Toward an ecological aesthetics: music as emergence

André Luiz Gonçalves de Oliveira[1], **Luis Felipe de Oliveira**[2]

[1]Departamento de Teoria e Prática – Escola de Música - Universidade Estadual de Maringá (UEM) – Maringá – Pr – Brasil.

[2]Pós-graduação em Filosofia – área de concentração "Ciência Cognitiva e Filosofia da Mente" - Universidade Estadual Paulista (UNESP) – Marília – SP – Brasil.

‹alguns@hotmail.com, luisfol@bol.com.br›

[DISCUSSION PAPER]

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Abstract. *In this article we intend to suggest some ecological based principles to support the possibility of develop an ecological aesthetics. We consider that an ecological aesthetics is founded in concepts as "direct perception", "acquisition of affordances and invariants", "embodied embedded perception" and so on. Here we will purpose that can be possible explain especially soundscape music perception in terms of direct perception, working with perception of first hand (in a Gibsonian sense). We will present notions as embedded sound, detection of sonic affordances and invariants, and at the end we purpose an experience with perception/action paradigm to make soundscape music as emergence of a self-organized system.*

1. Embedded sound

The sonic phenomenon is result of a mechanic event generated by the movement of any body composed with some elastic material, or a simulation of it in a computerized environment[1]. This event, in all case, is always embedded in a specific situation, with a specific characteristics deriving of the relation between the perceiver and his environment. An account of just one side of this relation will be a partial account, as the physical or the psychological approach of human perception. Even in field of AI (artificial intelligence), for example, the environment is usually not taken into account. In the other hand, psychoacoustics seems to better fit this dualist aspect involved in perception, looking at both, brain and environment, but with assumptions that we consider misleading in some senses.

In general, psychophysics uses to have a vision of the mind as a computer, or in a weak sense as a unit of information processing. Some theories of neuroscience are pretty related to that in the local (neuronal) sense, as in Churchland and Sejnowsky (1992); and some of the theories of psychology are computational in the other sense, searching for global notions explaining mental phenomenon in an information processing point of view, sometimes with no local correlations. As we believe, the ecological approach to perception seems to share some problems with respect of global notions without local correlates. However, this should be transposed with other theories, like dynamical systems (Kelso, 1995) and some neuroscience novelties. Anyway, ecological approach takes into account the dynamical system of a perceiver embedded in an environment, the theory of direct perception doesn't put one or another side apart. And this is very important when trying to explain perception in real world, and not only in toys problems, like the typical models of AI and robotics.

So, we must consider perception in a real world situation. The sonic phenomenon in natural ambient results from a mechanical disturb of some object, or more then one. The sound waves that go inside our ears are not a direct product of these disturbances, but are modified by the acoustical features of the environment. Reverberation, echoes, amplitude shifts and timbre modulations are generated by environment and are important in the sense that they carry information to a perceiver in

[1] Beside the processes of synthesis in computetional envirmnoment, dereived from mathematical functions transposed in sonic events.

his surroundings. As we can see in Oliveira and Oliveira (2003)[2], the sound waves carry information from the source of sound, until the sonic environment, information that will be used to act and to behave in accordance with specific situation.

All of this should be satisfactory explained by acoustics in physics. Nevertheless, the ecological approach considers the explanations of physics in the point of view of a perceiver, and now perception is an emergent property that can't be reduced to physics. Perception is a higher level, over the mutual interactions of perceiver and environment.

2. Detecting sonic invariants[3]

The perception of reverberation of a room is a good example for us to illustrate what we think when we talk about detection of invariants, specifically structural invariance. Every room has its own acoustic features and sounds produced. Inside of it, there is a specific reverberation time, or a spectral shift by means of room resonance and so on. These are all acoustics patterns that structure sound waves, arranged in an acoustic array[4], coming to a person inside that room. In this sense, structural invariants are information-about a place. Other interesting case is the telephone communications, telephones as channels of communications have a specific band-pass filter and we could recognize sound recordings made over a telephone channel, even without knowing that the recording was phone conversations.

However, there is another kind of structural invariant that is related to objects (or a sound source) and not to places. We can illustrate with the timbre notion, the timbre of someone's voice, for example. Each person has its own timbristic features, which means the specific formant envelopes. Is the same for a spectral characteristic of a particular instrument, but the voice example are more suitable because it could be experienced by anyone and, of course, everyone can notice a particular structural invariant of someone's voice.

