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Rethinking Musical Affordances

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Abstract

The notion of affordance has been introduced by Gibson (1977, 1979) as the feature of an object or the environment that allows the observer to perform an action, a set of "environmental supports for an organism's intentional activities" (Reybrouck 2005). Studied under very different perspectives, this concept has become a crucial issue not only for the ecological psychology, but also for cognitive sciences, artificial intelligence studies, and philosophy of mind. This variety of approaches has widened the already ambiguous definition originally provided by Gibson, contributing to the development of different standpoints in open contrast with each other (see Zipoli Caiani 2011). During the last two decades, moreover, many researchers tried to extend the notion also to musical experience, aiming to draw a coherent theory of musical affordances (e.g. Clarke 2005; Nussbaum 2007; Krueger 2011a; 2011b). In this paper, we will argue for a particular concept of musical affordances, that is, as we see it, one narrower and less ambiguous in scope and more closely related to its original. Taking the discovery of canonical neurons as our starting point, we will (i) introduce the general notion of affordance, (ii) discuss some significant contributions in this area of research, mostly focusing on *musical affordances* and (iii) propose a motor-based interpretation of musical affordances.

Keywords: musical affordances; canonical neurons; motor intentionality; musical understanding; embodied music cognition.

Visual-motor affordances and the power of action

In the context of motor action research, there is a common agreement[52] regarding a basic understanding of the notion of *affordance*, usually intended in terms of a set of possible motor actions evoked by the intrinsic properties of an object or the environment. According to Gibson (1979), indeed, the visual perception of an object leads to an *automatic selection* of those of its intrinsic properties that support the individual's physical interactions with it. These properties, however, are not only abstract, physical or geometrical features, but „incarnate the practical opportunities that the object offers to the organism which perceives it" (Rizzolatti & Sinigaglia 2006: 34). When, for example, an object like a cup is located in the subject's *peripersonal space* (Costantini et al. 2011), it can represent the goal of the individual's grasping act and this subject/object interaction is codified through an *affordance*. A key role for this current understanding is played by the neuroscientific evidence of *canonical neurons* (Rizzolatti et al. 1988; Rizzolatti, Fadiga, 1998; Rizzolatti et al. 2000; Raos, et al. 2006; Umiltà et al. 2007; Rizzolatti & Sinigaglia 2008), a set of neurons which discharges when an individual simply observes an object without performing any movement, as well as when he/she grasps that object. The selectivity of these neurons, appreciable through the congruence between the codified motor features and objects' visual properties, advocates for their pivotal role in the process of transforming the visual information of objects into the appropriate motor acts (Jeannerod et al. 1995). The discovery of these "visuo-motor" neurons shows how an object can *afford*, according to the subject's motor expertise, a set of possible actions that can be performed thereon, relying on a *sub-cognitive* form of understanding, not linked to mental representation or higher mental faculties. Gallese (2009), in describing the canonical neurons, states that

> *[t]he most interesting aspect [...] is the fact that in a considerable percentage of neurons, a congruence is observed between the response during the execution of a specific type of grip, and the visual response to objects that, although differing in shape, nevertheless all "afford" the same type of grip that excites the neuron when executed [...].The intrinsic relational functional architecture of primates' motor system likely scaffold the development of more abstract and detached forms of intentionality, as those characterizing thought in our species* (Gallese 2009: 489-490).

The basis of the intentional relationship between an organism and the environment, therefore, can be reconsidered in terms of how the *motor possibilities* (Poincaré 1908; 1913) of the subject's body can interact with the surrounding objects, advocating for a *motor approach* to intentionality (Sinigaglia 2008). This form of intentionality doesn't require any high-level, metacognitive ability as "the intentional character, the 'aboutness' of the representational format of our mind could be deeply rooted in the intrinsic relational character of body action". (Gallese 2009: 489). In other terms, cognition can be seen as *embodied*, namely, it arises from the bodily interactions with the environment, depending on "the kinds of experiences that come from having a body with particular perceptual and motor capacities that are inseparably linked and that together form the matrix within which memory, emotion, language, and all other aspects of life

[52] Despite the opposition of Fodor, Pylyshyn (1988).

