Chapter 12

Towards a theory of proprioception as a bodily basis for consciousness in music

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Musical consciousness is a difficult concept to define for a number of reasons. Not only is music a very broad and inclusive term comprising different activities (playing an instrument, listening to performances and recordings, composing, remembering music), but consciousness also presents different levels of awareness. When music is ongoing, consciousness can be defined as the ability to be aware of its elements: melody, rhythm, instrumentation, structure. However, musical consciousness also involves other aspects, such as the ability to evoke images, emotions, and memories—attributes that are closely related to the self.

Classical consciousness studies have proposed two different types of consciousness. According to Edelman, *primary consciousness* refers to 'the state of being mentally aware of things in the world', whereas *higher-order consciousness* includes the 'recognition by a thinking subject of his or her own acts and affections' (Edelman 1989: 112). Higher-order consciousness requires not only the engagement of the body, but also the language and social interaction needed to form a concept of the self. This self-concept entails meta-consciousness rather than just an awareness of the world. From this perspective, primary consciousness takes place in the perception of sensory stimuli while higher-order consciousness is concerned with the perception of the self.

This chapter aims to highlight the importance of the body as a basis for consciousness, and is in three sections. The first addresses primary consciousness as a source of awareness in the perception of ongoing musical material in which the body is involved. The second focuses on higher-order consciousness—our capacity to become self-conscious. It can be argued that both types of consciousness, traditionally studied separately, can be considered as belonging to a continuum, as stated by Merleau-Ponty: 'all thought of something is at the same time self-consciousness' (Merleau-Ponty 1962: 371). Based on this idea of a continuum, it will also be argued that primary and higher-order consciousness are both built on bodily input (Edelman 1989, cited in Wider 1997: 140) and that the feeling of that body is possible through proprioception. The third section will use ideas from O'Regan and Noë's sensorimotor contingency theory (2001a, 2001b) to offer an explanation of how musical consciousness takes place.

Primary consciousness

Primary consciousness involves being aware of the world—being aware of perceptual events such as sounds, colours, odours, etc. Primary musical consciousness implies being aware of music's ongoing elements: instruments, themes, modulations, harmonic progressions, cadences, variations, etc. We are aware of these elements because we have a body engaged in perception which allows us to explore musical stimuli. In order to study primary consciousness in music, we will examine ideas from Mark Johnson's embodied mind theory (1987: xv) in which he suggests that we use bodily metaphors to understand abstract domains.[1] Within this embodied-mind paradigm, the body is considered to play a central role in cognition and perception.

Many common statements about music show evidence of a physical metaphorical understanding at work, such as that 'dissonances produce tension'; 'the tonic restores calm'; a person singing is 'out of tune'; pitches are 'high' or 'low'; an anacrusis is 'suspended'; or chords 'push forward to the cadence'. Although Johnson's theory has its origin in linguistics (Lakoff and Johnson 1980; Kittay 1987), it has subsequently been applied to a number of different disciplines including mathematics (Lakoff and Núñez 2000) and politics (Dirven 1994; Lakoff 1996; Schön 1979)). It has also been used in relation to music by a number of scholars (Brower 2000; Cox 1999, 2001; Echard 1999, 2006; Feld 1981; Marconi 2001; Martínez 2004; Saslaw 1996; Spitzer 2004; Zbikowski 1997), since it provides conceptual tools, called 'image schemata', that can be fruitfully applied to musical events.

