

Musical Listening and Abductive Reasoning: Contributions of C. S. Peirce's Philosophy to the Understanding of Musical Meaning

Luis Felipe Oliveira^{1,3}, Willem F.G. Haselager²,
Jônatas Manzolli³ and Maria Eunice Q. Gonzalez⁴

¹Department of Communication and Arts, Federal University of Mato Grosso do Sul

²Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen

³Interdisciplinary Nucleus for Studies in Sound Communication and Department of Music,
State University of Campinas

⁴Department of Philosophy, São Paulo State University

Background in music philosophy. Questions about musical meaning are usually discussed within the area of philosophy of music. These questions gained particular urgency in the Modern Age, when music had lost its connection with the old cosmologies that assured its position among the other disciplines related to harmony and numbers. In the last centuries philosophers and composers have tried to explain music as art and one of the most prominent attempts was the formalist perspective advocated by Hanslick. From that perspective music is considered on its own without any required connection with something non-musical, and its meaning or its content consists of the very unfolding of musical structures over time that are intelligible to the intellect through some form of reasoning.

Background in music psychology. We consider two psychological theories of musical meaning that have been developed by two authors: Leonard Meyer and David Huron. Meyer created a theory of musical meaning based on the Gestalt principles and the practice of music analysis; Huron has constructed a theory based on experimental psychology and statistical analysis of music. On the one hand, both theories are complementary, especially regarding the role hypotheses have in the process of music signification; on the other hand, both lack an explanation of how hypotheses are generated.

Aims. This paper aims at connecting the contributions of C.S. Peirce's philosophy to the studies and investigations of musical meaning. Firstly, we consider his pragmatic concept of meaning; secondly, we analyze the role abductive reasoning has in his logic of discovery, outlining how the generation and evaluation of hypotheses can help to explain an encountered phenomenon. Thirdly, we apply the insights derived from this to an analysis of musical meaning, by indicating how a meaningful interpretation of a musical piece can be provided through the generation of hypotheses about its underlying structure.

Main contribution. If the assumption is correct that hypotheses formulation is at the basis of music signification processes, we believe that Peircean philosophy, especially his semiotics, can help to elucidate how hypotheses are generated during music listening, furnishing an interesting and fruitful picture of musical meaning and complementing the psychological perspective on it with a logical and pragmatic point of view.

Implications. C.S. Peirce's thought is extremely interdisciplinary. The Peircean approach to musical meaning in collaboration with empirical studies of music psychology, can offer a more complete logical description of hypothesis generation (the basis of music signification). Moreover, the Peircean approach can strengthen the speculative practice of music philosophy, by providing a pragmatic and logical concept of meaning in music in close dialogue with scientific approaches.

Keywords: musical meaning, abduction, pragmatism, logic of discovery.

• *Correspondence:* L.F. Oliveira, Departamento de Comunicação e Artes, Universidade Federal de Mato Grosso do Sul, Unidade VIII, Cidade Universitária, Caixa-postal 549 CEP 79070-900, Campo Grande – MS, Brasil. Phone +55 67 3345 7591, Fax +55 67 3345 7630. e-mail: oliveira.lf@gmail.com

• *Received:* 01 December 2008; *Revised:* 09 March 2010; *Accepted:* 24 March 2010

• *Available online:* 03 May 2010

• doi: 10.4407/jjms.2010.05.001

This paper relates the concept of musical meaning to the notion of abductive reasoning as described in the pragmatism of C.S. Peirce.¹ We argue that the logical notion of abduction or abductive reasoning could help to complement theories that take exclusively psychological elements into account. Abductive reasoning has been considered one of the most important contributions of Peirce's philosophy to the study of creativity and discovery, in science, art and other domains (see Queiroz & Merrell, 2005 for a comprehensive account of abduction in different domains). According to Peirce's account of creativity, the interaction between three kinds of reasoning (abduction, deduction and induction) is responsible for the typical action of the mind: to free the organism from doubt and act in proper ways. The process of liberating the mind from doubts begins with the generation of hypotheses. As will be explained in the third and fourth part of the present article, the main function of abductive reasoning is to generate hypotheses that may clarify or explain an anomalous situation that prevents the mind from following its habitual path.

In the first part, besides briefly discussing the traditional esthetic perspective of musical meaning, we present two more recent theories on this subject in the field of Psychology of Music. More specifically, we take Leonard Meyer's and David Huron's accounts of musical meaning into consideration. Although both theories leave room for hypothesis generation during listening to music meaningfully, they do not explain how this could be done biologically, psychologically or logically. We then consider the nature of abductive reasoning and its role in the guiding of the creative mind, from the perspective of C.S. Peirce's pragmatic philosophy. We start with a general introduction to his philosophical ideas and then focus on his concept of abductive reasoning. Finally, we present some examples in order to illustrate how the concept of abduction could provide a logical complement to the earlier mentioned recent positions on musical meaning.

Philosophical and esthetical background

Musical meaning is implicitly or explicitly involved in almost any work about music and philosophy. In the ancient times of pre-Socratic Greek philosophy, music was considered from the perspective of a cosmology that was sustained by the concept of number. Music and geometry were considered as different manifestations of such *arché*, or ordering principles, and music involved not only organized sound but also poetry and dance. Plato did not significantly alter this cosmological perspective on music as held by Pythagoras, limiting himself at discussing its ethic and esthetic character and its role in the *paideia*, the greek education; for Plato music was considered more a (perhaps pleasurable) threat than a virtue to a healthy society. In addition, in the Platonic metaphysics, music and art were taken as second-order copies of the ideal realm, as copies of the already mimetic domain of the appearances. Aristotle was less concerned with the hedonistic dangers of music or with its position in a metaphysical system than he was with its formal congruence and structure, and claimed that any art has its intrinsic pleasure by virtue of its harmonious configurations.

In later centuries, the Platonic and Pythagorean ideas on music were translated and adapted to the emerging Christian doctrine. Roughly, one can suggest that the theory of music as imitation and based on the concept of number underwent no further fundamental developments until the modern age, in spite of the growing development of musical theory over the centuries. The Copernican revolution, inaugurating the Modern Age and a new cosmology, brought new challenges to the philosophy and esthetics of music (see Scruton, 1997). Music was no longer supported by its relation to the unified and harmonious universe so its validity and importance had to be attributed to other factors. The doctrine of mimesis was sustained, but more and more attributed to passions rather than to nature or ideal reality. During the 18th century musicians and philosophers shared a belief that music evokes passions in a sort of sonic discourse comprising small meaningful unities called figures that imitate certain affects (see Bartel, 1997), reminding us of Harnoncourt's term of "eloquent music" (Harnoncourt & Collins, 1984). However, Bowman (1998) claims that the romantic esthetics of music, especially in Germany, sought to locate music's significance within the spirit, as ideas in the mind. The problem turned out to be how something apparently non-conceptual as music could communicate anything at all. Usually, philosophers were more concerned with situating music into an esthetic system that was coherent with the general epistemological system they were creating than to attend specifically to the very appeal of music perception, still supporting the implicit idea that music somehow imitates emotions and affects in a sort of obscure language. Philosophically, music was completely analyzed in virtue of its adequacy in relation to the esthetic principles of modern metaphysics, as in Kant or Hegel for instance, rather than to its own perceptible structures and forms. Generally, in modern philosophy, apart from some theoretical idiosyncrasies, music was always understood as a kind of emotional mimetic artifact, as Schueller (1953: 345) describes:

Kant called music a language of the emotions and Hegel called it a language of sentiment. The statements in ancient literature and history which make similar assertions have been repeated so often that they hardly need retelling. The history of western thought also is full of statements linking music with the emotions, merely human ones during the eighteenth century, and even mystical, transcendental, or metaphysical ones during the Romantic Movement. In the eighteenth century, Rousseau in France, Marpurg and Mattheson in Germany, Burney in England, several empirical philosophers in Scotland, all agreed that music is a moving art. And, in nineteenth century, Kierkegaard, Schumann, and Wagner thought of it as a language of feelings. Schopenhauer, Pater, and, in this century, writers like Conrad and philosophers like Croce in their different ways spoke of it as a kind of illumination through emotion.