are meshed" (Thelen 2001: XX). However, notwithstanding the importance of this new *embodied* paradigm (see also Merleau-Ponty 1945; Varela et al. 1991; Gallese 2011), the current ecological account for *affordances* inspired by Gibson seems to be characterized by epistemological vagueness. Indeed, one of the assumptions at the basis of this perspective is that *every set of behaviours ascribable in terms of a unitary action has the right to be described as an act potentially evoked by its related affordance*. In order to clarify this statement we can think about the possible analogy[53] between these two different conditions: (i) a cup affords the act of grasping and (ii) the sight of a movie-trailer affords the act of going to the cinema. From an ecological standpoint, those actions (grasping and going to the movies) are both homogeneous and describable as unitary. But the *inferential* feature of the second one makes it unsuitable: otherwise, every *a-posteriori* correlation between events and actions should be considered *affordative*. To get an idea of the variety of phenomena included under the concept of affordance we can indeed have a look at this excerpt from E.J. Gibson (1982):

> *Air, the medium we live in, affords breathing. It affords walking or driving through, and seeing through, at least in communities that are free of smog* (Gibson 1982: 55).

This example presents some incongruences with the necessary setting of a scientific research on the notion of affordance. Even if sometimes the air is breathable, this does not imply that breathing is a *goal-directed act*, intentionally linked with the portion of air considered as an *intentional object* (Menin 2011: 12). We cannot indeed integrate every possible interaction between the two poles of action (subject and object) into a genuine reflection on the issue of affordances without applying a rough *objectivation* (see Husserl 1901; 1907; 1936), hence depriving the notion from any phenomenological characterization. The relationship between a subject and the air that the agent is breathing cannot be described as cognitive, or as constituent of any intentional relationship. It can only be described in terms of physical-chemical events[54]. But if some events do have affordances, we should investigate the *object* of these, and also the role of the relevant *subject*, considering the coding of perceptual information with regards to the *motor knowledge* of the perceiver, as the aforementioned literature on canonical neurons clearly states. In the realm of music, the concept of affordance – far from being successfully addressed yet – has been investigated during the last few years in order to clarify the subject/object relationship characterizing musical experience, with a particular emphasis on the surrounding, sound-made environment. What does music *afford*? How can a subject *make sense* of a series of sounds intended as musical? Which

[53] This example has been presented firstly in Menin 2011.

[54] With regard to this point, we claim that the original Gibsonian ambiguity needs to be explicitly overcome, if we are to develop an experimentally expendable notion of "affordance". If it is true that one of the most fascinating features of affordances resides in its being direct and someway "automatic", thus not requiring any cognitive or attentional mediation, we cannot go, on the basis of this not-needed mediation, to the extent of saying that no intentional sensorimotor relationship is required for an affordance to take place. The notion of "basic motor act" introduced in the recent literature (e.g. Rizzolatti, Sinigaglia 2008) clearly highlights goal-directedness as the central feature of sensorimotor interactions.

modalities are involved in this sense-giving process? The current body of knowledge in this area is extremely broad, and besides the obvious interest of music researchers, it does involve scholars from different backgrounds. Hence, the following section presents some of the trends in the current debate, providing incentive for further discussions as well.

Musical affordances in current literature

In this section we try to take a closer look at the notion of musical affordances, focusing on the works by Clarke (2005), Nussbaum (2007), Krueger (2011a; 2011b), and Reybrouk (2005), probably the most influential and well-known studies on this specific and problematic issue.

Ways of Listening by Eric F. Clarke (2005) aims to face the problem of musical understanding through a Gibsonian interpretation in order to overcome the interrelated dichotomies of subjects/objects, passive/active listening and autonomy/heteronomy of musical experience. However, as we try to show, the epistemological caution necessary in dealing with such a complex body of problems is not always fully addressed. The author firstly suggests that musical structure is not a construction within the mind, but, rather, something inherent in the environment, with which our auditory system would *resonate*. Secondly, Clarke describes the dynamics of these resonances, introducing the key notion of *affordance* (36) without rigorously discussing the problematic aspects implicit in the controversial Gibsonian concept. Two of the most quoted excerpts of Clarke's book help highlighting the consequences of this option, elucidating what kind of *phenomenic topography* is included in his notion of musical affordance.