Johnson argues that we understand abstract domains—such as psychology, mathematics, economics, and music—in terms of more concrete and better known domains—our body feelings and experiences. Newborn infants' first relationships with the world are sensorimotor (Piaget [1926] 1973). Manipulation and movement allow them to build up what Johnson calls 'image schemata', and these schemata help them to understand abstract domains. An image schema is a 'recurring, dynamic pattern of our perceptual interactions and motor programs that gives coherence and structure to our experience' (Johnson 1987: xiv). Image schemata can convey up–down, balance, front–back, full–empty experiences that can in turn be used in abstract thinking through metaphor. Metaphors function by 'mak[ing] use of patterns that obtain in our physical experience to organize our more abstract understanding' (Johnson 1987: xv), allowing us to comprehend the world in terms of what we already know. For instance, the up–down schema is projected metaphorically onto an understanding of price changes (prices are rising); near–far can be used to understand an emotional relationship with a friend (he is a close friend); and the path metaphor allows us to see life as a journey (I have to keep to, or change my course). Although image schemata are created from many different bodily activities, they share an idiosyncratic internal structure, which is an abstraction of the core of the experiences themselves. Riding a bike, skating, and watching a see-saw in motion all share certain features that go into the formation of the balance schema while abstracting from the particularities of each specific activity, and the schema itself has an internal structure based on the compensating actions of gravity and other forces.

In music, for instance, the cycle schema helps us to understand recapitulation in a sonata, or the cycle of fifths (Brower 2000: 343); and Saslaw (1996: 222–3) shows how path and container metaphors are projected in the understanding of a cadence, how near–far and path have a role in conceptualizing the proximity of harmonies, and how major and minor chords can be understood in terms of balance (a major third being considered an inversion of a minor third). As noted by Zbikowski, the verticality schema is the result of experiences such as 'perceiving a tree, our felt sense of standing upright, the activity of climbing stairs' (1997: 202), and is used to conceptualize pitch relationships in music. Balance plays a role in understanding the attraction of the tonic and the movement to other degrees, and path in understanding the arrival of the dominant (Echard 1999: 140). As these examples illustrate, understanding music in terms of image schemata contributes significantly to our awareness of the role and function of musical elements.

Although Johnson claims that we make metaphorical projections between image schemata and abstract domains, he does not explain how it is possible for us to choose or use these metaphors. In order to project a schema, we must identify certain significant features of the target domain that will enable us to select the right schema. Thus, it seems necessary to set up some sort of connection facilitator mechanism. In the case of music, one of a number of specific questions might be: How do we establish the connection between the up–down schema and musical pitch? Among other possible explanations,[2] Arnie Cox (2001) proposes the 'mimetic hypothesis', in which he stresses that we conceptualize musical sounds through activities that we are able to perform ourselves. Musical sounds are understood as vocal sounds: *cantabile* as singing, *sotto voce* as whispering, jazz trumpets as screaming, and recitative as speaking. We can also mimic the actions of a performer: a violin sound can evoke the motor imitation of the gestures needed to perform it. Cox makes reference to evidence from the field of cognitive neuroscience, and in particular to the role of mirror neurons. Discovered by Rizzolatti,[3] mirror neurons were originally found in the ventral premotor cortex of macaque monkeys. They become activated not only when a monkey executes an action, but also when it sees the same action performed by others (Rizzolatti *et al*. 1996, 2000). Mirror neurons 'allow us to directly understand the meaning of actions . . . of others by internally replicating ("simulating") them' (Gallese *et al*. 2004: 396). Within the field of linguistics, the motor theory of speech perception (Liberman and Mattingly 1985) had already suggested the presence of common cognitive representations underlying both speech production and perception, while Molnar-Szakacs and Overy (2006) consider that mirror neurons must be involved in this process. In music, Haueisen and Knösche (2001) showed that pianists exhibited covert (involuntary) contralateral primary motor cortical activity while listening to pieces in which they were well trained; and Lahav *et al*. (2007) showed that non-musicians can show activation in motor areas of the brain when they listen to previously learned melodies.

The common underlying idea, supported by mirror neuron research and Cox's mimetic hypothesis, highlights the role of bodily feeling in image-schematic understanding in music. The proposal is that, although we may not actually move while listening to music, we mimic internally the actions of the performers (fingering, breathing, balancing, etc.)—this imitation being more accurate in trained musicians. Furthermore, other kinds of simulation may also occur when we identify image schemata, since internal action simulation is more abstract than the concrete actions of the performers. So, in the case of the metaphoric projection of image schemata, simulation of physical actions or feelings is considerably more subtle—for example, when we simulate a vertical displacement in the melody, or the effect of gravity on the strong and weak beat, or tension and release in the resolution from dominant to tonic.

