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The Role of the Body in Instrumental and Vocal Music Pedagogy: A Dynamical Systems Theory Perspective on the Music Teacher's Bodily Engagement in Teaching and Learning

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Instrumental and vocal teachers often employ their body in teaching to facilitate sensorimotor engagement with the voice or an instrument. Yet, teacher's bodily engagement in instrumental and vocal education is scarcely addressed in music educational research studies. In our view, this scarcity is related to the lack of a framework about the role of the music teacher's body in instrumental and vocal education. In this article, we will adopt a dynamical systems theory perspective to set first steps in conceptualizing the role of the instrumental and vocal teacher's body in teaching and learning music. From this perspective, learning processes are viewed as emerging from the learner's goal-oriented, situated, adaptive actions in the learning environment. Teachers play a significant role in that environment, due to the different types of constraints (e.g., environmental and task constraints) they can introduce to aid learners in finding a solution for a musical task. In this article, we argue that different types of teacher's bodily engagement can act as constraints in instrumental and vocal music learning, thereby facilitating the learning process in non-verbal ways. To demonstrate this, we describe four types of bodily involvement: physical modeling, action demonstration, pedagogical gestures and touch. In summary, based on existing theoretical and empirical research, the article will present a first conceptualization of the role of the music teacher in instrumental and vocal education viewed from a dynamical systems approach.

Keywords: instrumental and vocal music education, dynamical systems theory, constraint-led pedagogy, physical modeling, action demonstration, pedagogical gestures, touch

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INTRODUCTION

In recent years, insights gained from theoretical and empirical work on the embodied nature of human interaction with music are gradually finding their way into the domain of music education (e.g., Bresler, 2004; Bremmer, 2015; Van der Schyff et al., 2016; Nijs, 2019; Nijs and Bremmer, 2019). Within the scope of music educational research, few studies focus

on embodiment and instrumental and vocal music education from the perspective of the learner (Nijs, 2017; Schiavio and Van der Schyff, 2018). Even fewer studies specifically investigate the role of the music teacher's body in instrumental and vocal education (Nafisi, 2013a; Simones et al., 2015). This is remarkable, as teacher–students relationships have been found to play key roles in how students develop musically (Creech and Hallam, 2010; Burwell, 2012), and not only the verbal but also the non-verbal communication between teachers and students forms the heart of the music teaching and learning process (Mills and Smith, 2003; Lennon and Reed, 2012). However, up till now, studies on teachers in instrumental and vocal education tend to focus on their verbal communication (Simones et al., 2015), demonstrating that language can play a constructive role in music teaching (e.g., Meissner and Timmers, 2019), but also has its drawbacks. For example, teachers' explanations, often in the form of imagery or metaphor, are prone to ambiguous interpretation (Howard et al., 2004; Hoppe et al., 2006), and language cannot visualize musical concepts, nor visualize different layers of music simultaneously (Bremmer, 2015). A viable way to address this shortcoming is to add gestures to music teachers' verbalizations, as these can convey important complementary information and promote effective learning by offering learners a second message (Singer and Goldin-Meadow, 2005; Bremmer, 2015). This type of multimodal encoding can lead to a deeper understanding (e.g., Sweller, 1994; Lakoff and Johnson, 1999). Also, verbal instructions and feedback can break the flow of musical learning (Bremmer, 2015; Van den Dool, 2018). Again, gestures and movement can provide a solution as they can be used *during* music making to scaffold both technical, expressive and musical matters for learners (Van den Dool, 2018). This way of scaffolding, also well-known to conductors (Bonshor, 2014; Durrant and Varvarigou, 2015; Jansson et al., 2019), allows learners to experience the time-based character of music without language interfering (Bremmer, 2015).

Although the use of the body could complement a language-based pedagogy, and although the way music teachers employ their body might be important in facilitating effective sensorimotor engagement with the voice or an instrument (Nafisi, 2013a; Simones et al., 2017; Zorzal and Lorenzo, 2019), currently a solid framework about the role of the music teacher's body in instrumental and vocal music education is still lacking. We believe that dynamical systems theory could provide a starting point for developing such a framework. From this perspective, learning processes are viewed as emerging from the learner's goal-oriented, adaptive interactions in the learning environment (Abrahamson and Sánchez-García, 2016; Schiavio and Van der Schyff, 2018). As such, the dynamic relationship of the learner with the learning environment, in which the teacher plays a significant role, is a fundamental component of musical learning at all levels of musical development (Philpott, 2001; Simones, 2017).