> *Music affords dancing, worship, co-ordinated working, persuasion, emotional catharsis, marching, foot-tapping, and a myriad other activities of a perfectly tangible kind (Clarke 2005: 38).*
>
> *In the specific contexts of musical hermeneutics, musical material can be conceived as affording certain kinds of interpretation and not others [...]. Interpretation is also action – the speaking, writing, gesturing and grimacing in which interpretation is manifest [...]. The recapitulation of the first movement of Beethoven's Ninth Symphony affords writing (or speaking) about in terms of murderous sexual rage, or the heavens on fire. Interpretative writing and speaking are forms of action* (204).

Looking at the examples provided in the first list, allegedly belonging to the class *of perfectly tangible acts* that can be afforded by music, we can notice the same incongruities we have previously reported about Gibson's standard account: mainly, the lack of any consistency in the conceptual and phenomenological structure of the provided concept of affordance. It is indeed problematic, for instance, to assume that music is in some way the intentional object of all this variety of behaviours. Moreover, the second excerpt shows Clarke's bias to equate *percepts* and *concepts* (Nonken 2008), objectifying the class of musical acts, intended only from an *a-posteriori* point of view.

From this standpoint, there is no substantial difference between the way music affords foot-tapping and the way it affords writing pieces of musical criticism. With regard to this point, someone could argue that Clarke is not actually confusing percepts with concepts, but rather trying to unify our understanding of perceptual and cognitive aspects of musical experience. Our objection, however, remains valid. Indeed, if this holistic stance is one of Clarke's main concerns, it is quite clear that he treats this position as a claim and as a presupposition at the same time, hence giving rise to a circular argument. In conclusion, the meaning of *to afford* which emerges from Clarke's *Ways of Listening* does not exceed the colloquial concept of *to evoke*, or *to elicit*, showing that musical experience is, in a vague sense, evocative. The book's main conceptual contribution, besides its remarkable general introduction to ecological psychology and musical understanding, indeed, could be summed up as a rather direct application of a standard ecological account to the study of musical experience, broadly intended.

More ambitious is the theoretical proposal of Charles Nussbaum (2007) who actually aims to unravel the *riddle of musical experience* (2007: XI) in light of its *representational* nature. To understand the problem he is dealing with, we can first have a look at this citation:

> *It takes only a small amount of perspicacity to realize that music is remarkable, indeed an astounding, phenomenon. The emergence of human musical experience from the audition of organized tones remains deeply puzzling, truly "a riddle wrapped in a mystery inside an enigma," a riddle, moreover, of very long standing* (Nussbaum 2007: XI).

In our opinion, this statement is highly misleading, especially with regards to the set of problems involved in musical understanding. The apparently naïve implication that musical experience builds up from the auditory perception of analytically isolable basic elements is not only unwarranted, but it also stands in open contradiction with the most fruitful studies of action-related aspects of perception (Rizzolatti & Sinigaglia 2008: 50-52).

> *If we are to unravel the riddle of musical experience, we need a thread on which to tug. Construing music as representational, as a symbolic system that carries extramusical content, I hope to persuade you, exposes such a thread (1).*

As this quotation clearly shows, the enigmatic position of the musical problem and the representative option proposed in the book are closely interrelated. This epistemological situation does present analogies with the *post-Cartesian* dilemma concerning the emergence of a thinking substance from an extended body: in both cases, the hypostatisation of the starting dichotomy necessitates an *ad-hoc* solution in order to mediate between the two substantialised realms. It is worth to note, with regard to this topic, that the notion of *affordance* is usually connected with a strong *anti-dichotomist* position, as Gibson (1976: 129) first pointed out. In Nussbaum's work, however, an affordance is conversely meant as a *mediation tool*, functional to the perpetuation of a radically dualistic stance. Indeed, according to this scenario, musical affordances are considered to be conceptual bridges between a *low-level* dimension of musical experience, conceived in terms of a meaningless isomorphic transcription on a pitch-time diagram

of the stimulus, and an idealised *high-level* dimension that includes every aspect of musical experience, broadly meant. Even without discussing the proposed theoretical framework, we can rule out Nussbaum's contribution as irrelevant to our aims, as he considers affordances to be a *cognitive form of understanding*, linked to mental representation or higher mental faculties, thus in contrast with any position developed from an ecological standpoint.