Despite the fact that when we listen to a piece of music we may have the impression of perceiving everything, perception is selective; the simultaneous perception of all attributes of a piece of music is impossible. One reason for this is that the musical events that we metaphorize through image schemata emerge into consciousness and become the dominant ones, conditioning us to miss many other features that are less pertinent in the specific context. In his ecological approach to perception, James Gibson (1979: 141) explains the ability to perceive the world in terms of the relationship between action and perception.[4] He asserts that actions determine the environmental features on which we focus, thus facilitating perception; and he underlines the idea that what we perceive when we look at objects are their *affordances*, not their qualities. When we hear a sound we do not perceive the pitch, the timbre, and the duration as independent properties of the sound, but rather we perceive a glass breaking, a baby crying, or the wind blowing. Affordances are the opportunities for action that an object or event in an environment presents to a perceiver, and they determine the way that he or she perceives that object or event.

Listening to music affords mimicking the performer's gestures and simulating a wide range of physical feelings derived from the projection of image schemata: going up and down with melodies, travelling along a path with themes, and so on. Bodily actions (internal simulations) filter the stimuli that give rise to our perceptions, and those actions cause us to perceive certain aspects of reality and to overlook others. In doing so, we become conscious of music as a result of being aware of the simulated actions we perform when exploring musical features.

Higher-order consciousness

According to Edelman, higher-order consciousness includes the 'recognition by a thinking subject of his own actions and affections'(1989: 112), but in the formulation proposed by Bermúdez (1995: 153), it involves additional layers such as the capacity 'to think of one's body as one's own; to recognize oneself as the bearer for mental states; to master the grammar of the first-person pronoun; to view oneself as one object in the world among others, or as one person in the world among others; to have memories about one's past self; to construct autobiographical narratives; to formulate long-term plans and ambitions'. As already stated, primary and higher-order consciousnesses, although studied separately, belong to a single continuum. Higher-order consciousness refers to self-awareness, but the perception of stimuli in the environment also requires the perception of the self. The subject's actions filter the stimuli that engage our perception, and also provide fundamental information about the perceiver's position in space, and movement. In observing a bird in the sky, information from receptors in our neck complements the visual information and informs us about the exact relative location of the bird. As Gibson argues, perceiving external stimuli entails a reciprocal relationship with the perceiver's own actions—and in that sense involves perception of the self: 'the optical information to specify the self, including the head, body, arms and hands, accompanies the optical information to specify the environment' (Gibson 1979: 116). As a result 'awareness of the persisting and changing environment (perception) is concurrent with the persisting and changing self (proprioception in my extended use of the term)' (Gibson 1987: 418).[5] Wider also considers consciousness and the sense of ourselves to 'require the processing of bodily data' (1997: 143), and Edelman (1989) argues that 'without external stimuli and proprioceptive input, primary consciousness could not arise' (cited in Wider 1997: 144). Both primary and higher-order consciousnesses therefore seem to be based on bodily awareness. Since primary consciousness deals with the perception of things in the world, proprioception is needed in that process, since 'all perceptual systems are propriosensitive as well as exterosensitive' (Gibson 1979: 115).

Proprioception provides us with information about the state of our own bodies and allows us to adapt our actions to sensory information. It works both consciously and subconsciously: subconsciously, it adjusts muscles and joints for global motion, and in a conscious way it allows access to awareness of a particular part of the body at any time. The term 'proprioception' was coined within neurophysiology by Charles Sherrington (1906) who proposed it to refer to the information we obtain from our own bodies.[6] Proprioception gathers information about pressure and temperature from the skin receptors, the relative state of the body segments, balance and posture, skin-stretch, fatigue, and effort as well as information from internal organs (Eilan *et al.* 1995: 12). Proprioceptors are mechanoreceptors of various types, which carry various kinds of information depending on their location: muscle spindles and Golgi tendon organs are sensitive to variations of muscular strength (Kandel *et al.* 2000: 723); Pacinian corpuscles, located in deep layers of the joint capsule, detect the pressure and weight of body segments; and Ruffini corpuscles, situated in the individual joint ligaments, also convey information about muscle strength (López Muñiz 2004: 55). The vestibular apparatus, located in the inner ear, is sensitive to head movements (Escudero 1998; Kahle 1997; Sobotta and Becher 1994).[7]