Besides, there is another kind of invariant called transformational. This is a pattern of change of object's features evolving in time. Patterns are not static over time but they have a particular way to evolve, its structural invariants are transformed by its transformational invariants. In sound domain, we could think about the spectral behavior of a sonic event. As we know, the spectrum isn't static as the theory of Helmholtz tried to defend, but every sound, especially non-synthetic, have what we call above spectral behavior. We think about spectral behavior in the light of Pierre Schaeffer's theory, especially his typo-morphology of sonic objects (1966). The typo-morphology developed by Schaeffer is a catalogue of transformational invariants of sonic objects. Here we should remember Denis Smalley (1986 and 1997), when he purposed a descriptive tool based on aural perception named spectromorphology

All this kinds of invariants are information-about some sonic event and makes the acoustic environment of a perceiver. That is where the hearing is embedded.

[2] "The ecological approach to auditory perception extended and reviwed: a compositional perspective"
[3] The notion of sonic invariants are explained in Oliveira and Oliveira 2003 and 2002.
[4] The notion of acoustic array can be fined in Gibson (1966), in Oliveira (2002) and in Oliveira and Oliveira 2002 and 2003.

3. Embodied embedded hearing

As Gibson postulated in his 1966 book, the study of perception should not be concerned with just the sense organs, as the outer, middle and inner ear, but must be in a commitment with the whole body. We must be aware that the human ears are placed in the head, which is mobile over the shoulders by the movements of the neck (in some animals even the ear is mobile). Besides, the head is on a body that moves around, searching actively for information. So, the perceptual system is embodied and embedded. These facts put more complexity on the study of perception, and make the job of computer modelers much more ambitious, but this must be under consideration.

The perceiver is an active searcher for information available for him and suitable for this physiological constitution. Beyond the fact that the environment shifts the stimuli, also the perceiver shifts it as he moves his body-head system around. In this sense, as we saw in the previous section, sensations are always changing and what matters in that information is not. Information is the stable face of world. The perceptual system are embodied and embedded in a fusion of instable sensations where it picks up stable information. The physics, in branches like acoustics, deals just with sensations, and doing that put apart the most important fact: the information. Information cannot be studied outside the relation of perceiver and environment. Information is not a reducible aspect of perception, in other words, it is not reducible to the scope of physics. Information, in this way, is an emergent property of the interaction of organism-environment system.

To detect information, perceivers have special abilities as self-tuning capabilities. The term special is not related to over-natural forces or metaphysical instances but to emergent properties of perceptual and physical interactions of perceiver within environment. We think about emergent properties in the sense that they are not reducible to physics, but in the other hand, they aren't a completely independent metaphysical instance. This is the kind of property of a perceptual system called self-tuning. Self-tuning is not reducible to physics because it deals directly with information, is the capacity of an organism to better interact with surrounds to pickup information about environment and information for your action in the turn of your life. Besides, that process is denominated self-tuning because the organism has no conscious control over the tuning of perceptual systems, over the local parts of it, as the muscles of ear, for example the stapedic muscle. Self-tuning is a self-organization processes to better fit the perceptual system with adequate information.

4. Detecting affordances

The ecological psychology gives us an adequate set of notions as invariant and affordance, which are both interesting tools to deal with emergent properties of auditory perception. Affordances are emergent properties in the sense that it is only present when a perceptual system is acting to detect information inside a niche. Affordances aren't only in the physical world or at the organism itself. As Michaels and Carello (1981) point out, affordances are known as *information-for*, i.e., the information specific to an organism with a specific perceptual system to detect it. An event or object of world affords some actions to an organism and, at the same time, others organisms could not even detect it – affordances are species specific.

What about the detection of sonic affordances? A sonic affordance, as we think, can be described by a set of possibilities of to behave in front a sonic event in one specific context. In this view, sonic affordance is what sound can 'tell' us in a perception-action perspective. What we can do about a perceived sound, how we can act when hearing a sound, and usually with no commitment of cultural, coded sounds. For example, the sound of crying or laughing affords reactions independent of cultural aspects of communication. Other example is the sound of a shot that can afford different reactions in different contexts, as in an athleticism competition or inside a classroom of a school. These are examples related to direct perception, but other sounds must be considered within a meaningful ambient. In this sense, the perception is not direct, but second-hand perception, in Gibsonian terms.