In this article, we will present a first step in conceptualizing the role of the music teacher's body in instrumental and vocal music education viewed from a dynamical systems theory perspective. Offering an alternative to representational or computational theories of cognition, this theory has become influential in domains that relate to the topic of embodiment in music education, such as musicology (e.g., Demos et al., 2014; Van der Schyff et al., 2018), education (Renshaw et al., 2010; e.g., Koopmans and Stamovlasis, 2016), developmental psychology (e.g., Van Geert and Steenbeek, 2005) and social psychology (e.g., Obhi and Sebanz, 2011; Kyselo and Tschacher, 2014; Vallacher, 2019). Insights emerging from these domains help to shed light on the dynamic complexity of the educational environment that shapes learning and teaching. As such, we believe that the dynamical systems theory not only can shed new light on existing empirical studies in instrumental and vocal education, but also holds the possibility to generate new experimental paradigms and new kinds of explanations (Schöner, 2009).

In the first part of the article, we will take a closer look at dynamical systems theory in relation to instrumental and vocal music teaching in general. We will argue that the self-organizing behavior of the instrumentalist and vocalist can be affected by different types of constraints introduced by the music teacher's engagement. In the second part, we will specifically discuss how physical modeling, gestures and touch can act as constraints in instrumental and vocal music learning, facilitating the learning process in non-verbal ways (Bremmer, 2015; Simones et al., 2017; Zorzal and Lorenzo, 2019).

DYNAMICAL SYSTEMS THEORY AND LEARNING NEW SKILLS

Dynamical systems theory was originally developed in mathematics and the physical sciences where it took flight in the late 1960's (Aubin and Dahan Dalmedico, 2002). It provides a conceptual framework for describing the behavior of a system as the emergent result of a self-organizing, complex, multicomponent system, evolving over time (Ennis, 1992; Newell et al., 2001; Thelen and Smith, 2006). Viewed from this theory, change and development are non-linear processes, whereby properties of a system constantly emerge through the interaction between components, and between the components and the whole of a system (Newell et al., 2001; Thelen and Smith, 2006). In the 1990's, the dynamical systems theory was introduced in the field of psychology (Thelen and Smith, 1994; Van Gelder, 1995). According to Van Gelder (1995), this theory can be used to explain the workings of the mind more adequately than representational or computational theories of cognition. In his view, the mind is conceived as a coupled system interacting with the environment, whereby this coupling evolves over time as a function of a small number of variables. Since its introduction in psychology, dynamical systems theory has been very important for our thinking about both motor and cognitive development, describing *how* a system changes over time rather than *what* changes in a system (Spencer et al., 2011).

More recently, it is also increasingly applied in the domain of education. From a dynamical systems perspective, learning is seen to be situated in dynamic contexts where the development of new knowledge and skills is the result of multiple interactions between learners and their learning environment (e.g., other learners, teacher, school system) over time (Chow et al., 2011).

Through the development of a functional relationship between learners and their learning environment, new skills knowledge and skills are established (Simones, 2017; Chow et al., 2011; Renshaw and Chow, 2019). Learners develop such a relationship through attuning to affordances in the learning environment (Abrahamson and Sánchez-García, 2016). Affordances can be viewed as environmental properties that provide a learner with 'opportunities for action' (Renshaw and Chow, 2019, p. 10; Schiavio and Van der Schyff, 2018): tools (e.g., instruments, string bow, scores), activities (e.g., music lessons during or after school), and places (e.g., classrooms, concert halls) all have properties that hold the possibility to elicit certain actions. Viewing the role of teachers within a learning environment, they can ensure that key information is made available in tasks, thereby aiding learners' attunement to the specific affordances of that task. For example, while guiding the learner in learning a new piece of music, a teacher may highlight certain aspects of that piece through gestures e.g., visualizing a specific rhythm, thus helping the learner attune to a specific aspect of the music. As such, the emergence of functional relationships between the learner and learning environment can be facilitated through the teacher (Renshaw and Chow, 2019). Importantly, acting upon affordances is always linked to the learner's particular abilities (Hirose, 2002). Indeed, whether the affordances will be perceived, selected and processed by learners in order to change their way of acting, depends on their current knowledge, skills and experience (Chemero, 2003). Due to this reciprocity between perception and action, connecting to the learners' abilities is a crucial aspect of designing a powerful learning environment, allowing learners to build knowledge and acquire skills based on their current skills, knowledge and experience (Bransford, 2000).