Let us imagine our proprioceptive consciousness when playing a musical instrument. Actions are monitored by proprioception, so that when playing the piano, we regulate the position of the arms, hands, and fingers by proprioception, and control movements of the torso and head. When we move even a small muscle, the entire body compensates for this movement through proprioception, maintaining balance and stability. In executing actions, our attention is usually diverted away from the body, although we may remain conscious of it. This idea can be explained in terms of what Gallagher calls the *body schema* (1995: 235), which constitutes the capacity of the body to adapt to the environment. When we move, our proprioceptive system, through the body schema, works in real time to allow the body to adjust to its own movements. Although we are not aware of every detail of our body, the body schema provides a holistic representation of the body, providing a feeling of belonging: we do not doubt who it is that is moving, and that the body is ours. This feeling of belonging, and the perception of the whole body, enables us to be conscious of ourselves as integrated entities.

Supplementing the body schema concept is what Gallagher calls the *body image*, which refers to 'the subject's perceptual experience of his body, the subject's conceptual understanding of the body, and the subject's emotional attitude towards his/her own body' (1995: 228). In a more explicit manner, it allows us to focus on certain movements or postures of our bodies, and is intentional. Beginner musicians need to consciously control the position and movements of their bodies (Legrand 2007: 501) whereas experts do not. However, experts need what Gallagher calls 'performative awareness' of the body even while not paying attention to specific parts (2005: 74). When one plays the flute, for instance, specific goal-oriented gestures are performed: flautists control their breathing, tongue articulation, and fingering, controlling timbre and pitch with air pressure and blowing angle. Although they might not be *continuously* aware of all of these movements, they will have access, if they need it, to an awareness of these gestures. As stated by Gallagher and Zahavi (2010, 'Although I may not be aware of certain details about my bodily performance, this does not mean however that I am unconscious of my body'. Flautists typically also make a variety of gestures that are not directly oriented to the production of the sound, such as flexing their knees, moving the flute up and down, twisting their torso, balancing, swinging their weight from one foot to the other, etc. Some of these become deliberate at certain times, but most remain below the level of conscious awareness. Most of the gestures of a skilled performer are below conscious awareness in detail, but within awareness globally, as they 'mov[e] in a way that *feels right*' (Cole and Montero 2007: 303).

When a flautist plays, it is not only perceptual aspects of the body (the knowledge of fingering, phrasing, balancing, weight change, or pressure) that constitute higher-order consciousness, but also stored emotional attitudes towards the piece, his relationship with the instrument, his idea of what it is like to play the flute in front of other people, as well as his bodily feelings in both difficult and easy passages. There are certain movements that are typical of most flautists, and other gestures that are characteristic of the specific musical style, or of the specific performer. All of these, as well as specific bodily feelings (for example, the flautist's attention to one hand, or the shape of the embouchure) contribute to self-consciousness within music performance. With proprioception as a basis, we recognize that our feelings, movements, thoughts, and beliefs are indeed our own. On the one hand, performers will have a feeling of integrated belonging (schema-based), and on the other hand they will have access to awareness of specific aspects of the body or the music as required (image-based).

The process of consciousness

Although primary and higher-order consciousness have classically been studied as separate, I have argued that they are closely related to each other: on the one hand, higher-order consciousness requires knowledge of the world in order to create an idea of the self; and on the other, in primary consciousness, the perception of the body is also involved in the perception of the world. Although Gibson suggested that perceptual information is also proprioceptive, he did not develop this idea in any depth, but rather introduced the concept of affordance to understand the actions that subjects can perform with objects, in turn determining and determined by the way subjects perceive those objects.

