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Graphicacy: Imagining, Creating, and Interpreting a Musical Work through Images

Abstract. For Charles S. Peirce, any visual-spatial thinker has the ability to communicate his ideas with a higher degree of resolution by applying *graphicacy* as a way to integrate perception, intuition, and imagination in order to interpret spatial information without the use of language. In a musical context, creating a drawing can be compared with the creation of a graphic representation of music conceived in the composer's imagination. This peculiar fact directly indicates the need to use drawing as one of the fundamental ontological figures of a musical work. In musical terms, graphicacy could be related to the traditional form of musical notation, however, based on Charles S. Peirce's philosophical postulates for what concerns scientific reasoning and its implication in drawing as a cognitive activity, non-traditional diagrammatic form of musical notation has the ability to engage and integrate various forms of perception, intellect, and emotion, providing a higher range of communication between the imagination and the reality of the musical matter. Two alternative forms of diagrams are presented in the following paper: (1) looking backwards during the second half of the 20th century, Iannis Xenakis proposed perhaps the first and most innovative method for electro-acoustic musical creation using drawing as a form of immediate representation of continuous musical fantasies—the UPIC system; (2) as for the second type, I will deal with the notion of the *macro-timbre* continuum, together with the methodology of chrono-graphic recording and the *eau'oolin*[1] system created by Julio Estrada. In each of these types, the musical imagination leads to different results in terms of musical organization in the final score, and finally to the interpretation of the musical work as a new form of communicating the primary idea represented in a diagrammatic form.

Keywords: abductive reasoning, graphicacy, imagination, Julio Estrada, Iannis Xenakis, Charles S. Peirce.

Introduction

The present paper addresses the issue of graphicacy and its implications in the art of musical creation from the second half of the 20th century until the first two decades of the 21st century. For this reason, the author presents two major composers who, among others, applied graphicacy as an ontological figure in their musical output: Iannis Xenakis (1922–2001) and Julio Estrada (b. 1943). In order to present my hypothesis, the trajectory of this paper is presented in two parts. (1) The concept of graphicacy is approached as a starting point from the postulates of abductive reasoning proposed by the American mathematician and philosopher Charles S. Peirce, who considered graphicacy or the ability to represent ideas through images, and *beelddenken* (or "pictorial thinking") as a form of communicating ideas without using any verbal form, together with imagination as an essential part of scientific discovery. (2) The relationships that exist between graphicacy in the process of musical creation, and how the two aforementioned artists individually developed this method to better connect the musical imaginary with the reality of sound. In an effort to illustrate the relationship between graphicacy and the process of musical creation, first of all, the author of this article presents a brief discussion of Iannis Xenakis's statements regarding the implications of drawing as an elementary part of the cognitive process of creativity; as a second example, the document delves into the compositional philosophy of Julio Estrada's composition, discussing the necessary arguments to support the author's hypothesis regarding the imagination, the chrono-graphic recording of the musical material, and its implications regarding the interpretation of the musical score.

1. Abduction and Scientific Imagination

In Charles S. Peirce's pragmatic philosophy, abductive reasoning is essential because it serves to explain the process by which the mind leads to the formulation of a new theory. Peirce generally described this type of thinking as follows: "Abduction consists of examining a mass of facts and allowing these facts to suggest a theory" (as quoted in Pechlivanidis 2017, 138). In Peirce's theory, the concept of imagination is semantically close to the concept of intuition, which is why he emphasized the need to study both spheres of brain activity: imagination and rational thinking. He argued that "if pragmatism is the doctrine that every conception is a conception of conceivable practical effects, it makes conception reach far beyond the practical. It allows any flight of imagination, provided this imagination ultimately alights upon a possible practical effect; and

[1] From the Nahuatl language: *eua*—to fly; *oolin*—movement.

thus many hypotheses may seem at first glance to be excluded by the pragmatical maxim that are not really so excluded" (Peirce 1931–1935, CP 5.196).

In the fifty years that Peirce devoted to analyzing this philosophical archetype, he did not formulate a single general definition of abductive reasoning, but offered various interpretations of it. In the philosopher's essays, we find several analytical definitions and terms used to define this type of inference, as mentioned by Christos A. Pechlivandinis: "Abduction, retroduction, hypothesis, hypothetical inference, presumption are the terms used by Peirce for 'abduction'" (Pechlivanidis 2017, 145).

Charles S. Peirce studied the phenomenon of abductive reasoning not only in terms of philosophy. He noticed its usefulness in pedagogy, he used this form of reasoning to explain the processes that take place in chemical compounds and physics, and also to solve mathematical problems by experimenting with diagrams, which he classified as an exercise of the imagination to access abductive reasoning. Graphical experiments carried out with this method proved to be very useful in school teaching at the primary level of education. Seymour Simmons III emphasized this issue by distinguishing between two spheres of influence of Peirce's pedagogy: "First, Peirce's own use of drawing reminds us that drawing is a cognitive matter, involving the full range of thinking skills while integrating thought with perception and feeling—in short a whole-brain, holistic experience with applications across the full range of disciplines. Second, Peirce's experimentation with perception and interpretation urges teachers to focus students' attention on the way drawings are read and the mechanisms in which they are accurately, inaccurately, and diversely understood" (Simmons III 2017, 129). The author claims that the implications for teaching drawing under Peirce's approach to abductive reasoning could lead "to reestablish[ing] its role, as an essential aspect of graphicacy, in general education" (Simmons III 2017, 130). In this last envelope the author highlighted the term *graphicacy*, which refers to "the ability to convey or interpret spatial information not easily communicated in words or numbers" (Simmons III 2017, 119).