Next to providing key information, teachers can support learners in becoming perceptually attuned to the affordances that are relevant for learning a certain skill by introducing constraints (Abrahamson and Sánchez-García, 2016). Constraints can be defined as interventions blocking out an ineffective involvement with a task (Abrahamson et al., 2016), by limiting what learners can do and thus preventing them being overwhelmed by a task and, at the same time, by offering an openness to possibilities, aiding learners in finding a solution for a task (Hopper, 2012). In doing so, rather than focusing on rote physical actions or error prevention, teachers invite learners to move beyond what they must or must not do (Weddle and Hollan, 2010), by providing them with constraints that allow them to construct how to use affordances in a learning environment in flexible and variable ways (Marton and Pang, 2006; Renshaw and Chow, 2019).

A CONSTRAINT-LED APPROACH TO TEACHING AND LEARNING

Based on the principles of dynamical systems theory, a constraint-led approach to teaching and learning is being developed, most prominently within the field of physical education (Renshaw et al., 2010). Although "constraint" in colloquial language can have a negative connotation, within a constraint-led pedagogy it refers to the boundaries placed on an individual that shape or limited certain behaviors (Newell, 2003). In this pedagogical approach, the manipulation of constraints is used to present learning content that challenges and guides learners in finding solutions for problems or to achieve the envisaged results. Newell (2003) distinguishes between three broad categories of factors shaping or limiting behaviors: environmental constraints, organismic constraints, and task constraints.

Environmental constraints refer to physical factors surrounding learners, shaping certain or limiting behavior (Rosengren and Braswell, 2003). Examples of environmental constraints include the size of a space, temperature or social factors such as peer groups (Hopper, 2012). Within instrumental and vocal music learning, environmental constraints are e.g., the acoustics of a room, or a peer group's musical preferences. Secondly, *organismic* constraints refer to the characteristics of an individual such as the physical structure of a person's hand, the level of perceptual, emotional and cognitive functioning, the degree a person is able to self-regulate and motivate, or the amount of muscle strength a person has developed (Renshaw and Chow, 2019). In relation to instrumental and vocal music learning, organismic constraints are, for example, handedness, lung capacity, or, the musician's motivation to achieve a specific goal. Finally, *task* constraints are mediated by a teacher or peer and include the goal of a specific task, providing feedback on the task, asking questions, or the materials used during a learning experience (Rosengren and Braswell, 2003; Hopper, 2012). In instrumental and vocal music learning, a teacher can mediate a task constraint for instance by inviting a learner to interpret a specific musical passage in different ways.

In a learning situation, the environmental, organismic and task constraints interact and configure in a certain way, determining a set of possible outcomes a learner is able to produce (Rosengren and Braswell, 2003; Schiavio and Van der Schyff, 2018). In general, the objective of a constraint-led approach to teaching is to optimize the learner's opportunities to develop cognitive or motoric skills that are both task appropriate and suited to the learner's organismic constraints (Abrahamson and Sánchez-García, 2016). In adapting to the particulars of an individual learning process, music teachers can introduce different types of constraints, amongst others through the use of their body. On the one hand, teachers can function as an environmental constraint through scaffolding in a physical way during the process of learning (Abrahamson and Sánchez-García, 2016). On the other hand, by introducing task constraints through for example gestures and touch, they can also guide the learner's search for motor-action solutions in more directive ways (Abrahamson and Sánchez-García, 2016). **Figure 1** presents an overview of the constraint-led approach to teaching and learning.

In the following paragraphs, we focus on constraints as introduced by the instrumental and vocal teacher's bodily involvement in the interaction with the learner: physical modeling, action demonstration, pedagogical gestures, and touch.