In the 19th century, when musicology was becoming a structured area of its own, Edward Hanslick undertook, against this background rather daringly, the task of defining and explaining musical beauty in terms of music itself. He also attempted to formulate a new point of view to all other issues of musical esthetics. His negative thesis was that music is not the imitation of emotions or passions; his positive thesis was that music's content is its very form, its very notes shaped by the intellect (Hanslick, 1901). Music has to be understood in terms of its unfolding structures of musical ideas. Musical scholarship has to mirror the practices of the natural sciences and seek for what necessarily takes part in its description and to break the appeal of common-sensical, yet unreasonable opinions. Any extra-musical connotation should

not be considered part of the meaning of music, musical structure alone is sufficient for musical understanding, and relations of musical structures to emotional contents or reactions are at least misleading, if not “pathological” in esthetical discussions. One might say that Hanslick threw out the baby with the bath water, but it was important in that time to undertake such a formalist approach for bringing music itself more into the focus of esthetic discussion. Despite Hanslick’s attempt to formulate a philosophical analysis based on formal elements, he did grant that musical meaning is grounded in perception, so musical meaning can be thought of in terms of the dynamical process of listening to music’s phenomenal developments, in relation to expectations and frustrations. In Hanslick’s words (1901: 135):

The most important factor in the mental process which accompanies the act of listening to music, and which converts it to a source of pleasure, is frequently overlooked. We here refer to the intellectual satisfaction which the listener derives from continually following and anticipating the composer’s intentions—now, to see his expectations fulfilled, and now, to find himself agreeably mistaken. It is a matter of course that this intellectual flux and reflux, this perpetual giving and receiving takes place unconsciously, and with the rapidity of lightning-flashes.

However, as Meyer (1956: 4) mentioned, Hanslick’s account lacks in explaining “the manner in which an abstract, non-referential succession of tones becomes meaningful.”

The psychology of musical meaning

Leonard Meyer claimed in the very beginning of his 1956 book that the history of esthetics could be split into the referentialist and the absolutist theories. The former group would include perspectives such as the mimetic or discursive theories of musical meaning, theories that ground an understanding of music on the basis of extra-musical phenomena such as emotions or affects. The latter group relates to the formalist account as advocated by Hanslick and sympathizers, that consider musical content as musical form only. Meyer tried to synthesize both absolutists and referentialists perspectives into a single frame, considering meaning and emotion as different consequences of the same process of structural listening. The basis for his (esthetic) theory was to be found in the psychology of listening rather than in philosophical discourse.

The main assumptions of Meyer’s account of structural listening are the mental principles offered by Gestalt Psychology (e.g. Koffka, 1935). The Gestalt principles are general enough to be related to any mental process that involves perception and cognition of formal qualities and could help to explain how individual tones are grouped together thereby forming higher-level units. The basic Gestalt principle is the law of *prägnanz*, a word best translated by conciseness, which can be described as the tendency of a (mental) system to always seek for the most concise, steady, regular, ordered, economic, simple form or process possible (Kubovy, 2001). The law of *prägnanz* can be decomposed in more specific principles, e.g., good continuation, closure, similarity, symmetry, proximity, and figure-ground relations. Based on such

principles Meyer derived his model of significance and affect in music listening. More specifically, the affective and/or meaningful response to music derives from the perception (and cognitive processing) of the formal qualities of music structures and the expectancies they generate. The Meyerian viewpoint (or better hearpoint), thus, does not theorize about music communication on the basis of it conveying extra-musical concepts or mimicking (or mimetizing) affects and passions, but on the basis of expectancies derived from perceived formal qualities. It seems that Gestalt Psychology offered the principles that were missing in Hanslick's visualization of the listening process.ⁱⁱ

Meyer's model of musical meaning is composed of three distinct instances (or processes): hypothetical meaning, evident meaning, and determinate meaning. *Hypothetical meaning* is the unconscious generation of expectations related to and specific of a stimulus situation, that could be described by probabilistic relationships between antecedents and consequents. *Evident meaning* occurs when the consequent becomes "actualized as a concrete musical event," reaching a "new stage of meaning" (Meyer, 1956: 37). The evident meaning appears when that relation between antecedent and consequent is actually perceived. There can be a conflicting tension between the two meanings, especially when the expected consequent is delayed or deceptive.

This dynamical process of signification could be visualized in a "causality chain," since each evident meaning turns into a hypothetical one in the unfolding of musical events, like

$$S_1 \dots C_1 S_2 \dots C_2 S_3 \dots,$$

where S_n means a specific stimulus and C_n a specific consequent Meyer (1956: 37). The fact that an actual consequent could or could not confirm the hypothetical meaning does not modify the nature and operation of the process.ⁱⁱⁱ The dynamic of hypothetical and evident meanings can be illustrated in Figure 1.

Determinate meanings, Meyer (1956: 38) said, "arise out of the relationships existing between hypothetical meaning, evident meaning, and the latter stages of the musical development." This kind of meaning has the distinctive characteristic of being manifest in the "timeless work" of memory, when the relations among stimuli are comprehended in their totality.^{iv} Determinate meaning happens when musical meaning becomes objectified, through a process that operates over an object of a listener's consciousness. In Meyer's perspective, as objects of consciousness they originate from anomalies detected in stimuli or when habitual responses are not suitable for dealing with specific sonic structures. Meyer (1956: 39) said that "if meaning is to be objectified at all, it will as a rule become so when difficulties are encountered that make normal, automatic behavior impossible."



Figure 1. The dynamic of hypothetical and evident meanings that might occur during the listening of J.S. Bach's Fugue in C minor from *Das Wohltemperierte Klavier I*, measures 9-11. The phrase under the x brace is the unexpected consequent, in relation to the antecedents in a sequential structure. (Example from Meyer, 1956: 48)

The same process, i.e., the inefficiency of habitual action, enforces both the determinate meaning and the affective reaction to the music. In this sense, the author justifies his position claiming that emotions and reflexive thought are not two distinct things, but different manifestations of the same psychological process: “both depend upon the same perceptive process, the same stylistic habits, the same models of mental organization; and the same musical processes give rise to and shape both types of experience” (Meyer, 1956: 39-40). It seems that an emphasis on one aspect or the other in musical experience is due to dispositions and beliefs regarding esthetic experience or formal musical training. When habitual operation works undisturbed, music listening and signification occurs in a quite unconscious manner, “following and anticipating the composer's [supposed] intentions” (Hanslick, 1901: 135).

In other words, meaning and affect derive from the tension between predictability and surprise created by musical structures during listening. Meyer describes the relationship between surprise and predictable structures in terms of norms and deviations within a music style, which could only be a matter of dispositions and habits embodied in musicians and listeners. Aiken (1947: 156) said that

(...) we speak of “traditions,” “styles of art,” “meanings,” and so on, as if these things had a kind of independent reality of their own which are eternally attached to works of art. But traditions and meanings are kept alive only through the dispositions and habits which form the subjective contexts of countless individuals. Works of aesthetic art, we must continually remind ourselves, exist only as objects of perception and feeling. There can be no aesthetic content whatever apart from the responses of individual men which give it meaning.