By contrast, O'Regan and Noë (2001a, 2001b) have developed what they call the 'sensorimotor contingency theory' (SCT) as a basis on which to understand how the subject actively explores the environment, and how attributes of the environment attract the subject's attention. SCT was developed in relation to vision as a way to explain consciousness in perceptual experience.[8] O'Regan and Noë pointed out that perceiving 'is not "generated" by a neural mechanism . . ., rather, it is exercising what the neural mechanism allows the organism to do. It is exercising a skill that the organism has mastery of' (O'Regan *et al.* 2004: 104). SCT stresses that when we move while perceiving, a sensorial change in the visual scene is produced by our movements, and experiments provide empirical evidence that eye movements have a role even in colour perception (; Bompas and O'Regan 2005, 2006; O'Regan *et al.* 2001). The theory asserts that visual perception is effective when the following conditions occur: (i) there must be eye movements (or the knowledge of how these movements will influence the stimuli) resulting in changes in the input sensory information; and (ii) the brain must be able to process that information and relate it to the position of the eyes in real time. Extrapolating to tactile perception, when we touch a sponge, we feel its softness by virtue of the movement of our hand as it grasps it, and the feeling that the sponge easily changes its shape. SCT asserts that perceptual knowledge of the world is mediated by knowledge of these sensorimotor contingencies (O'Regan and Noë 2001a: 940), which are laws governing the relationships between sensory changes and motor actions. These laws coordinate our movements and the changes these movements produce in the sensory input. O'Regan and Noë point out that there are distinct forms of physical exploration for each sensory modality: 'Hearing involves a different quality compared to seeing which has a different quality compared to tactile sensation' (O'Regan *et al.* 2004: 109).

Although SCT has been challenged as a way to explain consciousness (Clark 2006), it provides two interesting concepts that have a potential application for music. These concepts are *bodiliness* and *grabbiness*, also called corporality and alerting capacity. Bodiliness is the 'fact that when you move your body, incoming sensory information immediately changes' (O'Regan *et al.* 2004: 106)—a movement of your eyes towards a red surface, for example, changing the incoming light and brightness. As O'Regan *et al.* (2004: 106) put it: 'bodiliness is one aspect of sensory stimulation which makes it different form other forms of stimulation, and contributes to giving it its particular quality.' If an observer is looking at an object and walks towards it, it will expand in his visual field as he approaches. However, the visual image could also undergo the same expansion if the object itself gets closer to the still observer. Here, bodiliness informs the observer whether he is moving or not, disambiguating the two perceptual possibilities. Grabbiness, on the contrary, is 'the fact that sensory stimulation can grab your attention away from what you were previously doing' (O'Regan *et al.* 2004: 106): if while we are looking at a black screen a bright light suddenly appears on the right side of the screen, we will direct our head and eyes towards the light source.

SCT was originally developed in relation to vision, and evidence has been found of the importance of eye movements in visual perception. However, O'Regan and Noë do not claim that 'action is necessary for experiencing'. Their claim, rather, 'is that knowledge of the ways movements affect sensory stimulation is necessary for experience' (O'Regan and Noë 2001a: 1055). Within auditory perception, physical movements are not so obviously required, although some of them, such as rotations of the head, change the perception of location, and movements of the head in the direction of the sound source affect amplitude (O'Regan and Noë 2001a: 941). However, while listening to music, we 'do' things internally most of the time. Rizzolatti claims that mirror neurons are activated not only upon performing any goal-oriented action, but also when subjects observe other people's movements or listen to the sounds of such actions. It is for that reason that we can consider movement in music to be not only actual, but also virtual—as proposed by Clarke (2005:199).