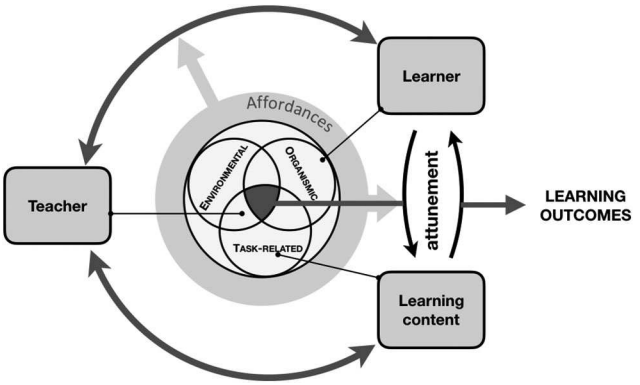

FIGURE 1 | Learning occurs within the learner-content-teacher triad, whereby the interaction between learner and learning content is shaped through the manipulation of a set of constraints. Through task design (e.g., tools and activities), the teacher creates a powerful learning environment. Within this learning environment, the teacher's bodily involvement affects and is part of the task-related and environmental constraints. Thereby, the teacher creates affordances that support the learner's attunement to the learning content and that provide the action possibilities that lead to desired learning outcomes.

ACTION DEMONSTRATION AND PHYSICAL MODELING

A frequently used teaching strategy involving the body in formal and informal music education is action demonstration and physical modeling (Metz, 1989; Campbell, 2001; Bremmer, 2015; Simones, 2017; Van den Dool, 2018). Simones (2017) defines action demonstration as moments of turn taking where music teachers first show students how a particular physical action could be performed when performing music, without actively engaging students who are mostly listening and observing the teacher, and consequently imitate the teachers' model. The goal of these kinds of demonstrations would be to provide students with an understanding of a movement that can be performed, for example, concerning the direction, intensity or the quality of the tone (Simones, 2017). Simones (2017) defines physical modeling as moments where teachers engage their students in the performance of a certain action to help them learn a new action needed to achieve a particular musical skill. Van den Dool (2018) adds that physical modeling by a teacher can also be used to *correct* a musical skill while playing.

Instrumental and vocal teachers most often value teaching strategies involving action demonstration and physical modeling (Zhukov, 2004; Millican Si, 2013; Nafisi, 2013b; Meissner and Timmers, 2019), believing they facilitate effective learning of musical skills (in opposition to verbal-only instructions), especially in function of developing an adequate body posture or grasping characteristics of a certain motion when playing an instrument or singing. To date, there is still a relative lack of evidence concerning the effectiveness of the use of these teaching styles (Simones et al., 2017), although some empirical research studies have explored what the outcome is of action demonstration and physical modeling in instrumental and vocal education. For instance, Simones et al. (2017) showed that action demonstration can be applied differently in piano lessons, leading to different learning outcomes. The types of action demonstration concerned blocking (repeated exposure to one concept at a time before the next) and interleaving (alternating among related skills e.g., between practicing scales, chords, and arpeggios). When learning staccato, piano students showed greater learning outcomes though observations that were intercalated with students' immediate imitation of teachers' action demonstrations, in comparison to a block of observations followed by a block of imitations. Also, Van den Dool (2018) found that pop students rely on bodily movements modeled by their band coach: as soon as they make a rhythmical mistake, they start imitating the rhythmic movements of their coach, leading to a quick repair of rhythmic or cohesive problems in a band.

From a constraint-led pedagogy perspective, the empirical studies of Simones et al. (2017) and Van den Dool (2018) show that action demonstration and physical modeling can serve to introduce different constraints, thereby facilitating the learning process in diverse ways. While the study of Simones and colleagues shows that timing of an action demonstration is an important aspect of designing task constraints, Van Dool's study shows that the teacher's physical modeling can become an environmental constraint that supports the learner's band playing.

However, from a constraint-led pedagogy view, physical modeling and action demonstration may also seem directive and uni-directional. These strategies may restrict a student's development of creativity, personal musical interpretation and expression (Rodrigues et al., 2009; Burwell, 2012), as physical modeling and action demonstration can leave the learner with little space for adaptive and explorative learning (Haston, 2007). Yet, Bremmer (2015) observed that—in teaching rhythm skills in general music education—music teachers emphasized their rhythmic movements more strongly when they wanted the learners to imitate new rhythmic movements, thus, redirecting the learners attention. By sensitively observing their learners, teachers not only exaggerated but also *altered* the movement to be emulated (Bremmer, 2015). Physical modeling and action demonstration can then be perceived to be "interactive rather than unidirectional" (Downey, 2008, p. 205), with the teacher adapting to the learner in flexible ways, subtly changing their constraints and allowing the learner space for finding a solution.

