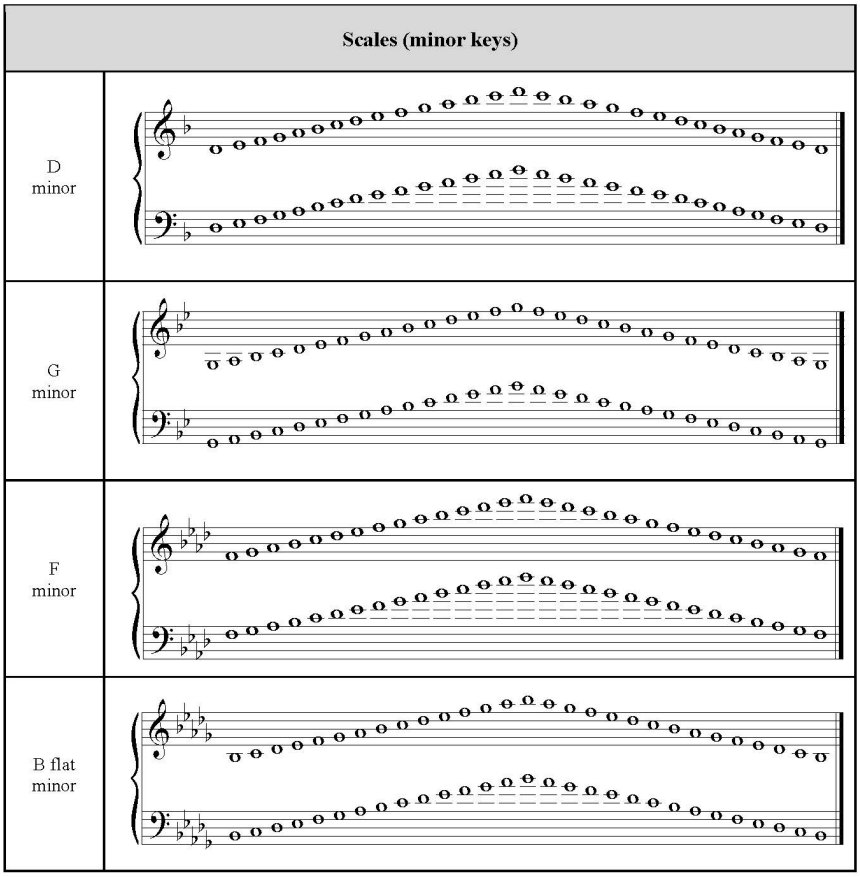



Fig. 1 : Table of scales (major keys).

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| Fingerings | |
|---|---|
| Right hand | 1 2 3 1 2 3 4 1 2 3 1 2 3 4 5 (...) 4 3 2 1 3 2 1 4 3 2 1 3 2 1 |
| Left hand | 5 4 3 2 1 3 2 1 4 3 2 1 3 2 1 (...) 2 3 1 2 3 4 1 2 3 1 2 3 4 5 |

Fig. 2 : Table of scales (minor keys) and fingerings.

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### 3.3 Interviews

We used a verbally semi-guided mode in which students were asked to explore the links between movement and playing (sound production) to observe qualities that arise through this process like, for example, changes in contact with the supporting surface (e.g., floor or chair), direction of parts of the body in relation to the instrument and other parts of the body, the whole body in gravity and space, and qualities of the bodily experience while playing. These may include the sense of muscular effort, smoothness of action, parts of the body involved and also being aware of eventual muscular tensions.

Individual sessions started with an explanation of how the session would be carried out. To create a relaxed environment allowing physical and mental space for exchange in which the student could feel secure and comfortable, we gave a brief introduction of the session and we avoided recording (video or audio) the interviews. Then we asked them to choose a scale they were familiar with and to play it a first time without any particular instruction.

Data collection was divided in two sequences (1) to collect first spontaneous comments on participants' bodily perceptions while playing and (2) a sequence following this action to make them go further in terms of focusing attention and self-awareness. This second sequence aimed to collect more precise information regarding their capacity to be aware of their movements, perceptions and feelings. The interviews, performed in French, were conducted with the following open-ended questions :

First sequence

1. What do you need to think about in order to play a scale ?
2. What body parts did you use in order to play it ?
3. And now, for a less obvious question : how are you feeling physically while playing the scale ?