Thus, in Meyer's account there are two kinds of mental processes in operation when music becomes meaningful and affective: the applications of Gestalt laws and of habits and beliefs.^v Gestalt laws make us perceive the formal qualities of sound stimuli,^{vi} and (learned and culturally dependent) habits of listening and esthetic beliefs (see Aiken, 1951) make us perceive what musical structures are normative and what are deviant within a musical style. Both processes give rise to expectations that form the basis of a meaningful and emotional relationship with music. These expectations (related to the perception of norms and deviations) are culturally embedded, which means that they exist as habits and dispositions embodied in each and every individual of a community. Meyer's theory was important because he furnished a fruitful hypothesis of how listening works and gives musical form to otherwise

unrelated sound stimuli, permitting meaning and emotion to be accounted for in esthetic musical experience.

The perspective Leonard Meyer initiated was debated mainly through theoretical discourse and evidence collected in the practice of musical analysis. Conversely, David Huron (2006) has developed a theory of musical expectation based on the practice of experimental psychology and statistical analysis. Despite their very different approaches, both theories share similarities and could be taken as complementary. Huron offers a more updated account of musical expectation combined with detailed neuroanatomic underpinning of psychological theories, and an overall more biological perspective on musically induced emotions. Biologically speaking, “accurate expectations are adaptive mental functions that allow organisms to prepare for appropriate action and perception” (Huron, 2006). Anticipations or expectations are present in all spheres of experience, and it seems that the development of the human neocortex is related to the generation of expectations (Barlow, 2001).

Emotions are often taken as a counterpart of expectations, acting as motivators or enhancers^{vii} of the objectives and purposes of organisms (Frijda, 1987, 1986; Scherer & Ekman, 1984). Huron (2006: 4) synthesizes such views saying that “emotions encourage organisms to pursue behaviors that are normally adaptive and to avoid behaviors that are normally maladaptive.” The relation between anticipation and emotional state is at the kernel of Huron’s theory. Briefly, when expectations fail in predicting a future outcome, and consequently the situation could be potentially dangerous to the organism, its emotional state is characterized by a negatively valenced feeling, that, through associative mechanisms, becomes linked to the specific situation. In the opposite way, when the prediction is correct, there is a positive emotion that acts as a reward for the organism’s predictive success.

Anatomically, two different neural pathways have been suggested that operate concomitantly and are correlated with the feelings of surprise, as rendered in Figure 2. The fast, limbic, track results, in the case of dangerous stimuli, in negative emotional states, and prepares the organism for quick action while being in an unpredicted situation—being surprised means previously having predicted wrongly. The slow track involves cortical areas responsible for providing a contextualized but time-consuming appraisal. The slow appraisal can reach a valence in contrast to the outcome of the fast track, for instance when the situation analysis reveals that the event besides surprising was not dangerous to the organism. The contrast between the negative and the potentially positive appraisal reinforces the final positive state. Thus, for Huron (2006), positive emotions can come from two possibilities: (i) when the anticipation is correct (limbic reward); and (ii) when the anticipation is not correct but is also not dangerous (contrastive valence).^{viii}

It should be noted that prediction in Huron’s account is mainly a matter of probability, and as such the main mental process involved in generating prediction is induction. Induction is a way to economically deal with future events as if they are similar to those encountered in previous situations; if a strategy ran fine a few times it might also run fine again. This way, past experiences can be understood as steering behavior or to drive expectancies about the future. Relating this to music, the listening

experience of a person provides the basis for his or her musical expectations while listening, and these expectations, Huron claims, could be adequately described by a statistical analysis of the repertoire listened to.

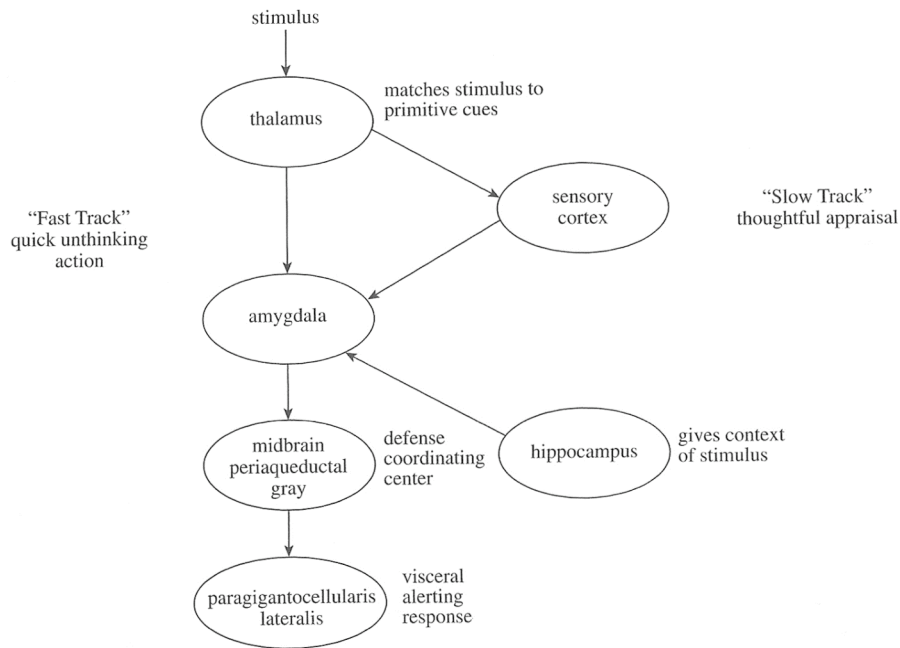


Figure 2. Schematic diagram of the neural pathways involved in emotional reactions of surprising events. The fast track is responsible for the negative valence right after the perception of a surprising event. The slow track involves appraisal and could be positively, negatively or neutrally valenced. In most cases, the contrastive interaction of both systems is associated with feelings of surprise. (Figure from Huron, 2006: 20)

Huron (2006) has proposed four types of expectations: veridical, schematic, dynamic and conscious. Each expectation in his model is related to a specific kind of memory.^{ix} Veridical expectations are associated to specific listening situations of determined musical works, it is represented in episodic memory, which codes a sort of autobiography. Schematic expectations reflect general cultural patterns of music structures and forms; it is coded into semantic memory and gets learned by exposure to a certain cultural environment. Dynamic expectations involve information coded in short-term memory and are driven by the unfolding of musical structures, as the interaction of antecedents and consequents described by Meyer. Lastly, conscious expectations are verbal and explicit about what could happen next, running in a sort of “working memory,” and its operation is similar to what Meyer called objectification of meaning. The three kinds of pre-verbal, unconscious expectations are responsible for the most situations during ordinary listening, when there is no necessity of

deliberative reasoning and expectations are inductively applied. Table 1 summarizes musical expectations and memories in Huron's theory.

Table 1. Types of memories and musical expectations in Huron's theory.

Memory	Expectation	Description
Episodic	Veridical	Reflect specific works and situations
Semantic	Schematic	Reflect general cultural patterns, resulting from a lifespan of listening
Short-term	Dynamic	Reflect real-time adaptive responses while listening
Working	Conscious	Reflect conscious thought and explicitly knowledge

Leaving aside their many differences, both Meyer and Huron estimate the role surprise has in musical listening, resulting in affective responses by means of breaking the expectations, culminating in the objectification of meaning for the first and contrastive valence for the second, and in this sense both perspectives seem complementary rather than contradictory. However, when a listener's inductive and statistically learned schemas prove themselves wrong or inappropriate, a new schema should be generated. Meyer did not consider how beliefs and habits, the basis of his esthetical consideration, are generated; Huron explains that mental schemas are statistically extracted from a repertoire, i.e., they reflect general structures recurrent in a musical culture and points out that inductive failure plays an important role in the generation of new schemas. This perspective has a very abductive flavour and the current paper can be considered as a more detailed proposal on how it can be worked out from a Peircean viewpoint. Specifically, we will focus on the role of failed expectations in the qualitative generation of new hypotheses, and how one could conceive the background against which the notion of 'failed expectations' can be understood. Thus, we are concerned with the meaningfulness of the generated hypotheses. In the final sections of this paper, we will sketch the outlines of an analysis of this problem based upon Charles S. Peirce's pragmatist perspective.