Bodiliness and grabbiness are of particular importance because, as explanatory tools, they cater for some unexplored issues in Gibson's theory. Gibson states that we perceive objects in our environment according to what we can do with them (affordances). Depending on these affordances, we perceive certain features of objects rather than others. SCT proposes that we perceive objects in the world because we move towards them (grabbiness) as the environment guides our perceptual system provoking automatic orientation reactions;[9] and that we move differently when exploring different things (bodiliness). These two concepts constitute interrelated sides of the perceptual process: the movements that cause changes in the sensory input alternate with the abrupt changes in environmental stimuli that make our bodies move towards them. Perception and the body form an indissoluble whole.

Turning now to music, during listening our perception roams around different aspects of the material, exploring melodies, instruments, chords, structure, and style; and we are aware of that exploration through bodiliness. Referring back to Johnson's image schemata, we realize that we are experiencing melodies because we are singing virtually with the orchestra; we will know that we are exploring silence because we stop moving (internally) with the music; we will know that we are experiencing a *crescendo* because of increasing tension in the muscles; and we will experience rhythm because of the way that it allows us to synchronize our movements (virtual or actual) with the beat. This constitutes bodiliness: the bodily feeling in one's explorations, related to the sensory input. Grabbiness, by contrast, captures the idea that the environment guides the subject in perception. Certain features in music are more likely to draw our attention—to make us move internally—than other stimuli,[10] although this process may be different for each person. A fugue allows a listener to follow the main theme (subject) when it sounds successively in each voice, by virtue of its imitative relationships. In an orchestral piece, a listener might be more likely to be 'grabbed' by timbre, as in the case of *Klangfarbenmelodie* (tone-colour-melody), the term that Arnold Schonberg gave to the technique of distributing a musical line around several instruments. And sonata form might cause listeners to concentrate on structure, identifying the development when the main musical material starts moving to other keys, and recapitulation when familiar material returns in the tonic. Or we may be 'grabbed' by the unexpected change from minor to major in a *tierce de Picardie*.

Bodiliness and grabbiness are closely related to each other. When a certain pattern in music grabs our attention, we will move according to that pattern. Similarly, if we move internally to explore a stimulus, and sound and movement are correlated, then we will be able to perceive it. For example, the phenomenon known as pseudo-polyphony, found among other places in J.S. Bach's solo violin and cello music, consists of the creation of two or more concurrent contrapuntal lines (or streams) using a sequence of single-sounding tones, produced by the rapid alternation of pitches separated by relatively large musical intervals (see Pandey 2005: 549). According to bodiliness, when we listen to one of these passages we are unable to sing along to the literal succession of pitches, because of its speed and pattern of intervals. As a result, we tend to 'sing' (internally, virtually) a melody consisting of either the higher, or the lower, pitches. The fact that we sing only certain pitches (a factor of bodiliness) makes us perceive the high pitches as belonging to a single line, even though they are interleaved with lower pitches. High pitches may also constitute grabbers since their salience (grabbiness) makes us focus our attention on them when they appear.

Musical grabbiness and bodiliness can also be facilitated or encouraged. When music students have to learn about the structure of a piece, teachers often use techniques that help them to hear and understand the structure. For example, a dance may allow the students to feel in bodily terms certain parts of the piece (bodiliness is induced). Alternatively, various kinds of graphic representation can help to draw attention to different aspects of the music that the students should listen to during the piece: instruments, phrases, rests, repetitions, etc. As defined by Boal and Wuytack, 'the musicogram is a graphic notation of the music, a visual representation of the dynamic development of a musical work. In the musicogram, conventional music notation is replaced by a symbolic system that is more simple and accessible to non-musicians, and which is intended to help the perception of the total structure of a work' (2006: 1266). Musicograms work as grabbers when listeners have not yet developed the necessary bodiliness for listening to structure in music.

Conclusions

Throughout this chapter I have argued that consciousness is based on the body. Primary consciousness in music, which can be characterized as the awareness of musical material, also depends on proprioceptive information, leading back to bodily awareness. In order to perceive musical events we make use of image schemata as a way to understand more abstract musical attributes: if we understand the pitch structure of a melody in terms of verticality, we simulate this internally by moving up and down in a virtual space, and can become aware of this simulation. Proprioception by means of the body image allows us to focus on specific movements, even if they are internal and never externally manifest. Similarly, higher-order consciousness depends on the ability of humans to be aware of themselves. Body image allows us to be aware of goal-oriented movements while, on the other hand, body schema, with its role in body motion control, provides us with information about the body as a whole, and a body that we perceive as ours. While emotions and concepts are implicated in the creation of self-awareness, proprioception is a key agent in this process: it constitutes the basis on which to determine that the experience of listening or playing is subjective in the sense of being acquired through the self.