Second sequence

4. So, what other body parts did you use ?
5. And how did you feel ?

Students whose level allowed it (7-12 years of practice) were asked to modify dynamics and tempo in a third additional sequence.

Open-ended questions emerged from author's more than twenty years of teaching experience and were further discussed with other teachers of the Conservatoire piano department. We wrote-down the answers during the interviews (Annex 1) in the setting of a normal piano lesson. In order to preserve the anonymity of the participants, herein, we number the students from S1 to S10.

## 4 Results

Importantly, we observed that the exercise was a completely new experience for all participants. They had indeed never previously participated in a session specifically

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designed to explore bodily awareness and to put their experience into words in the context of conservatory piano lessons. This indicated that the sample of participants could be considered as naïve and was therefore *ad hoc* for the purpose of the exploration. The interviews are displayed in the Supplementary Material (tables S1 to S10) and some main outcomes are summarized in Table 3.

Overall, open-ended questions led students to easily shift the attentional focus from the mind (thinking about notes and fingerings) to the body. At first, they consistently declared that for them, playing piano was mainly a matter of fingers and mind. Indeed, while playing the first sequence without any instruction, only two students alluded to parts of the body which were not in direct contact with the keyboard (feet, back, shoulders). Noteworthy, among these two was the youngest student, also enrolled in dance courses in the Conservatoire. As the interviews advanced, all participants progressively became aware of other parts of the body involved in playing. At the end of the exploration, they all identified at least one additional part of their bodies relative to the initial ones (Table 3).

Interestingly, none of the participants declared being aware of their feelings and only one of her body while playing the first sequence (without instruction, see Table 3). For older students, connecting with bodily sensations was easier. Moreover, words reflecting a more global vision of the body appeared in students aged 13 and over. When students were asked "what body parts they use to play", we collected answers like "straight back ; adjusts posture (S9) ; regulates posture leaning (S8) ; upper torso (S7) ; belly (S6) ; energy (S6) ; pelvis, weight and ready to bounce" (S10). The level of language as well as the insight differed according to the age of the student. The spontaneity of some answers of younger students as "I never asked myself the question" or "I used my buttocks", contrasted with those of the older ones like "I am searching for my centre of gravity" or "My legs in order to be well grounded". These answers convey that the degree of body awareness as well as the insight both depend on age. We wish to underline that increased awareness on bodily sensations and feelings is the unmissable step to elicit the subsequent verbalization of the experience. The opportunity to verbalize what is felt, i.e., to name what is experienced, acts as a catalyst in the process.

The link between kinetic energy and sound production is a major issue in piano technique. In this sense, it is noteworthy that without asking any specific question, during the second sequence, some students (see Tables S7 and S9) realized spontaneously that changes in movement or posture have an impact on sound production. Participants whose pianistic level allowed it (aged 13 to 22, 7-12 years of practice) were asked to modify dynamics and tempo in a third additional sequence. They declared that shifting position (Tables S8 and S10) or attention (Table S9) modified sound.

We also clearly noticed that focusing on bodily perceptions allowed all the participants to reduce tension, thus gaining in comfort. As a first step towards the development of metacognitive abilities, this exploratory exercise indeed allowed the students to become aware that the development of acuity in body sensation would firstly enable them to play more comfortably (see Tables S1-3) but could also improve their level of instrumental performance, that is to say, broaden and develop their piano technique

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(e.g., S9 and S10). The interviews provided a specific framework to discuss and explore perceptions, sensations, feelings. In particular, it broadened aural feedback to explore and analyse if the elements that emerged, could have an incidence on sound quality and comfort. The exploration resulted in a wider perceptive space of listening in its broad sense.