Meaning in the pragmatism of C.S. Peirce

The amount of writing of C.S. Peirce is so impressive that even nowadays, almost one century after his death, a great part of his work remains unpublished, accessible only through the manuscripts at Indiana University.^x Undoubtedly, a great part of the academic efforts directed at drawing the implications of Peirce concentrate on his semiotics, which form part of his logical system. As it is going to be further explained, Peirce's semiotics differs in many ways from traditional formal logics, in special because it allows the study of qualitative aspects of logical relations. Thanks to this unique characteristics, many scholars have focused on the understanding of musical signs based on the Peircean semiotic triad expressed by the dynamic relationship between object-sign-interpretant. The central idea is that signs, different from symbols (that constitute only a particular case of degenerated signs), have

quality properties. In this sense, signs constitute the main vehicle of meaning, which results from the action of a triadic process Peirce denominated Semiosis (CP 3.484):

(...) by "semiosis" I mean (...) an action, or influence, which is, or involves, a cooperation of three subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs. {Sémeiōsis} in Greek of the Roman period, as early as Cicero's time, if I remember rightly, meant the action of almost any kind of sign; and my definition confers on anything that so acts the title of a "sign."

Semiosis is, then, a process of interaction between components of a triad involving a sign—that specifies an object to an interpretant—, an object that determines the sign, which in turn determines the interpretant. The fundamental notion to be understood here is that of sign. According to Peirce:

A Sign is everything which is related to a Second thing, its Object, in respect to a Quality, in such a way as to bring a Third thing, its Interpretant, into relation to the same Object, and that in such way as to bring a Fourth into relation to that Object in the same form, ad infinitum. (CP 2.92)

In this sense, Semiosis is sometimes described as a qualitative emergent or process of a semiotic system, which can deal with different kinds of signs. (Queiroz & El-Hani, 2006). In a diagram, El-Hani et al. (2006: 14), following Peirce, display the interactions between the three components of Semiosis, as illustrated in Figure 3:

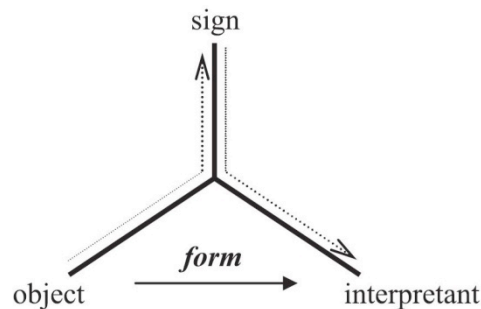


Figure 3. A Diagram expressing the dynamic interaction between the three terms of Semiosis (Diagram from El-Hani et al. 2006: 14).

The logical study of the necessary conditions for Semiosis is the subject matter of Semiotics, which constitutes the basis of all other aspects of the Peircean philosophical system; all of them grounded in the presupposition of three fundamental categories: firstness, secondness and thirdness. In a very summarized way these categories can be described respectively as: Firstness, the one which encompasses the domain of absolute freedom, pure feeling without form or constraints, allowing genuine novelty to come into existence. Secondness encompasses all forms of contrasts originated by duality and the presence of diversity, potentially leading to adjustments of earlier existing habits. Thirdness comprises continuity, generality, and all forms of laws. Although these three categories are intrinsically correlated, it is the

first one that allows genuine creation whenever a shock, produced by the experience of an anomaly, occurs in the domain of Secondness.

Hopefully this very summarized description of Peirce's categories allows the appreciation of the following passage by Ibri (2009) describing in a more poetic way qualitative aspects of abductive reasoning:

Peirce, at times, allows himself an explicit moment of poetry when he says that in the abductive moment the researcher must "sit down and listen to the voice of nature until you catch the tune . . . The invention of the right hypothesis requires genius—an inward garden of ideas that will furnish the true pollen for the flowers of observation." (CP.) This apprehension of the tonality also enables him to say that "man's mind must have been attuned to the truth of things in order to discover what he has discovered. It is the very bedrock of logical truth." Evidently, for a logician with a classical education, these statements must sound out of character. But Peirce, according to our basic hypothesis in this essay, starts from that original aesthetic unity and introduces the logical value of the qualities of feeling, giving it an ontological meaning under the category of Firstness. It comes from his appreciation of the freedom of the mind as heuristically fundamental for the discovery of theories.

Despite Peirce's emphasis on the interrelatedness of his thoughts, given the richness of Semiotics, we are going to limit ourselves to the analysis of just some aspects of his overall system focusing specifically on the pragmatic approach to the Logic of Discovery. Pragmatist philosophy, especially the Peircean pragmatism, has a fundamental commitment to a specific concept of truth, intrinsically connected to the experimental method of inquiry. For Peirce, truth is a property of beliefs, although never a definitive one, and always submitted to practical, i.e., experimental, investigations. Investigation is motivated by doubt resulting from a conflict between well established beliefs and facts; both of them play an important role in the inquiring mind. As Peirce stresses:

Thus, both doubt and belief have positive effects upon us, though very different ones. Belief does not make us act at once, but puts us into such a condition that we shall behave in some certain way, when the occasion arises. Doubt has not the least such active effect, but stimulates us to inquiry until it is destroyed. (CP 5.373)

To liberate the mind of a state of doubt is the main aim of investigation that may lead, when successful, to a new and always provisory (thus fallible) belief. A belief is a stable habit; doubt is absence of habit.^{x1} The truth is linked, thus, with the habits of mind to deal and act in accordance with facts; when there are incongruous correspondences between beliefs and facts, there is doubt. True beliefs are anchored to practical effects, as the pragmatic maxim states:

Consider what effects that might *conceivably* have practical bearings you *conceive* the objects of your *conception* to have. Then, your *conception* of those effects is the whole of your *conception* of the object. (CP 5.438, author's emphasis)

In this sense, meaning is also attached to practical issues:

In order to ascertain the meaning of an intellectual conception one should consider what practical consequences might conceivably result by necessity from the truth of that

conception; and the sum of these consequences will constitute the entire meaning of the conception. (CP 5.9)

In another paragraph, the author emphasizes this point:

(...) the whole function of thought is to produce habits of action; and that whatever there is connected with a thought, but irrelevant to its purpose, is an accretion to it, but no part of it. If there be a unity among our sensations which has no reference to how we shall act on a given occasion, as when we listen to a piece of music, why we do not call that thinking. To develop its meaning, we have, therefore, simply to determine what habits it produces, for what a thing means is simply what habits it involves. Now, the identity of a habit depends on how it might lead us to act, not merely under such circumstances as are likely to arise, but under such as might possibly occur, no matter how improbable they may be. What the habit is depends on when and how it causes us to act. As for the when, every stimulus to action is derived from perception; as for the how, every purpose of action is to produce some sensible result. Thus, we come down to what is tangible and conceivably practical, as the root of every real distinction of thought, no matter how subtle it may be; and there is no distinction of meaning so fine as to consist in anything but a possible difference of practice. (CP 5.400)

Thus, according to Peirce, meaning is pragmatically connected to habit formation, it is a necessary condition for the occurrence of action. Meaning is also at the heart of inquiry and of the process of hypothesis generation known as abduction.