Not only is the awareness of environmental stimuli intertwined with the awareness of one's own body—an idea already presented by Gibson—but also both the body and sensory stimuli belong to a feedback continuum in which they depend on each other—as proposed by SCT. Human beings, within the process of perception, switch constantly from bodiliness to grabbiness. Bodiliness implies awareness of our own body—observing how it has an influence on the perception of stimuli—whereas grabbiness relates to the capacity of environmental stimuli to attract our attention—in relation to the bodily responses in us that they elicit. In this perceptual interplay, bodiliness and bodily awareness prove to be fundamental in our sensitivity to the characteristics of perceived stimuli. When a person listens to music, a number of its aspects may produce bodily responses, both overt and covert. Depending on the type of activity or sensation elicited, various features appear in consciousness, such as rhythm, melody, form, instrumentation, tempo, harmony, tonality, and ornamentation. The internal singing of a melody implies a sort of concealed activity rather different from following the pulse or anticipating the *accelerando* and *ritardando* in a musical piece. When a person listens to music, only certain aspects of the material reach consciousness. On the one hand, a listener's body performs virtual actions leading to the perception of particular features; and on the other hand, the awareness of those internal actions helps to achieve an understanding of the nature of the elements explored. Critically, action in music is not random, but is guided by music itself, though a variety of factors makes it more likely for some musical actions to predominate, these factors including the listener's background, experiences, knowledge, context, emotional state, and training. Similarly, the music itself has the capacity to draw the listener's attention, and in this way the concepts of grabbiness and bodiliness allow us to explain how certain features in music make themselves evident to us, while others remain hidden from our consciousness. This was something that Renaissance polyphonists understood very well when they placed the 'grabby' tritone, the so-called *diabolus in musica*, in the middle voices—hidden in order not to be heard.

The constant interchange between bodiliness and grabbiness provides one way to understand individual differences in the experience of music listening. Both bodiliness and grabbiness require a feeling of matching movement and music. Despite the fact that certain pieces of music themselves contain grabbers, at a certain moment a listener may not experience any automatic orientation response. Moreover, although a listener performs internal actions in order to understand what he is hearing, this may have no effect on auditory perception. O'Regan and Noë (2001a: 1012) explain how our movements will affect the vision of an object close to us, but will not affect other objects in next room. People strongly habituated to one particular listening perspective, such as Western classical music, may apply it to significantly different types of music—for example looking for bar structures within Indian classical music, resulting in difficulty in understanding *tāls*. Indian classical music uses a combination of additive and divisive rhythms,[11] by contrast with the exclusively divisive rhythms of Western classical music. For listeners unfamiliar with Indian music, there may be a significant reduction in the music's bodiliness nor grabbiness, or a bodiliness or grabbiness that does not correspond to the regularities of the musical material: the internal actions they perform do not have an impact on the stimulus (no bodiliness), or the musically relevant characteristics do not attract their perceptual attention (no grabbiness). There is a failure of what Varela (1988: 109) calls a 'structural coupling' between the music and the listener's actions.