| Participant | Age | Sex | Years of practice | Music material | | Before (play with no specific instruction) | | | During /after (play with body-focused attention) | | Previous body-centered experience |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | KEY | RANGE | To play, they think about | Body parts involved | Sensation | Comfort increased | Become aware of other body parts | |
| P1 | 8 | F | 2 | G Major | 2 octaves | Fingers, rhythm | 2 | Tense | ✓ | 4 | No |
| P2 | 10 | F | 3 | E Major | 2 octaves | Notes and fingerings | 1 | Don't know | ✓ | 3 | No |
| P3 | 10 | M | 2 | C Major | 2 octaves | Fingerings and notes | 2 | Don't know | ✓ | 4 | No |
| P4 | 11 | M | 4 | E Major | 3 octaves | Rhythm, feet, hands | 2 | Don't know | ✓ | 3 | No |
| P5 | 12 | M | 5 | G minor | 3 octaves | Fingerings, sharps | 2 | Don't know | No change | 3 | No |
| P6 | 13 | F | 6 | D Major | 4 octaves | Hands synchronicity. Energy comes from the belly | 1 | Tension in the arms, back and in general | ✓ | 2 | No |
| P7 | 14 | F | 7 | D minor | 4 octaves | Fingerings, accidental notes | 3 | Don't know | ✓ | 4 | No |
| P8 | 19 | M | 12 | B Major | 4 octaves | Brain, ear, fingers | 1 | Don't know | ✓ | 0 (focused on audition) | No |
| P9 | 20 | F | 11 | F minor | 4 octaves | Fingerings, tempo, synchronicity | 2 | Tense | ?? | 4 (attentional shift) | No |
| P10 | 22 | F | 12 | B flat minor | 4 octaves | Don't know | 2 | Tense | ✓ | 3 | No |

Fig. 3 : Participants and individual session content

## 5 Discussion

Briefly, the key findings of this study conducted with a pedagogical perspective, can be summarized as follows : (i) the experimental design succeeded in shifting the attentional focus towards the body and permitted the participants to become aware parts of the body involved in playing besides those in contact with the keyboard (ii) the degree of bodily awareness, as well as the insights on this are related to age (iii) verbalization allowed the participants to realize that changes in movement or posture have an impact on sound production and (iv) focusing on bodily perception led to reduced tension and gain in comfort.

### 5.1 Redirecting attention to bodily perception

Playing an instrument requires the participation of the whole body. However, the conception that only the body parts mobilized to actuate the instrument (to produce sound) are used to play (e.g., fingers on the keys for keyboard instruments, mouth and fingers for wind instruments, etc.) is commonly spread among students. The study herein supports the existence of this believe and suggests that the identification of body parts involved in music production is somewhat independent of age and practice for students that have not acquainted with somatic awareness. However, the degree of somatosensation (touch, proprioception and haptic ability) gradually develops from 2.5 years to 18 years even if improvements do not progress linearly across time (Taylor et alii 2016). As young students declare that they play only or mainly with the fingers,

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older ones connect quickly with other body parts involved in playing the instrument (e.g., the fingers, the head, and the upper body (S7). For instance, S7 started saying "It's mainly the fingers and the head" and on the second sequence declared "Oh yes ! I use my shoulders and also the lower back". Among the five participants aged 8 to 12, only one student answered that she used the arms, the back and the pelvis to play (see Table S1). She was indeed the only participant whose answer conveyed body perception before asking "what body parts do you use to play ?". This indicates not only that she was aware of using certain parts of her body to play the piano apart from those in contact with the keyboard, but also that she was able to make them explicit. This suggests higher self-awareness, which lead us to hypothesize that it could be linked with the fact that she was the only student of our sample following dance courses in the context of the Conservatoire.

In the first sequence, when we asked to play the scale without any specific instruction related to the question "how are you feeling physically while playing the scale ?", students between 8 and 12 reported that they had not asked themselves this question and just answered "I don't know". S2 did not even answer that question as if she could not understand the relationship between playing and physical sensations. These answers reveal that there is a gap between what the person believes she knows about her lived experience and what she could say about it ; in other words, a transition is needed from pre-reflective consciousness of the lived experience to a reflective consciousness of the same lived experience (Husserl 1989). Husserl points out that lived experiences are simply lived, without at the same time being 'viewed'. By definition, pre-reflective consciousness is normally invisible in the present moment, as if it were visible it would not be pre-reflective, whereas being visible, being 'taken into view' is a matter of reflective consciousness (Vermersch 2014).