Abductive reasoning and the logic of discovery

Peirce's logic of discovery is developed in the context of his semiotic study of creativity. Peirce believed that in order to understand how a mind creates new habits one should first dive in the domain of Logic, for any semiotic system is foremost a logical system. But one has to consider that the term logic has a rather broad sense within the Peircean philosophical system. The process of gaining knowledge about the world, of investigating facts and overcoming doubts begins with the creation of hypotheses, which, ultimately, is the primordial manifestation of what Peirce considered to be a logical-semiotic process: reasoning.

From the Peircean perspective, the process of hypothesis creation begins with doubt. Doubt indicates a conflict between expectations and facts; given that expectations are not always successful, sometimes there is a conflict between the expectations of well-established habits and the dynamics of environmental events, producing a *surprising effect*. From Peirce's semiotic perspective, there are two kinds of surprise: active and passive.^{xii} *Active surprises* occur "when what one perceives positively conflicts with expectations"; *passive surprises* occur "when having no positive expectation but only the absence of any suspicion of anything out of the common, something quite unexpected occurs, such as a total eclipse of the sun which one had not anticipated" (CP 8.315).^{xiii} The distinction between active and passive surprises captures the difference between situations where an explicit expectation is thwarted (i.e. the anticipated event is not occurring), and situations where no explicit expectations are formed and something out of the ordinary takes place.

According to the logic of pragmatism, surprising situations require the reformulation of beliefs and the formation of new habits. Given the nature of beliefs, understood as coherent and stable assimilated habits, the mind seeks to overcome conflicting situations by creating new habits, which in turn may generate beliefs if they are more consistent than the previous ones. As stressed by Gonzalez & Haselager (2005), according to the Peircean view, conflict and doubt will persist until the mind forms a new set of beliefs, transforming the surprising situation into a “matter of course.” In this process, several hypotheses are created as candidates of a new *system of beliefs* that will adjust the originally anomalous experience.

In addition to his inspiring arguments in defense of a logic of discovery, Peirce (CP 5.189) offers a description of the process of creative reasoning, which he called abductive reasoning:

A surprising fact, C, is observed.
But if H were true, C would be a matter of course.
Hence, there is reason to suspect that H is true.

It is important to keep in mind that abduction is fallible—it does not provide certainties, as happens with deductive reasoning—, its main function is to help with the construction of new counterfactuals whenever old habits stop carrying out their task of rendering the world meaningful. Nevertheless, as pointed out by Peirce, abduction is very useful in guiding the mind when confronted with surprising events and anomalous facts, helping to free the mind from doubts. It is worthwhile to briefly consider a terminological issue. Induction proper refers to the generalization from a set of examples (sometimes called ‘enumerative induction’, e.g. Harman, 1992; see also Haselager, 1997). This is to be distinguished from the process of abduction that also could be labeled as a hypothesis generating kind of induction (dubbed ‘hypothetical induction’ by Harman). Our use of the term ‘abduction’ is not to make a terminological point, but serves to emphasize the importance of the overall Peircean perspective to the topic of musical meaning.

Peirce emphasized the effortlessness, almost perceptual nature of the abductive process. As he said:

Abductive inference shades into perceptual judgment without any sharp line of demarcation between them (...) The abductive suggestion comes to us like a flash. (CP.5.181; see also Haselager, 2007)

In another passage he suggests that abduction is almost like an instinct:

This Faculty is at the same time of the general nature of Instinct, resembling the instincts of the animals in its so far surpassing the general powers of our reason and for its directing us as if we were in possession of facts that are entirely beyond the reach of our senses. It resembles instinct too in its small liability to error; for though it goes wrong oftener than right, yet the relative frequency with which it is right is on the whole the most wonderful thing in our constitution. (CP.5.173)

Peirce considered that abduction’s “only justification is that from its suggestion deduction can draw a prediction which can be tested by induction, and that, if we are ever to learn anything or to understand phenomena at all, it must be by abduction that

this is to be brought about” (CP.5.171). Knowledge (be it scientific or artistic) is constructed by the integration of these three kinds of reasoning—deductive, inductive and abductive—, assuming the primary role that abduction plays in elaborating hypothesis and surpassing conflicting and uncertain situations.

It seems that the existence of a lawlike quality of the principle of *prägnanz* of Gestalt psychology, which states that the mind will always seek for the most steady, simple or coherent pattern (instead of the unstable and complex ones), could be understood as an instantiation of habit within the Peircean perspective. In this sense, it is interesting to recall that Peirce claimed that abduction is also involved in perceptual judgments, which despite their natural and possibly unconscious character, are hypothetical rather than definitive, a matter of habit rather than of unchanging fact.

Additionally, what is more interesting here, is that abductive reasoning can be considered as a valuable analytical tool for the expansion of knowledge, helping with the understanding of the logical process of formulation of new hypotheses. In regular and coherent situations the mind operates deductively and inductively upon stable habits. When anomalous situations occur, abduction comes into function by helping with the reconstruction of articulated frames (the generation of explanatory hypotheses) so that the mind can be free of doubts.

On the basis of this brief summary of Peirce’s view on the nature of abductive reasoning, we suggest that it could be worth investigating the question concerning the possible existence of a general principle underlying the emotional meaningful response that accompanies musical listening. To conclude, we are going to present evidence in defense of the hypothesis that Peirce’s pragmatic view on abduction can bring some light in the understanding of the process of music signification.

An abductive perspective on musical meaning

Now we should recall the course we have assumed so far, in order to see how and why Pragmatism and the Logic of Discovery can contribute to studies on music signification. We have begun with Hanslick’s argument against the mimetic theories of musical meaning so popular in musical esthetics (and common-sense understanding of music) of his days, i.e., that musical content could only be instantiated as the forms musical structures have in the perceptive domain of listening. However, despite his partially correct view, Hanslick could not explain how chunks of musical structures generate forms and how they are turned into meaningful elements; he was concerned more to show that music could not convey extra-musical meanings than in explaining how music could be intelligible exclusively on its own terms. Approximately hundred years later, Leonard Meyer tried to theorize about what the Hanslickian formalism lacked: he furnished a theory of musical expectation as the basis for musical affective and meaningful responses, without considering the possibility of extra-musical connotations.^{xiv} As we have seen, he distinguished three kinds of meaning: hypothetical, evident and determinate. Most important in Meyer’s theory is the concept of *hypothetical meaning*, the basis of musical expectations, and consequently, of any significant (and affective) experience of music.

There seems to be a correlation between emotional states and the efficiency of generated expectations in listening. Meyer pointed to that psychological correlation, but his theory did not establish effectively how it would be originated, besides indicating that the frustration of expectations seemed to be at the basis of emotional reactions of music. It was Huron who fifty years later discussed the neurophysiological perspective on the relation between expectations and emotions. Huron ascribed the affective experience of listening to the phenomena of contrastive valence and limbic reward in response to the organism predictive efficiency. And in support of his theory of musical expectation, David Huron has provided us with a considerable amount of experimental data regarding musical expectations and affective responses.

However, neither philosophy nor psychology (nor neuroscience) have so far provided the conceptual means to investigate the generation of hypotheses that lead to expectations (meaningful experience) that, in turn, can result in affect during listening (emotional experience). Logically, Huron's theory is constructed on the basis of the traditional deductive-inductive inferential form, explaining through it how musical listening operates in anticipating the upcoming events. Induction is the logical inference which permits a hypothesis to be verified against the facts. But, how and why is such a hypothesis created in the first place? Differently, Meyer's account of musical meaning is not logically, but psychologically elaborated, and also fails at explaining how hypotheses are generated in perception. Meyer assumes that expectations somehow reflect what Aiken (1951) called esthetical beliefs and dispositions; Huron assumes that expectations reflect general schemas apprehended by exposure to a cultural environment—in this sense, both authors presuppose an inductive perspective: the application and verification of a previous schema.