Applied to instrumental and vocal music education, this interactive aspect of action demonstration and physical modeling could imply that teachers and learners are dynamically interdependent on each other's responsive coordination, and together, could reach a close level of sensorimotor coordination by observing, anticipating and tracking each other's musical and expressive actions (Abrahamson and Sánchez-García, 2016). Often, learners do not observe and imitate indifferent, pre-defined models: a music teacher who demonstrates or models a musical skill or expressive movement does not simply enact a musical practice but also provides directions and feedback intimately tailored to the learners needs (Downey, 2008; Bremmer, 2015). Thus, physical modeling and action demonstration can be viewed as the coupled dynamical system

of teacher and learner that constantly self-organizes and modifies itself to reach an optimal configuration, facilitating the learner's music learning process (Schiavio and Van der Schyff, 2018; Koopmans, 2019). Through joint action, both teacher and learner continually seek to enhance performance and to predict performance outcomes (Kochman et al., 2014). In this system, the learner learns to make sense of the actions of the music teacher who models or demonstrates, to interpret musical actions and to transform these observed patterns into personal motor actions (Weddle and Hollan, 2010).

Learners can also (temporarily) "latch on" to the music teacher's body and co-experience expressive aspects of music such as dynamics, and directions of musical phrasing (Bremmer, 2015). As such, action demonstration and physical modeling can be viewed as a form of social action-scaffolding (Bruner, 1996), in which the physical presence of the teacher can serve to introduce different types of constraints for a learner (Niedenthal and Alibali, 2009), thereby shaping how learners engage in exploring and searching for functional movement solutions (Atencio et al., 2014). When the learner is able to perform a musical phrase or musical skill independently, the need for the learner to orient his or herself to a music teacher can become less.

PEDAGOGICAL GESTURES

Whereas, music teachers' action demonstrations and physical modeling are instances in which they perform a certain skill, expressive movement or technique, intended for learners to observe, imitate and learn from Simones et al. (2017), pedagogical gestures in instrumental and vocal lessons do not necessarily need to be imitated. As a body movement carrying an intention and/or a perceived meaning for the learner (Simones et al., 2015), pedagogical gestures are often used to represent music, or to attract the learner's attention to specific musical information (Bremmer, 2015), and can initiate a response or change in musical behavior (Kochman et al., 2014). In instrumental and vocal music education, teachers commonly employ pedagogical gestures intuitively to accompany speech, music or music making to support the learning process (Fatone et al., 2011; Nafisi, 2013a; Kochman et al., 2014; Simones et al., 2015).

Music teachers' pedagogical gestures can have different forms and meanings, depending on the age, instrument and voice, or genre being taught, and the social, cultural context in which the music teaching takes place (Fatone et al., 2011; Bremmer, 2015). For instance, in instrumental education, Simones et al. (2015) found that piano teachers employ gestures co-existing with music such as "musical beats gestures" (up and down movements of hands, arms, and/or head to denote the tempo or speed of music) or "conducting style gestures" (up and down movements of hands and arms with a rounder shape providing temporal but also expressive information about music) in their lessons. Co-verbal gestures piano teachers employed were: deictic (pointing gestures), iconic (expressing images of objects or actions); metaphoric (expressing images of the abstract); and co-verbal beats (up-and-down movements of hand, arms or head). In vocal education, Nafisi (2013b) found that singing teachers employ gestures such as "physiological gestures" (gestures visualizing actual internal physiological mechanisms related to the singing process), "sensation-related gestures" (gestures illustrating singing metaphors, imagery and/or acoustic phenomena) and "musical gestures" (gestures representing a musical phenomena) that all co-existed with both speech and music.

The last decade, more and more empirical studies are conducted that investigate which types of pedagogical gestures music teachers use in instrumental and vocal music education, when they are used and which effect they generate in music learning (Fatone et al., 2011; Nafisi, 2013a,b; Kochman et al., 2014; Simones et al., 2015; Simones, 2017; Van den Dool, 2018). For example, in an exploratory case study Simones et al. (2015) found that piano teachers adapted their pedagogical gestures to the learners' proficiency levels, supporting the dynamical systems's view of teaching as an interactive process, with the teacher adapting to the learner in flexible ways. Also, in an experimental study, Nafisi (2013b) sought to prove the effectiveness of pedagogical gestures for improving the quality of the vocal tone during a musical phrase in classical vocal education. She found that compared with the teaching intervention excluding pedagogical gestures and movement, the teaching interventions that incorporated gestures and body-movements showed more positive outcomes for improving tone quality. Nafisi (2013b) suggests that pedagogical gestures bypass verbal explanations that give explicit attention to bio-mechanical principles concerning the use of the voice and, instead, concentrate on the visualization of the core features of a musical phrase. In this case, the pedagogical gestures seemed to be able to mediate the task constraints more effectively than language due to ability to visualize information for the learner.