### 5.2 Mind-body connection and age

For these younger students, attention was mostly directed toward the notes and fingerings than toward an explicit awareness of how they were using their bodies. Otherwise, it was easier for students aged 13 to 22 to connect with bodily sensations and put forward answers like "I use my stomach (belly), I distribute energy from there" (S6), "The upper body" (S7), "The ears" (S8). It was from 12 years old that the answers became richer and more explicit showing an increased ability to connect with one's sensations and feelings. The older the students were, the more this ability seemed to be refined. We cannot consider this particular point as if it were only related with age as these students have been following piano studies over some years and ineluctably their cognitive processes in terms of perception-action have certainly evolved. Importantly, no student had followed somatic education, so our observations on self-awareness are not biased by students' education and the sample can be considered as homogenous in this respect.

### 5.3 Bodily awareness and musical expression

Our study used a simple technical exercise (scale), which being outside the context of a musical piece was not supposed to entail expressive interest as recognized for instance, by S10 who said "I think that I should have been more focused but it's a boring exercise

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to me…". At this point, a reflection emerges : music as an artistic expression of the human being, is about conveying feelings, emotions and thoughts through movement, therefore, how would musicians be able to reach expressive performances without being connected to their feelings, thoughts and perceptions ?

In line with findings affirming that the body provides musical expression (Friberg/-Sundberg 1999) it has been shown that pianist's movements express the mental and physical intentions inherent to expressive performance (Davidson et alii 2001). According to research on expressive movements in piano playing (Davidson 2007), rocking movements emanate from the hip region, which represents the center of gravity in the pianists sitting position and constitutes the pivotal point for all upper body movements. In addition, Davidson gave evidence on the links between technique and movement. Interestingly, on the second sequence, two students of our sample intuitively found this core element for movement and sound production : S1 declared to use her back searching by motion the center of gravity (she rocked back and forth) and smiled, a little embarrassed answering "also my buttocks" and S10, "I used my pelvis more and I was drooping less, as if I was ready to bounce". Thanks to this exploration, they clearly realized the causal link between them. This supports the importance of awakening bodily processes through verbalization to consciously employ them from early stages and the usefulness of this type of movement analysis throughout the studies.

The results of the interviews highlight a correlation between self-awareness and refining aural feed-back on piano playing. Following the instruction : "Now you are going to play the scale again while focusing on your body and then you will tell me how you felt and what other body parts you used", S9 declared that she felt more relaxed and she used "the ears more" (focusing in audition). Shifting attention to the body, allowed her to increase comfort while focusing on sound production. Expressing it in a different way, S8 also described the link between posture (motion) and sound production saying, "I lean over the piano a little more to use more force".

### 5.4 The importance of bodily experience verbalization

The importance of verbalizing the motor act is essential for musicians, particularly in a teaching context. A significant observation of this study is the appearance of a path that unfolds as open-ended questions gradually progress. For instance, to the first question S5 answered "I didn't ask myself that question" and two items later she observed "I move my upper body according to the ascending and descending movement of the scale". On this point it may be pertinent to ask, do not verbalizing means the subject is not aware ? Of course, verbalization may depend on multiple factors (i.e., age, context, personality, etc.) and does not necessarily mean the person is not aware. Open-ended questions were precisely conceived to direct attention on bodily perceptions as a starting point for verbalization and answers like S5 state that they were not consciously aware of physical involving while playing (simply lived) until they asked themselves the question (taken into view). As a result, they seem to discover the experience as they verbalize it, while recognizing it as their own lived experience. Putting into words the way they use their bodies to play, appeared to be a necessary step to make mental processes more transparent and opened to

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a better understanding of the mind-body-sound interaction. Verbal reconstruction experiences constitute a sensory awakening and lead to refining their proprioception. To illustrate this point, a participant aged 10, answered not being aware of physical feelings while playing the exercise and only thinking about notes and fingerings. As the interview progressed, she said "thinking about it, I feel more relaxed", and with no other instructions, she moved several times as if to "adjust" her seating position to find her gravity center. To the question, how you felt and what other body parts you used ? participant S8 declared, "Oh yes ! I use my shoulders and also the lower back" and "I was more relaxed, I used my ears more". These answers reflect, first, that focusing on physical sensations allowed to detect tensions and modulate muscle tonus to relax, and even more important, the core role of auditory feedback ("I used the ears more") to control sound production related to motion.