It seems to us that precisely at this point that Peirce's Logic of Discovery could be of relevance. It is plausible to suggest a relation between the psychological formulations from Meyer, the experimental and biological evidence from Huron, and the logical perspective of Peirce's pragmatism, offering a more comprehensive picture of how musical expectations are constructed during listening and result in emotion. In short, our thesis here is that at the basis of the process of signification in music is a very specific sort of logical reasoning which is responsible for the formulation of hypotheses in any domain of experience: *abductive reasoning*. Regarding Meyer's belief that musical meaning begins with a hypothesis (hypothetical meaning), abduction is the logical inference which permits such hypothesis to be created. In relation to Huron's statement that musical emotion (and meaning) is a matter of inductive application and verification of a previously existent schema, abduction is the kind of reasoning that creates schemas, especially when the existent ones prove themselves wrong in relation to facts (perceived events).

Figure 4. Beethoven's 'Waldstein' Sonata Op.53, beginning of first movement.

Pragmatically speaking, musical meaning, or better, musical signification, is a particular form of a general process of signification instantiated primarily and initially by means of abduction. At the same time it bears emphasis, as stated by Peirce, that the interaction between abduction, induction and deduction is always involved in any process of acquisition of knowledge by any semiotic system. In music signification, as well, there is the interaction of the three kinds of reasoning.

On the bases of the inductive argument^{xv} there is a probabilistic perspective of understanding that would result merely from the exposures of a subject to works of a specific repertoire. But it seems that induction (and deduction) alone could not fully constitute the act of musical listening because the work itself does not tell us how we listen to it – it does not contain within itself the habits of listening that we use to understand it – even after several exposures. It is the Peircean analysis of habits, surprise and new hypothesis generation (by means of abduction) that provides the tools for analyzing this meaning-related aspect of musical listening. The beginning of a piece of contemporary music is a good example of how emphatically the esthetical beliefs and the listening habits one has might so often be wrong. The suggestion that only exposure to an artistic environment is responsible to the generation of habits or schemas also leads to a too passive view of such processes. Changing habits, in a pragmatic perspective is a matter of dispositions to investigate and to reformulate beliefs whenever it is productive (i.e. leading to more adequate habits). Even with very basic cognitive operations like grouping and segmenting the notes of a simple melody there is not a unique (and always true) rule that could be employed aprioristically or apprehended by repetitive listening. Assuming otherwise would imply that the work was revealing its secrets after several listening sections, even

when listened to with the same wrong habits over and over again.^{xvi} If nothing changes, nothing starts making sense. Perceiving units, phrases, formal structures in a broader sense are matters of hypothetical reasoning, from which one can deductively extract information that in turn are inductively verified against the sonic events, which constitute what we call a piece of music. We can take a Beethoven's Sonata as an example for the integration of three types of reasoning during listening (see Figure 4).

Every listener familiarized with the classical style would hear the first chord of a piano sonata as the tonic chord. The feeling of the tonic in this case will not last long as the introduction of the D major chord signalizes a new harmonic direction, at the end of the second measure. The listener rapidly recognizes a cadence structure in the form of IV – V – I (in G major). Cadence structures are normally understood deductively, they point unequivocally, as a matter of necessity, to a specific harmonic direction (assuming a tonal syntactic context). In accordance with the fact derived deductively, the mind generates expectations that are inductively verified in what follows. And even on these few chords, the primordial hypothesis that the first chord was the tonic has to be reformulated, in order to (retro-)understand it as the subdominant. But the music goes on and the composer breaks out such expectations introducing a strange chord for the context of G major. The listening mind has to seek again for what it would be, and quickly the cadence pattern arises again (IV – V – I), but now in another key. At this point there are two recognizable structures leading to different and contradictory tonalities. Besides the information deductively gathered, the frustrated expectations inductively generated, the mind must formulate a hypothesis in order to continue listening to this music actively and understandingly. In what follows, a new chord appears, an outsider from both keys over which cadences were made previously. And the new structure suddenly becomes another cadence (iv – V – i), now leading to a minor key that sounds not conclusive at all. In resume, we have three phrases that lead, deductively and inductively, to contradictory consequences—nothing is for sure in Beethoven—during the very first measures of this piece. The way to understand it, in the perspective of the Peircean Logic of Discovery is to formulate hypotheses that explain the anomalous facts, the contradictory structures perceived—something that occurs while listening, in a glint, instinctively (CP 5.173).

In an extremely homogeneous musical structure, induction and deduction will be manifest much more regularly than abduction, and in such case expectation would be a matter of probabilistic determination. In contrast, within a heterogeneous musical structure, abduction will manifest itself more often. Consider, for instance, composition by juxtaposition of different musical structures in early Stravinsky's music, which is made without any transition or movement and with structures which themselves are not stereotyped or consensual (as the cadences in Beethoven's example). We believe that in such a situation the listener has to create hypotheses relating the different thematic materials that the composer has made to follow each other. This kind of music require more of the abductive aspect of listening, especially because it is syntactically not so standardized as tonal music is; deduction would be less efficient in determining facts that would lead to expectations, verified inductively.

This kind of process which we have presented in relation to single works also occurs in broader contexts. The habits a listener has reflect the musical environment within which he or she is embedded. Inside dynamic musical environments musical habits have to be generated and adapted very frequently. A stable and invariant set of habits would not be suitable for a meaningful experience over different stylistic repertoires, for instance—new listening habits might be generated every time a new musical style or system emerges, or a significant variation starts occurring. The correlation between norms and deviants of musical systems and styles^{xvii} are also dynamically altered and, correlatively, the habits of listening must also be altered in the listener's *conceptual space* (Boden, 1994).

A conceptual space is a multidimensional structure that contains the principles that constitute and unify any area of knowledge. For instance, the tonal system is a generative system that could be considered as a conceptual space. Explorations made by composers not only investigate the possibilities of such a system, but occasionally also lead to transformations and expansion of its structure. The atonal transfiguration of the tonal system is one example of the transformation of a conceptual space within the music domain (Boden, 1994: 81). Gonzalez & Haselager (2005) have proposed that abduction could be considered as the logical inference that makes the expansion and transformation of conceptual spaces possible.

Conceptual spaces are not only suitable to the description of the action of a composer, but to the habitual action of the listener as well. The set of habits that according to Peirce constitutes the beliefs of a person can be understood as providing a conceptual space. In this sense, listening habits and esthetics beliefs are elements of a music-conceptual space. In the perspective of listeners, their conceptual spaces are altered every time a new habit or belief is created in response to a new sort of music. From the point of view we hold here, listening is a potentially creative action. The alteration of the listener's conceptual space encompasses new beliefs, new habits,^{xviii} which will generate new possibilities of action (in music listening), that are correlated to new forms of structural organization in music.^{xix} By outlining the importance of habit formation, surprise and hypothesis generation (abduction), the Peircean perspective emphasizes the possibility of, and stresses the need for, empirical investigations of adaptive and creative listening.

Imagine how listening to Stravinsky's *Le Sacre du Printemps* may change the musical experience of a listener. For a listener familiar with tonal musical (especially the concert repertoire from 18th and 19th century) the first audition of Stravinsky's *Le Sacre* would be daring enough. How could a reiterated chord as the one in the Adolescent's Dance makes sense without any sort of harmonic movement, assuming that traditionally harmony only makes sense as movement?^{xx} But in this case not only the lacking of harmonic movement is preeminent, but also the chordal non-standard constitution of two simultaneous chords (the triad of Fb Major and Eb seventh chord). Figure 5 illustrates such a passage. We believe that the audience of this Stravinsky's piece will create or reformulate their habits of listening, trying to make sense of *Le Sacre* as *music*, i.e., as a constellation of sound stimuli that matches the experience they have with artifacts they recognize as music—alternatively one could deny that this work has musical attributes and should not be called music at all. But suppose

once a (active) listener has altered his conceptual space after hearing *Le Sacre*, how would it change his later music experiences?