Another approach aimed at developing a sustainable notion of musical affordance is provided by the recent works of Joel W. Krueger (2011a; 2011b). The author claims that "an affordance is a relational property of the animal's environment perceived by that animal as having a functional significance for that animal" (Krueger 2011a: 4). He also states that music is perceived from birth as an *affordance-laden* structure that *affords* a sonic world (Krueger 2011a: 1) that further *affords* possibilities for, among other things, (1) emotional regulation and (2) social coordination. From an epistemological standpoint, however, this proliferation of *affordative levels* seems – at least – suspicious, and gives rise to three questions:

(i) Does music afford a sonic world in the *same sense* as this sonic world affords emotional regulation?

(ii) What would be the relevance of such a claim in the study of the *intentional relationship* between a subject and a musical object?

(iii) How should we describe the *animal-environment* relationship if music affords a sonic world that further affords acts of any type?

In trying to answer these questions, we find out that the *mediation* offered by the notion of "sonic world", besides being unnecessary, if coherently implemented would substantially compromise the *direct character* of the concept of affordance, explicitly acknowledged by Krueger (2011a: 7). Moreover, the mainly homeostatic (emotional and social-related) conception of the activities elicited by musical experience seems to divert from the embodied approach that the author claims to embrace. Besides these issues, the crucial point of Krueger's argument is the characterization of musical space, developed in league with the tradition of *spatiality-for-action*(e.g. Poincarè 1908; for a TMS study, see Cordellicchio et al. 2011) mainly discussed in the *visuo-motor* domain (Rizzolatti et al. 1997; Sakata et al. 1997). In his paper *Doing things with music* (2011a), Krueger faces the problem of *musical space* from a purely ecological standpoint, defining musical environments (or sonic worlds) as *comfortable* or *stressful*, whereas in his other work, *Enacting musical content* (2011b), he does contrast inner (or structural) and outer musical space. *Outer musical space* is here identified with the localisation of the occasional sound source, whereas *inner musical space* is described as "the piece's inner syntactical structure established by the way that constituent components (e.g. tones, rhythmic progressions, etc.) go together, lending the musical piece its sonic coherence as a composed object" (2011b). Since outer space is meant as *non-musical* (related to the localisation of musical stimulus), we would assume that *inner space* and *sonic world* are interchangeable notions, defining from different standpoints the same musical *space for action*. But this assimilation is hardly accomplishable. The notion of *sonic world* arises indeed from a standard ecological standpoint,

while the concept of *inner space* descends from a – at least to our knowledge – misunderstood embodied approach, in which the musical surface is identified with a Cartesian diagram with time and pitch as axes, embracing *de facto* the "pharmaceutical model" (Sloboda 2005: 319) of musical understanding which Krueger explicitly refuses (Krueger 2011a: 3). As a result of this irreducible duality of approaches, the notion of *affordance* connected to the concept of sonic world seems extremely relational, as it is associated with *every kind* of activity that music could possibly elicit, whereas the one connected to the concept of inner space is conceived from a completely *objectivistic* point of view. What both of these concepts are missing, in our opinion, is the *intentional character* needed to make musical affordances a *phenomenologically* relevant notion.

A better awareness of the range of issues implicit in the *enactive* approach to human musicality is shown by Mark Reybrouck (2005),who addresses in his work for an embodied characterization of musical experience. The author, using syncretic integration of different perspectives (from classic pragmatism to cognitive economy), aims to overcome the prevailing *objectivism* in the realm of musical understanding, by applying the key notion of *sensorimotor coupling* (which defines the perception-action loop) to the analysis of this topic. His strategy consists in defining the two domains of (i)*musical experience* and (ii) *motor cognition*, showing how they can be connected in such a coupling. "Musical experience", he claims, "is not basically different from an auditory experience at large. It is continuous with the natural experience or experience proper (see Dewey 1934) with a difference in degree rather than in quality" (Reybrouck 2005: 9). This equivalence between *experience proper* and *aesthetically connoted perception*justifiesthe application of a general concept as sensorimotor coupling to the peculiar realm of musical understanding, considering the importance of action in acoustic perception (Kohler et al. 2002). On the other hand, the processes of motor cognition are introduced through the discussion of the pivotal notion of 'image schemata', defined as "recurring, dynamic pattern[s] of our perceptual interactions and motor programs that give[s] coherence and structure to our experience" (Johnson 1987: XIV). The two classes of image schemata presented as the most relevant to the study of musical experience are the "container schema" and the "source-path-goal schema". While the *container schema* is "a pervasive mode of understanding everyday experiences in terms of 'in' and 'out'" (Johnson 1987: 12), the *source-path-goal schema* represents the feature of being oriented towards a goal in a continuous, temporally extended path (Johnson 1987: 12).The author then illustrates the musical analogies of these image schemata, introducing the concept of "musical affordance":