The use of directed attention to develop self-awareness has been applied in somatic approaches. For instance, Feldenkrais put forward the following steps to awareness : "First of all you have to have the attention free to bring it somewhere in order to feel the sensation, to diminish strain and effort. Then, you have the tools to go into deeper sensation, developing your listening, developing your discernment, and that altogether gradually brings you to awareness". During the interviews, the same succession pattern appeared (1) shifting attentional process to focus on bodily sensations (2) adapting effort and strain (3) refining bodily and aural perception (4) bottom-up processes leading to awareness (Feldenkrais/Boullet 1993).

Our study shows that students' conclusions have been found by self-observation and experience ; we only invited them with open-ended questions. It is precisely through experiencing by themselves instead of following teacher's verbal instructions that musicians could ground vivid and effective strategies, setting up the first steps to metacognition (Flavell, 1979).

### 5.5 Paving the way to mental practice

While metacognition implies conscious awareness, other processes such as memory traces left by the experience of somatosensory integration (relationship between movement, touch and sound) are less conscious, but nevertheless constitute significant internal representations that will ground mental practice. Expert musicians use mental practice as one of the effective ways to improve a performance (Driskell et alii 1994). These authors have shown that this improvement is particularly effective when the cognitive aspects of the movement task prevail. At its core, mental practice training thus requires refined levels of bodily perception and can be for the student, in parallel of the physical practice, a very important tool in the acquisition of instrumental skills.

The present study awakens both conscious (reflective thinking and self-assessment) and unconscious (bodily perceptions and experience of motion related to sound production) processes that pave the way to metacognition and mental practice, respectively.

Mental practice (or mental rehearsal) makes reference to different procedures : (i) silent reading of a score, which implies the ability to imagine the sound "in the head" (Halpern, 1988) and also "notational audiation"(Brodsky et alii 2008) (ii) thinking

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about movement related to sound (iii) rehearsing without the instrument. The capacity to simulate sensations (e.g., sound) and actions (movement) are preponderant in these processes. We know that cortical areas are recruited even in the absence of sound (Zatorre/Halpern 2005) and that to imagine a movement (kinesthetic or somatosensory imagery) without doing it physically, activates the same areas of the brain (Jeannerod 1994). The remarkable human ability to use kinesthetic imagery in mental practice as a form of training has been studied in different contexts (e.g., sports, functional rehabilitation, music) as, both processes being functionally equivalent, it improves motor skill acquisition by stimulating the neural networks underlying movement planning and control (MacIntyre et alii 2018 ; Moran et alii 2012). In the field of music, it has been demonstrated that mental practice improves later performance (Lotze 2013 ; Theiler/Lippman 1995) and that from a neural perspective, mental and physical practice yield similar changes in neural response (Jackson et alii 2003 ; Pascual-Leone 2001).

These findings are really relevant as mental imagery (mainly motor and auditory) is a fundamental ability in mental practice, which constitutes a common form of mental rehearsal away from the instrument. Of course, other mental images unrelated to motion (e.g., extramusical references or metaphors) are commonly associated as well to mental practice. When S4 says, "I use my feet to stay well rooted. The hands to play. The brain to know what fingering to use", she is shifting attention to map herself in the action and acquires a mental image (awakened by sensations) of her posture when playing. Although these comments are not directly related to mental practice, they evidence the integration of perceptual elements that will imprint the kinesthetic memory, which is at the basis of internal representations.

### 5.6 From sensation to awareness

With the question "how are you feeling physically while playing the scale ?" our study aimed to underline the importance of connecting sensations to motion. While it has been demonstrated that "motor skills can be improved if individuals are aware of the sensations that accompany the physical performance" (Wriessnegger et alii 2018), association of perceptions to motion are as valid in "real movement" as in an imagined one as both processes are closely related. Our study suggests that drawing students' attention to processes of action-perception that lead to kinesthetic (motor) representations, should be considered from early years of education as an important means in instrumental technique. Concerning developmental issues, research on mental imagery (MI) development through childhood and adolescence (Souto et alii 2020) showed substantial maturation in MI ability in the early years of elementary school, becoming mature in late childhood and early adolescence.

As pointed out by Souto, mental simulation of movement is important because it follows the intentions and plans of motor acts, assessing whether the actions performed correspond to the desired actions (Jeannerod 1994 ; Wolpert 1997) and, in a music performance context, this would be directly linked with de ability of mental rehearsal.