Figure 5. Stravinsky's Dance of Adolescents from the ballet *Le Sacre du Printemps*.

Once a new habit is present in his conceptual space it will be available together with his old ones in listening to music meaningfully and affectively, i.e., generating and verifying expectations over music structures, understanding relations between antecedents and consequents etc. The habitual repertoire of musical habits is enlarged, enriched. Imagine the same listener now (re)listening Beethoven's 3rd Symphony passage quoted in Figure 6.

Figure 6. Beethoven's 3rd Symphony, first movement.

Could it be that the steady harmony and non-usual chords from Stravinsky's music interfere with Beethoven's chords? If yes, one can say that after hearing Stravinsky, Beethoven will never be (or sound) the same. For the listener is not the same anymore: his conceptual space has been altered and consequently his actions will reflect his newly acquired beliefs and habits. This example is an illustration of one situation that demands for abductive reasoning in turning an unusual (surprising) piece into a meaningful one and in outlining the consequences of the generated explanatory hypotheses for the conceptual space that may result in new experiences while listening anew to already familiar works.

One could claim that merely by exposure the unfamiliar listener could derive new schemas, turning such extraneous music into a matter of fact. Thus induction and

deduction would be enough for a meaningful musical experience— but recall that Huron already suggested that inductive failure could play an important role in the generation of new musical schemas. In order to see why mere repetition of exposure does not suffice, we suggest to imagine a more radical example: *electroacoustic music*. We assume the hypothesis that electroacoustic music listening, although operating on the very same inferences as any kind musical listening (or any sort of semiotic process), presents an special interesting case for investigating adaptive listening due to the absence of a priori syntax and a broader range of possibilities than traditional musical systems. However interesting for our purpose, considerations of that repertoire require further developments that go beyond the scope of this paper and will be developed in another one.

Our perspective on musical meaning might perhaps best be seen as a perspective on music *signification*, considering that the term ‘signification’ came from the Latin verb *significare*, which means ‘to indicate,’ i.e., it is an action; what we mean is that it is more a *process of signification* than an object conveyed somehow by music. Although it is not only a process but a special case of processes: an *emergent process*. In what follows, we will elucidate why the pragmatic perspective on musical signification implies emergentist considerations.^{xxi}

The first consideration one have to assume in any emergentist theory is that reality can be described as a system composed of several different levels, each of which with its own elements and organizations and with its own emergent properties. An emergent property is instantiated by the structures and organizations of elements of a lower level; those elements exert the causation required for the existence of the emergent property. There is a strong correlation between the basal conditions and the emergents; if the basal conditions change significantly their structures and/or organizations the past stable emergents cease to exist. Clarke (2005) presents an emergentist account of musical meaning considering the following levels: physical → chemical/biological → mental → social/cultural. Clarke’s theory encompasses several levels, and in order to understand how a level is emergent, one must consider what kinds of features are involved in such an account.

Stephan (1999) considers the three main features involved in emergentist system: irreducibility, novelty and unpredictability of emergents. It means that an emergent property must be genuinely new in the system’s history, and/or unpredictable from the system actual behavior, because it is not analyzable from the system’s structure (for reasons of systemic complexity or inadequate computational tools, for instance), and/or not reducible to explanations of lower levels of the system’s structure. Clearly, the three features are related to each other. For example, if a property is not analyzable in terms of its basal conditions, and thus, it is unpredictable, one can say that a genuine novelty can arise within the system’s history which cannot be explained in a reductive fashion.^{xxii}

The musical signification process occurs only in the coupling between two independent systems: the listener conceptual space and the musical structures of a work. The (semiotic) process involved in music could be considered an emergent process, as any semiotic process (Queiroz & El-Hani, 2006, 2004). It is emergent for the signifying properties of the music-listener system are not reducible to any of the

structures in isolation. In this sense, musical meaning cannot be something conveyed *in* the music nor could be only a mental state elaborated by a detached mind. Furthermore, in most cases the coupling between independent systems cannot be predictable beforehand; besides some rough statistical approximations, no one can say what listening habits a listener has, or what kind of structures a work might have, even when the listener is embedded in a very specific cultural environment and the work reflect well-known music styles—as we see our music listening habits are always shifting during every significantly new musical experience we have. In this sense, musical meaning exists only as emergent property: a property of a semiotic system, which pragmatically unifies the possibilities of action of a listener (considering musical active listening as an action, guided by habits and beliefs) in relation to musical structures.

We claim that semiosis is at the basis of the emergent signification processes in music, in which the interplay between habits, surprise and abductive formation of new (esthetic) beliefs and listening habits will guide one's further musical experience and actions. Moreover, abduction works in conjunction with induction and deduction; the more familiar the repertoire, the less abduction it demands; the more surprising, unusual a piece of music is, the more abduction it require from the active listener. However abduction is always involved in meaningful listening to interesting music for the reason that such music is always at least a little bit surprising. As the conceptual space changes dynamically over time by the means of abductive reasoning, the musical structures coupled with such space will be perceived and appreciated differently. That is why music is never the same. Objectively, the music structure of a work is always the same and music analysis demonstrates that, but the coupling between them and the dynamical conceptual space of listeners will result in emergent properties that allow for endless variety.^{xxiii} Ultimately, one can hear the same work for a whole life and always find novelties 'there'. Music signification is necessarily a creative, emergent and pragmatically oriented (semiotic) process.

Acknowledgements

The authors would like to acknowledge the Academic Group of Cognitive Studies (GAEC) from the São Paulo State University, the Self-organization Group of the Center of Logic, Epistemology and History of Science (CLE) from the State University of Campinas, and the people from the Interdisciplinary Nucleus of Studies on Sound Communication (NICS) of State University of Campinas. The authors are also grateful to the anonymous referees, the colleagues from the CIM08 and the JIMS's reviewers for their valuable comments and suggestions. L.F. Oliveira would like to thank FAPESP and the DELTA/NUFFIC Program for his research support.

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ⁱ There is a large amount of well-known work about music and the thinking of C.S. Peirce, especially his semiotics, applying complex interpretations of the Peircean triadic sign chains in order to analyze and describe music. However, the philosophy of Peirce encompasses much more than his semiotics, which is part of his logical system. Our perspective in this paper is not concerned with sign taxonomy nor semiotic descriptions, but rather with the logical characterization of meaningful listening based on the interaction of abduction, deduction and induction.

ⁱⁱ In a sense, both Meyer and Hanslick seem to share lots of common thoughts about music listening and signification, but one should consider that beyond such a evident congruence there is a difference between considering music as a phenomenon the intelligibility of which is culturally dependent, as in Meyer's account, or universally shared, as in Hanslick's.

ⁱⁱⁱ It is important to remember that the dynamics of hypothetical and evident meanings are not only horizontal but vertical as well, or among architectonic levels, as Meyer (1956: 38) said.

^{iv} By “timeless work” Meyer means that the operation of memory is not constrained by the temporal flux of perception.

^v Actually, both types of processes might be more closely related to each other than the postulation of a dichotomy implies. Later we will see that in accordance with C.S. Peirce’s philosophy even the most basal perceptual phenomena are matters of habits and beliefs.