> *There are, as yet, many possibilities that stress the "action aspect" of dealing with music. I mention five of them: (i) the sound producing actions proper, (ii) the effects of these actions, (iii) the possibility of imagining the sonorous unfolding as a kind of movement through time, (iv) the mental simulation of this movement in terms of bodily based image schemata and (v) the movements which can be possibly induced by the sounds* (Johnson 1987: 24).

In discussing Reybrouck's contribution to the topic of our enquiry, we have to firstly acknowledge its rare pertinence to the range of problems related to embodied stances and the study of musical experience. Furthermore, Reybrouck's work clearly exceeds the limited topic of musical affordances, so our observations are not meant to refute his general proposal. That being said, we also have to express some concerns about the robustness of the conceptual framework developed, with particular regard to the topic discussed herein. In particular, the choice of defining *separately* the two realms of musical experience and motility seems weak, considering that Reybrouck himself acknowledges *non-objectivism* as one out of the two main claims defining an embodied approach (10).With regard to this topic, we propose a different option in the next paragraph. Moreover, the two definitions proposed appear to be questionable: indeed, as Clarke (2006: 1) pointed out, one of the dichotomies that a notion of musical affordance could help to overcome is that which opposes *autonomy* and *etheronomy* of musical experience, but the *full integration* of musical experience into mere acoustic experience proposed by Reybrouck seems to neglect this aspect. On the other hand, the notion of *image schema* and the *actual schemata* proposed could not be accepted by many proponents of embodied cognition (see Rizzolatti & Sinigaglia 2008), as these concepts seem to individuate a class of mental schemata, rather than a truly embodied kind of sense-making. This problem emerges clearly from the analysis of the notion of "goal" provided by the author: indeed, the kind of *goal-directedness* described by Reybrouck cannot be assimilated into the classic *motor grounded* one (see, for instance, Murata et al. 1997; 2000, for a focus on acts such as *prehension*). However, it does present similarities with the *teleological stance theory* advocated by the *Theory-Theory* supporters such as Csibra and Gergely (2003), where the understanding of the others' intentions and goals can only be possible from an *external*, ascribing, perspective (see also Dennett 1987).

Musical affordances through the motor perspective

In order to overcome the epistemological inaccuracies just portrayed, we propose, in the realm of music, to consider a musical affordance to constitute a property of the intentional relationship between musical subjects and objects. Indeed, the scenario described at first advocates for a new phenomenological characterization (Pelinski 2005; Schiavio 2012), where the intentional understanding constitutes the (musical) object of perception in regard to the motor repertoire (Rizzolatti et al. 1988; 2000; Buccino et al. 2004; Gangitano et al. 2004; Calvo-Merino et al. 2005; 2006) of the listener (Molnar-Szacaks, Overy 2006; Overy, Molnar-Szacaks 2009; Bangert et al. 2006; Lahav et al. 2007). This pivotal role of the body and its motor knowledge has been addressed in the phenomenological equivalence between perceiving and giving sense to the percept (Merleau-Ponty 1945), where

> *my body is geared to the world when my perception offers me a spectacle as varied and as clearly articulated as possible, and when my motor intentions, as they unfold, receive from the world the responses they anticipate. This maximum distinctness in perception and action defines a perceptual ground, a basis of my life, a general milieu for the coexistence of my body and the world* (Merleau-Ponty [1945] 1962 : 250).