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### 5.7 Body awareness in building up technique

Pianist and pedagogue Jean-Claude Pennetier declared : "some musicians give the impression, when they play, of having a head and hands drawn in bold and the rest of the body in dotted lines ! The result is rarely satisfactory in this case" (Pennetier 1998). Actually, the testimony of younger participants (ages 8 to 12) matches perfectly with Pennetier metaphoric words. Before the interview, when playing a scale with any particular instruction, students declared to play with their "head" (thinking about the task) and their fingers (see Table 1).

Instrumental technique cannot be reduced to mechanical aspects such as agility, equality, power, etc. A solid and versatile technique is a result of a long learning process that should offer a diverse array of means such as, among others, a dynamic sound palette, refined aural and touch perception, rapid attentional shifts -see Stachó's concept of mental virtuosity (Stachó, 2018)- that enable the musician to convey the content and the meaning of music with depth and sensitivity, etc. Consequently, it seems obvious that all these means could not be acquired approaching piano technique by "thinking about fingerings and sharps" (S5), or "head and fingers" (S1, S2). Musicians must rely on a technique that enables them to achieve the same finesse and precision of movement as dancers or sportsmen. Interestingly, S10 reported that being aware of the pelvis, she felt more to start the motion "as if I was ready to bounce". In terms of breathing strain and weight, S7 said, "I'm tenser when I play faster. The fingers are more active and the chest too. When I play louder, I throw my fingers around more and the muscles of my arms are more tightened".

In a bodily perspective, the musician should be aware of eventual tensions and wrong postural habits to consciously regulate muscle tonus. For instance, when we asked older students to play faster/louder, S10 argued "I raised my shoulders… which is not a good solution. When I play louder, I use my arms more and I notice that I lean over the piano more, too." Increasing speed and sound is a more demanding task from an energy and motor point of view. This injunction resulted in greater tension in the shoulder belt but interestingly she realized that exigence (or stress) often results in physical tension as she concluded, "which it is not a good solution". The interview allowed the student to notice that being connected to bodily sensations allows to better cope with exigence and stress and gives tools to consciously improve voluntary control. These observations point toward the importance to awaken bodily awareness to set up healthy habits.

Despite scientific findings supporting the indivisibility of physical body, perception, thought and emotion, body-mind duality still pervades in the French educational context, as music is mainly taught in a rational approach and the body clearly remains in the background. In agreement with this, the participants in our exploration had never undertaken this kind of self-awareness experience before, neither in instrument nor in other conservatory lessons. Learning based on experience was also new in this framework. Focusing on bodily self-use and learning from a verbalized sensory experience was a new perspective that had never been suggested to them. This is in contrast to active music pedagogies like Dalcroze, Kodaly, Orff etc., which give a substantial part to perception and movement from the very beginning of the studies

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that are grounded in experience before theory. With the lighting of principles of Merleau-Ponty's *Phenomenology of Perception*, our humble contribution aims to show how phenomenological insights into bodily awareness can be developed by research into somatic proprioception and acquisition of motor skills in the context of piano learning.

## 6 Conclusion

Although carried with a small sample, this qualitative investigation into body awareness in instrumental practice aims to highlight some important issues in piano performance, namely self-awareness, proprioception and mind-body-sound interaction. Our study also pinpoints that body awareness is mostly neglected within the musical education context of the Paris Conservatoires network.

In the light of our findings, this work pleads in favor of systematic integration of mind-body approaches in musicians' curriculum in the same way as they are part of dance programs because the musicians need to build up an accurate and integrative instrumental technique, which allows them a real embodied experience of music transmission.

### Ethics statement

Ethical review and approval were not required for the study in accordance with the local legislation and institutional requirements. Verbal informed consent was provided by the participants' legal guardian/next of kin.

### Acknowledgments

Thanks to Bruno Rossignol, Director of the Conservatoire Jean-Philippe Rameau (CJRP, Paris), who permitted this study to take place at CJPR and Jean-Charles Tillet, its General Secretary. Thanks to Iñaki Guijarro for helpful discussions during writing. We would like to specially thank the students and their families who participated voluntarily in the study.

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