The second-hand perception must have a code, its meaning is paradigmatic for a society. Is the case of tonal music in western culture and nowadays, perhaps in the whole world. Musical meaning, especially of the sort of music made with a well-coded system must be viewed as an emergent property of organism-environment-culture system. But that doesn't mean that music necessarily communicates anything in an objective fashion. For that we need a well know cultural codification of sounds and its meanings, like in natural languages when a meaning is historical embedded in culture. In music this is not exactly the case, we don't have a sort of dictionary of sound's meaning even with tonal music for western culture[5]. Because of that, when a composer wants to tell a story, he needs lyrics or some sort of textual description of a scene, like in programmed music of 19th century.

In moving toward an ecological aesthetics, we need to consider all these facts postulated by ecological psychology and theory from direct perception. Now we can go ahead and see the 'compositional affordances' that we picked up.

5. The paradigm of perception/action in soundscape music composition – music as emergence of a self-organized system

Considering sonic experience as described above, based on ecologic approach, we can think that the aim of perception orients the action. In other words, every action of one organism in his environment is guided, is oriented by perception. Gibson (1966, 1979) describes this process by the pickup of information, and for him, information is related as invariants (information about) and affordances (information for). In this sense we were capable to describe sonic perception as the detection of sonic invariants and sonic affordances. Michael and Carello (1981, p.47) say: "The concept of affordance brings perception and action together (…). For perception to be valuable, it must be manifest in appropriate and effective actions on the environment"

Now we purpose a reflection about an experience of composition/audition of soundscapes, focus on perception/action aspects, and described based on ecological

[5] This sort of codification was tried by baroque composers and theorists in the afecto theory of music, but was abandoned in the successive centuries

approach. We are working now to conclude and show a soundscape composition called "Music in Bar".

Our project can be resumed saying that we pretend to play the piece inside bar (in an usual day). We intend that the people in the bar perceive music (at least in some parts of the piece) as they perceive the sound of bar. So here we have a situation of direct perception of music, and this music can be adequately described as emergent behavior. We conceive this soundscape piece as an emergent phenomenon by the fact that it exists only when being played. There is a complex system involving the musicians (or controllers) and the audience interacting to each other to construct the work in real time. The musicians will be operating computers and mixers with previous recorded material of the same bar that the work will happen. The material is a fragment of the sonic environment of the bar and other sonic events like barking, rain sound, poem readings fragments, voices, and so on. The idea is to generate an ambiguous soundscape in the sense that the audience will make (conversation) sounds, like people usually do in bars, together with the previous sonic material of the bar's noise and some non typical bar's sounds.

This entire combine to create an emergent phenomenon in the sense that the work isn't reducible to the parts alone or in simple constellations. Besides, the work exists only when played in real time, creating new unpredictable music structures. We can call the notion of strong diachronic structure emergentism of Stephan (1998) in the sense that the work are not reducible, brings the notion of novelty of structures, and unpredictability.

In the other hand, we think that this sort of music hearing/composition process could be conceived as self-organizing system by the way listener and operators would behave. The operators will act over the stored sonic material (amplitude and spatialization manipulations) in accordance with some pre-defined behavioral conducts. The sonic features of the audience sound, in a circular causality fashion, stipulate these conducts. In this sense, we could develop a behavioral score, as a guide to the musician/controller actuation. Besides, the musicians will have the freedom to insert some non-typical bar's sounds when they think appropriate to generate non-typical perception/action situations. There will be, in many cases, an ambiguity of the sound affordances, the sound source and physical environment (the bar) displacement, for example, when a rain sound is heard and isn't raining at all, or a bark sound inside a bar. In this sense, we claim that there is a self-organizing system, because there is no one absolute center of control, all components of system take part in the construction of music; there is not one producer of this music, it emerges when specifics conditions are happen.

Also, we have a project to make an autonomous computerized system to manipulate the previous recorded sonic material. In that situation, the program will behave as the human operators described above. There will be some receptors, as microphones that will detect sonic information from the environment. Based on some sonic relational features of the input (like the amplitude, spectrum or pitch and so on) the program will manipulate the output of the stored sounds. So that even with such an artificial system, the resultant work will be self-organized and emergent as with the human operators.

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