Taking a constraint-led view, the diversity of pedagogical gestures can function to introduce constraints in different ways. First of all, gestures such as physiological gestures, sensation-related gestures in vocal education and musical gestures in instrumental and vocal education all have the ability to provide *additional* information of that which is not visible to a learner (Kochman et al., 2014; Bremmer, 2015). In the case of singing, many processes take place internally, beyond the sight of the learner, but music itself, too, is invisible. Gestures, in contrast to language, have the ability to represent these invisibilities and, therefore, can materialize meaning for the learner (Fatone et al., 2011). In this way, this type of gesture can function as a mediator between the learner and task: e.g., by visualizing musical concepts or internal physiological processes, extra information is given to the learner, making the task more accessible to the learner and assisting the learner with sense making (Weddle and Hollan, 2010; Simones et al., 2015).

Secondly, music teachers can employ gestures such as musical beats gestures, conducting style gestures and musical gestures to direct the learner's attention to specific expressive or musical aspects in the music (Bamberger, 2013; Bremmer, 2015). These types of gestures can function as an "attentional anchor" (Abrahamson and Sánchez-García, 2016, p. 216), *reducing* the complexity of the music being heard, sung or played by the learner. The learner can be prevented from

being overwhelmed by the complexity of a task by the teacher's gestures that can channel the learner's attention toward certain information, thus limiting what the learner can give attention to (Abrahamson and Sánchez-García, 2016). For instance, when learners want to grasp a syncopated rhythm, the music teacher can visualize only that specific rhythm through musical beats gestures, reducing the rhythmic complexity of a piece of music, and aiding the learner toward playing a syncopated rhythm (Van den Dool, 2018). Thus, the way the music can be interpreted can be constrained through the teacher's pedagogical gestures; they temporarily simplify musical content and may alleviate the overload of information for the learner (Foletto, 2018).

Thirdly, gestures can be employed to evaluate the learning process, reminding learners of a musical concept or skill and allowing for continuous non-verbal feedback during music making (Kochman et al., 2014; Van den Dool, 2018). Kochman et al. (2014) found that singing teachers will employ musical or technical gestures during a vocal lesson, with or without linguistic support, to remind the learner of the initial concept being learned. In this case, the pedagogical gestures function as an environmental constraint, used to scaffold the music learning process.

TOUCH

Next to action demonstration, physical modeling and pedagogical gestures, "haptic feedback" (Bremmer, 2015), "tactile modeling" (Metz, 1989) and "touch" (Zorzal and Lorenzo, 2019) all are similar "embodied" teaching strategies of literally manipulating the learner's body, used to direct their attention to a new movement, a different posture, unnecessary tension in the body, or to achieve certain intended sound qualities (Bremmer, 2015; Simones et al., 2015; Abrahamson and Sánchez-García, 2016; Simones, 2017; Zorzal and Lorenzo, 2019). In general, teachers' touch goes through their hands, and it might be continuous (e.g., lasting for a few seconds) or discrete (Zorzal and Lorenzo, 2019).

Although scarce (McHugh-Grifa, 2011; Bremmer, 2015), empirical research studies in instrumental music education are starting to explore how a music teacher's touch is applied as a task constraint during the process of learning technical skills. For instance, Zorzal and Lorenzo (2019) found that in guitar master classes touch was significantly related to teaching and guitar performance topics. Teachers tended to apply touch to call the learner's attention to technical, muscular, postural issues, or to the size and shape of their fingernails. Furthermore, teachers preferred to bring technical problems to the learners attention by touching their body. Also, in an exploratory case study, Simones et al. (2015) found that piano teachers guided and supported learners in a Pre-grade 1 and Grade 1 group through touch: while touching learners' hands, they played piano with their learners' hands.