Rather than postulating high-level cognitive abilities to account for understanding, the phenomenological explanation provided requires only my body, conceived as "the meaningful core which behaves like a general function" (46). A skilled guitarist might be unable to say where to put her/his finger to perform a solo, but s/he can use the *motor knowledge* of the fingers to reconstruct the actual set of notes played, by just putting the hand on the strings. We believe that this sensory-motor process not only represents the basis of musical understanding, but it can also shed light on the notion of musical affordance, relying on a sub-cognitive, pre-linguistic, intrinsically motor form of intentionality. In particular, the studies on the *ontogenetic basis of musicality* can provide some evidences of a non-cognitive characterization of the subject-object relationship of musical experience. Indeed, for instance, despite avoiding an explicit reference to the notion of affordances, the work of the French psychologist Francoise Delalande (2009) provides a discussion with a genuine and motor-based approach, in league with the *anti-mentalistic* stance at the basis of the recent thematic rediscovery of affordances. Trying to make sense of the ontogenetic constitution of a musical context from the sensory-motor exploration in infants, the author focuses on the dynamics of these sound-based objects' discoveries (see also Perone et al. 2008; Schiavio & Menin 2011). Indeed, when a child explores the environment and produces sounds, these sounds may surprise her/him, leading the infant to hear and produce them again, maybe introducing some variations (see Imberty 1983). This process of repetition with slight changes can be seen as the development of a sound discovery, whose characterization, rather than cognitive, is represented by the advance of the *sensory-motor* modalities of interaction with the object (Delalande 2009: 300). This ontogenetic, sense-giving and motor-based process reflects the constitution of the intentional relationship of musical subjects and objects, the only plausible scenario where musical affordances can be observed in infancy. This account for musical intentionality, hence, leads the discussion on the analysis of musical-related acts, chains of actions with a musical goal-directedness (*teleomusical acts*[55]) constituting the musicians' motor knowledge. Indeed, a correct characterization of these acts cannot be limited to the executive side of motility, because what allows the possibility of understanding a musical object in terms of its evoked acts (Overy & Molnar-Szakacs 2009: 492) is the *goal* rather than the actual performed movement (Kohler et al., 2002; Ticini et al., 2011).

[55] The term *teleomusical acts* has been coined by Schiavio & Menin (2011).

Conclusions

The scientific contributions we briefly reviewed were supposed to clarify the *conceptual topography* around the notion of affordance, dealing with the specific sets of events related to human musicality. Unfortunately, in our humble opinion, none of the above mentioned authors seems to have shed light on the nature of *musical affordances*. We therefore argued against the fitness of the presented theoretical frameworks to consistently make sense of the number of problems implicit in this notion by proposing an *embodied approach* that radically diverges from the standard accounts, considering musical objects as *entities constituted within the intentional motor-based relation that defines a musical context* (see also Schavio 2012). If *musical affordances* are properties of *the intentional relationship* between a musical object and a musical subject, as we have assumed, the significant consequences we can draw from this theoretical paradigm may have repercussions in the *ontogenetic studies* on human musicality, as well as addressing the need for new models of *musical learning*. The *situatedness* of musical affordances, indeed, as it is rooted in action-understanding processes rather than in mental forms of the transmission of knowledge, cannot be decontextualized from the subjective goals (Barab & Roth 2006), advocating for a teaching approach mostly based on the development of the individual's (musical, motor-expressive) *intentions* (Young 2004b) through a strategic study of the relevant (musical-directed) *motivations* (Merleau-Ponty 1945). As we have seen in the preview paragraph, in fact, what motivates children in exploring the environment and producing sounds primarily emerges as a *spontaneous* behaviour completely immersed in a bodily-based intentionality. Spontaneous exploratory activities are firstly focused on directing attention outward toward events, objects and their properties, and the layout of the environment (Gibson 1988). Through the manual exploration of objects, infants develop their motor acts and familiarize themselves with *musical structures* such as repetition and variation. The knowledge acquired from those discoveries will make the children able to construct a *musical context* as well as a basic vocabulary of *musical-directed acts* (simple sound-oriented actions such as *plunging*, *hitting*, *scratching* (Delalande 2009) can be seen as examples). From this standpoint, the notion of *musical affordance*, correlatively with the key concept of music-directed (or *teleomusical*) acts, becomes then crucial for understanding the ontogenetically originary elements of music experience, and the processes that lead to their development to a fully constituted musical – embodied – intentionality.

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