Consciousness can be different depending on the subject's personal context, type of activity, and the nature of the phenomenon. The subject's mood, preferences and circumstances affect this feedback process, and that is why listening to a piece of music is not always the same. Moreover, music is experienced through many different activities: playing an instrument, dancing, conducting an orchestra, as well as listening, and the relationship between bodiliness and grabbiness varies depending on the type of activity. Consciousness also takes different forms in listening to a piece of music as opposed to remembering or imagining it. Listening to a live symphony orchestra implies a kind of bodiliness very different from recalling Beethoven's Fifth Symphony, or conducting it. Although it may be true that a conductor has a better knowledge of the piece (including the form, harmony, timbre, phrase structure, and instrumental interplay), a listener might be thought to be more conscious of the music because she does not have to divide her attention between the music itself and directing the orchestra. And, however well we may know a piece, remembering it will have a very different phenomenal character from hearing it. In memory, the awareness we have of it remains global, until we start to reproduce the piece in our heads. This sort of global consciousness contains little bodiliness or grabbiness, by comparison with the equivalent phenomena as triggered by a live performance in a concert hall. In the latter case, music leads us to internal motion simulation, and exploration through motion grants us the perception of aspects of music that otherwise would go unnoticed: composing, remembering, analysing, and writing about music are necessarily associated with different kinds of musical consciousness.

Bodiliness is a source of perceptual information linked to the subject's own exploration and consciousness of the musical elements, but in live musical situations the subject's own bodiliness overlaps with those of others. At times, the musicians' gestures and audience reactions work as grabbers in a way that may provoke orientation responses in us, as when people look at certain instruments, or sing along with the vocalist, or clap in synchrony with the rhythm. All such actions have the capacity to make us perceive a particular timbre, focus on a melody or be aware of a beat. The gestures of a conductor towards a certain orchestral section or musician, their baton movements, and the gestures of the performers can also become silent grabbers of musical perception, and initiate automatic orientation responses that make us anticipate or focus our listening. Here, other people's bodiliness becomes grabbiness for us, to form an indissoluble unity that also contributes to our musical consciousness.

Musical consciousness is a complex phenomenon to study, due to the abundance of social, emotional, biological and cultural aspects involved. Nonetheless, I have argued that listening, comprising either the awareness of successive elements in a new piece of music or the more global consciousness that arises in relation to a known piece of music, is strongly influenced by the role and consciousness of our own bodies. Considered as the foundation of perception, our bodies enable us to explore the nature (rhythmic, melodic, structural, harmonic, etc.) of what we perceive, and also provide us with an experience particular to ourselves—the feeling that the musical phenomena we experience through composition, listening, imagination, or memory contain that character or property of being experienced by the self.

Acknowledgement

I would like to thank Rachel and Robert Antony, John Bachenski, and José A. Rey for their time and effort in assisting with the English.

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Notes

1. For a review of Johnson's embodied mind theory see Peñalba (2005).
2. Zbikowski (1997) states that there are invariant principles between the schemata and the music. Feld points out that schemata and music events must have some connotative or denotative similar features. Marconi (2001), whose approach is very close to Cox's, argues that the metaphorization process is possible through physiognomic perceptions that relate music to schemata.
3. Mirror neurons have also been studied by, among others Gallese (1998, 2001, 2003; Gallese and Goldman 1998; Gallese *et al.* 1999); Decety *et al.* (1997); Fadiga *et al.* (1995); Grafton *et al.* (1996); Rizzolatti *et al.* (1996).
4. A number of authors have applied Gibson´s theory to music (Clarke 2005; Giordano 2005; McAdams *et al.* 2004; Oliveira and Oliveira 2002; Windsor 1995, 2004 Clarke 2005).
5. Proprioceptive information assembles all the information about the body.
6. See Peñalba (2008) for a discussion of the role of proprioception in music performance.

7. The labyrinth is sometimes excluded from proprioceptive receptors, but since it provides information about the self, Eilan considers it to be proprioceptive (Eilan *et al.* 1995: 13).
8. For an application of some ideas from O´Regan and Noë's sensorimotor contingency theory see Peñalba (2006).
9. Gibson also proposes the term *invariants* to refer to the inherent properties of objects. These properties limit the possible affordances for subjects. The concept of grabbiness is rather different since it guides the subject's actions under certain conditions.
10. It may be that grabbiness also incorporates an expectation component, relating to the role of anticipation in music listening (see Huron 2006).
11. In divisive rhythms, larger units are divided into smaller rhythmic units.