From a constraint-led perspective, touch is not applied to prescribe rote physical actions, but to provide learners with a "felt-difference" which they can use to adjust their motor-actions (Abrahamson and Sánchez-García, 2016), thereby potentially changing their future performances of singing or playing (Abrahamson et al., 2016). When learners are taken through specific motions through touch, they attend to relevant information, adjust their movements, and, in this way start to develop effective, new musical actions (Abrahamson et al., 2016). Touch, however, is not only applied to direct the learner's attention to the body, but it also allows teachers to receive haptic information about the learner's body (e.g., to feel the degree of tension in a body). This haptic information informs and enables a teacher to simultaneously guide, monitor, assess and adapt their touch to the needs of the learner (Weddle and Hollan, 2010; Bremmer, 2015). Although a music teacher can employ touch as a task constraint, in the end it will be the learner who must discover a solution. Lastly, even though touch might be an effective task constraint, learners tend to be highly sensitive to being touched and the success of its application depends on music teachers' understanding of the (ethical) limits of physical contact with their learners as a pedagogical approach (McHugh-Grifa, 2011; Zorzal and Lorenzo, 2019).

CONCLUSION

In this article, we presented a preliminary concept of the role of the music teacher's body in instrumental and vocal education from a dynamical systems perspective. As music teachers' bodies tend to adapt to the needs of the learner and thereby flexibly switch between modeling, guiding and assessing the learning process to match the learners needs, their physical engagement has a pedagogical significance for learners. As such, music teaching and learning consists of an interactive experience in which both teacher and learner construct meaning through physical, verbal and musical behaviors (Simones, 2017). Thus, the instrumental and vocal teaching and learning process can be viewed as an emergent and dynamic phenomenon, resulting from the interactions between learners and the learning environment, including the music teachers: anything that happens at some point in time during the music lesson in the learner, will affect something in the activity of the music teacher and vice versa (Steenbeek and Van Geert, 2013).

Furthermore, we believe that the body of the music teacher can act both as an environmental and as a task constraint: through physical modeling and action demonstration teachers can scaffold the learner's music learning process; pedagogical gestures can function as visual representations providing additional musical, expressive and technical information, but can also act as an attentional anchor, channeling the learners attention; and touch can provide learners with a "felt-difference" which they can use to develop a more effective musical behavior. The musical, expressive and technical information provided by the music teacher's body has the ability to facilitate learners in searching and exploring solutions and aid them to become perceptually attuned to relevant music information (Abrahamson and Sánchez-García, 2016). Through their physicality, teachers can become a strong mediating factor, as they bridge an abstract and sonic

realm to a concrete and physical world for learners, thereby creating a multimodal learning environment that gives learners access to a shared meaning of music making (Bremmer, 2015).

Even though research is starting to point toward the importance of the music teacher's body in instrumental and vocal education, questions still remain about a bodily-based pedagogy. For instance, in this article, we presented what a bodily-based pedagogy ideally could involve. However, research studies are only just starting to investigate whether or not a bodily-based pedagogy is more effective for teaching certain musical concepts and skills in comparison to language. This kind of information is relevant to know when music teachers consciously want to design-in constraints for their learners through the use of their body. Furthermore, current research into a bodily-based pedagogy strongly focuses on the technical aspects of learning to sing and play - leaving questions about the role of the music teacher's body in learning expressive aspects of performing music aside. Also, how does a teacher channel emotions so that the learner does not become overwhelmed by a task? When learners try something beyond what they know, this could heighten their emotional stress, perhaps hindering their learning process. Although Swaine (2014) suggests that through physical co-regulation with a teacher, emotional responses of learners can be regulated in ways that it enhances rather than diminishes their attentional capacity, little research has yet been done in instrumental and vocal education to explore this topic. More research into the role of the music's teacher body in instrumental and vocal education, holds the possibility to challenge, expand and refine the preliminary concept we have presented here.

Finally, we believe that a dynamic systems theory perspective on the music teacher's bodily involvement in teaching and learning could encourage music teachers and preservice music teachers to reflect on the use of their bodies as environmental and task constraints in the music learning process. Alibali and Nathan (2011) note that in teacher education an emphasis is found on a language-based pedagogy. However, by giving insight in the way the teacher's bodily engagement can provide constraints for learners, a discussion can be initiated on how the instrumental and vocal teachers' verbalizations and body-based constraints can work together to implement effective teaching, learning and assessing strategies regarding instrumental and vocal education.

AUTHOR CONTRIBUTIONS

MB from the perspective of the teacher's role in vocal, instrumental music learning, and took the lead in writing. LN from the perspective of instrumental music learning, complemented, and discussed and revised it. Both authors contributed to the content of the manuscript.

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