^{vi} Leonard Meyer’s 1956 book is full of music examples that illustrate the Gestalt principles operating in music perception, and for further clarification of the formal Gestalt properties of music structures we encourage the reader to consult this book.

^{vii} There are many different theories of emotions, but there seems to be a convergence towards understanding emotion as related to a kind of motivator for the organism (for a panoramic view see Oatley, 2001; Juslin & Västfäll, 2008, offer a comprehensive view on musically induced emotions).

^{viii} Valence is a very well-known concept in Psychology (e.g. Barret, 2006; Rogers et al., 1977; Plutchik, 1980), and in many models of emotion valence is usually correlated with arousal, e.g., in the well-known Circumplex Model postulated by Russell (1980).

^{ix} We do not advocate here that the four types of memory that Huron distinguishes in relation to musical expectations are the only kind of memories that operate in music related activities. We believe that, despite Huron’s biologically inspired discourse, his mnemonic account is too much computational and disregard the possibility of an embodied knowledge of music. Take the example of a musician playing Beethoven: a normal pianist surely cannot tell you every note he plays in a Sonata, but he plays it without score—the coding in his memories is more motor-related, i.e. neuro-muscular, than content-related. This kind of memory is not accounted for in Huron’s theory. Also, there is evidence that in a listener motor-related brain areas are activated during the perception of musical structures and meaning (Haueisen & Knösche, 2001).

^x One of the most important editions of Peirce’s writings is the *Collected Papers of Charles Sanders Peirce*, in 8 volumes, edited by the Harvard University Press. Here we will refer to this edition using the usual system of reference: *CP* followed by volume and paragraph number.

^{xi} Peirce explicates this point as follows (CP.5.397-8): “And what, then, is belief? It is the demi-cadence which closes a musical phrase in the symphony of our intellectual life. We have seen that it has just three properties: First, it is something that we are aware of; second, it appeases the irritation of doubt; and, third, it involves the establishment in our nature of a rule of action, or, say for short, a habit. As it appeases the irritation of doubt, which is the motive for thinking, thought relaxes, and comes to rest for a moment when belief is reached. But, since belief is a rule for action, the application of which involves further doubt and further thought, at the same time that it is a stopping-place, it is also a new starting-place for thought. That is why I have permitted myself to call it thought at rest, although thought is essentially an action. The final upshot of thinking is the exercise of volition, and of this thought no longer forms a part; but belief is only a stadium of mental action, an effect upon our nature due to thought, which will influence future thinking.

The essence of belief is the establishment of a habit; and different beliefs are distinguished by the different modes of action to which they give rise. If beliefs do not differ in this respect, if they appease the same doubt by producing the same rule of action, then no mere differences in the manner of consciousness of them can make them different beliefs, any more than playing a tune in different keys is playing different tunes.”

^{xii} Studies of emotions that are often connected with these two kinds of surprise are the subject matter of psychology, but the analysis of the general structure of surprise belongs to the area of pragmatic logics—as we have seen logics is the basis of the Peircean philosophical system.

^{xiii} In this context, musical surprises will be often active, for, supposedly, listeners might have expectations even before the first note is heard (exceptions might happen when one’s mind is quiet), recalling Aiken (1951) for whom aesthetical experience is always a matter of beliefs and dispositions.

^{xiv} Meyer claimed that meaning in music should be sought in the listener’s experience, what, in a sense, Hanslick had already claimed. The difference between them seems to be more a matter of philosophical and psychological foundations than of a totally different perspective of musical meaning: Meyer had more developed theories of mind in comparison with the epistemological (and metaphysical) commitments which Hanslick assumed in his discourse.

^{xv} Like the very one postulated in Meyer’s and Huron’s theories.

^{xvi} What we are stating here is that the very work alone, i.e., the music structures one listens to, is not enough for a meaningful interpretation. Meaning also requires an *active* posture of the listener—musical

listening is action, in a sense—especially in a heterogeneous and dynamical cultural environment. Such a perspective on musical listening lead us to consider musical meaning as a kind of (semiotic) emergent property, but we will come back to this later in this paper.

^{xvii} See Meyer (1956) to verify how normative and deviant elements play a role in musical experience.

^{xviii} Or new schemas in Huron's terms.

^{xix} And/or new forms of correlations between norms and deviants in Meyer's terms.

^{xx} Harmonic movement can be thought as the progression of fundamentals of chords, or the movements of the bass and the superior voices in the practice of the continuo. In the sense of our example, one could extrapolate to Monteverdi's *concitato style* when a chord was also reiterated, although Stravinsky's case is more radical because of the absence of harmonic movement.

^{xxi} There is not room for a complete introduction to the area of emergentism here. We refer the reader to specific articles on this subject (e.g. Stephan, 1999; Emmeche & El-hani, 1999; Oliveira et al., 2003; Meric & Solomos, 2008, Solomos & Di Scipio, 2008).

^{xxii} A very important notion associated with emergentist theories is *downward causation*, when emergent properties constrains or direct the behavior of the basal elements which instantiated them, but a detailed explanation of such notion is beyond the scope of this paper (for further clarification see, e.g., Stephan, 2002; Kim, 1992).

^{xxiii} When out of this coupling new properties emerge, one can say that it will drive or constrain the possibilities for perceiving the upcoming musical events (that will be part of the very same ongoing coupling), and that this might be interpreted as a form of downward causation. However, for such an argument more space would be needed. Hopefully, further research can be devoted specifically to this subject.

Biographies

Luis Felipe Oliveira teaches music theory and analysis at Federal University of Mato Grosso do Sul. His research interest includes topics in music cognition and philosophy of music and recently his attention has been focused on questions about musical meaning and signification. He received his PhD in Music at the Interdisciplinary Nucleus for Sound Studies, at the State University of Campinas, after a research period at the Radboud University Nijmegen, his master thesis was accomplished at São Paulo State University in the Program of Graduate Studies in Cognitive Science and Philosophy of Mind. He received his bachelor degree in Music Composition and Conducting at São Paulo State University.

Pim Haselager is a Principled Investigator at the Donders Institute for Brain, Cognition and Behaviour of the Radboud University Nijmegen, the Netherlands. He teaches on a variety of topics related to the philosophy of AI and Cognitive Neuroscience. He is particularly interested in the integration of empirical work (i.e. brain imaging, computational modeling, and robotics) with philosophical issues regarding knowledge and intelligent behavior. He publishes in journals such as Cognitive Science, Cognition, Philosophical Psychology and Pragmatics & Cognition.

Jônatas Manzolli is composer and mathematician and is the research leader of the Interdisciplinary Nucleus for Sound Studies (NICS), UNICAMP, Brazil. He has Bachelor degrees in Mathematics (1979-84) and Music (1982-87) and Master degree in Applied Mathematics (1986-88) at the IMEEC/UNICAMP and PhD in Music Composition (1988-93) at the University of Nottingham (UK). His studied also Computer Music at the Sonology Institute, The Hague, The Netherlands. His research is concentrated on applications of mathematical models of complex systems to music composition and interactive systems. His musical works and multimedia performances had been played in Brazil, Europe and USA.

Maria Eunice Q. Gonzalez received her bachelor degree in Physics (1977, UNESP, Brazil), and her master thesis in Logics and Philosophy of Science (1984, Artificial Intelligence and the methodology of scientific discovery, UNICAMP, Brazil). Her PhD thesis (1989, A cognitive approach to visual perception) was supervised by Noel Sharkey and Peter Carruthers at the University of Essex, UK. Upon returning to Brazil in 1989, she joined the Brazilian research group on self-organization, at the UNICAMP. Since 1991, she is one of the coordinators of the research group on cognitive studies at UNESP focusing on Philosophy of Information and Ecological Philosophy.