According to Pechlivanidis, Peirce's reflections on the functioning of the imagination, vision, and instinct as elements of the reasoning process, contained in his notes that he kept since 1890, are characterized by a greater maturity in explaining the essence of abductive reasoning. The American philosopher defines imagination, intuition, and experimentation as the tools of reason used to formulate new theories. He also explains the differences between abductive reasoning and deductive and inductive reasoning. In his notes, he writes: "Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; induction does nothing but determines a value, and deduction merely develops the necessary consequences of a pure hypothesis" (Pechlivanidis 2017, 134–135).

Peirce focuses on abductive reasoning as part of his scientific discoveries in his notes entitled "The Nature of Inference" (1888). There he distinguishes between two methods of reasoning that justify the use of imagination, vision, and intuition. He explains it in this way:

> Leading principles are of two classes: those whose pretension it is to lead always to the truth unless from the false, and never astray; and those which profess to lead only to the truth in the long run. This distinction separates two great branches of reasoning, the one bringing to light the dark things of the hidden recesses of the soul, the other those hidden in nature. We may, for the present, call them Imaginative and Experiential reasoning; or reasoning by diagrams and reasoning by experiments. (Peirce 1931–1935, CP 4.74)

Further arguments demonstrating the advantages of abductive reasoning are considered in the notes entitled "Abduction" (Peirce 1931–1935, CP 7.218). Peirce describes the exercises of the imagination and intellect as mediators used in scientific research. When used in tests, they allow the researcher to choose the most satisfactory result. In this way, a hypothesis that provides an explanation of the phenomenon under study is formulated. Another situation in which the two mediators mentioned above are useful is a method of questioning everything that you want to create. It forces you to use your imagination and intuition. By means of imagination and non-conventional reasoning, a human being is able to perceive all the possibilities that may relate to an event that has taken place, as Peirce claims: "I have already pointed out that it is a primary hypothesis underlying all abduction that the human mind is akin to the truth in the sense that in a finite number of guesses it will light upon the correct hypothesis" (Peirce 1931–1935, CP 7.220).

According to Peirce, every scientific research is based on the reconstruction of previously used models of investigation. It is in this reconstruction that the imagination plays a determining role in order to provide new results that are questioned and reconstructed again until the researcher achieves a plausible hypothesis

which further will provide a new research. In this way, abductive reasoning operates on a continuum that transits between the following components as I propose: perception–guessing–observation of the reality–imagination–creativity–creation of new models–experimentation–testing new models previously conceived in the imagination–hypothesis–results–observation of the reality. From the above sequence, two important elements can be observed: 1) on the extreme sides the same component is presented—observation of the relationship—with the difference that in the beginning the intuition is highlighted in comparison with the opposite extreme where hypotheses are presented, which in the future could suggest new forms of intuition; 2) the center is dominated by imagination and experimentation, two essential components in the process of abductive reasoning, both crucial for musical creation as well. All the previously mentioned aspects of abductive reasoning focus on the exercise of imagination, intuition, and creativity as determinants of the ability to formulate logical, factual questions. Thus, Peirce's arguments about the advantages of abductive reasoning refer to the exercise of the imagination, while always focusing on the situations observed in reality. The absence of either of these two components of reasoning prevents us from achieving objective results.

2. Visual Thinking and Musical Reasoning

Based on the aforementioned sequence of components, we can stop at the central point—imagination and experimentation. According to Peirce's postulates regarding abductive reasoning, visual thinking increases imagination and at the same time develops creativity in order to find more eloquent solutions that, according to Peirce, do not require the use of language as a means of communication. Peirce express this idea as follows: "I do not think I ever reflect in words: I employ visual diagrams, firstly, because this way of thinking is my natural language of self-communication, and secondly, because I am convinced that it is the best system for the purpose" (as quoted in Simmons III 2017, 129). As Kathleen A. Hull emphasizes, for Peirce, visual thinking is perhaps one of the most basic and clearest ways to represent ideas, since the philosopher "assumes that the process of thought in the mind is not 'composed of distinct parts corresponding to the argument of the logical representation of it, each requiring a distinct effort of thought.' Thought … is continuous and begins at percepts, which cannot be fully represented in words. Language cannot represent the movements of thought" (Hull 2017, 152). What Peirce refers to in his statement is what is known by a group of scientists in the Netherlands as *beelddenken* (pictorial thinking).[2] People who can be diagnosed under this term are characterized by having the ability to think and express their ideas with images without the need to use words. It is very likely that Peirce belonged to this group of individuals, hence his facility and naturality to resolve mathematical and philosophical problems by applying diagrams as a form of scientific reasoning. Considering Peirce's hypothesis for what visual thinking and imagination concerns, it is possible to look for a connection between visual "thinking" and auditory "thinking," where abductive reasoning involves simultaneously an imaginary 3D image of a sound structure and a graphical structure of the sound in motion.

In a musical context, the practice of drawing directly influences the process of creating music by activating both auditory and visual perception. Creating a drawing can be compared to the creation of a graphic representation of the music created in the composer's imagination. This peculiar fact directly indicates the need to use drawing as one of the fundamental ontological figures of a musical work, indispensable in Xenakis's musical production which spans from the 1950s[3] and Estrada's musical practice.[4]

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2 This problem is addressed by the philosopher Kathleen A. Hull in the article entitled "The Iconic Peirce". Hull points to Maria J. Krabe's findings that "picture thinkers reason without the use of language and 'see' the answers to problems in an intuitive way" (Hull 2017, 151).

3 "From 1953–54, Iannis Xenakis began with precisely graphically recorded compositional designs, which were later rewritten into traditionally notated scores …. Design notation and performance instruction, audio recording, and computer presentation may present themselves in many works of contemporary music, especially in many of Iannis Xenakis's works, with varying degrees of precision and ambiguity" (Frisus 2020, 170).

4 Back in the year of 1983, Estrada propose a new chrono-acoustical methodology of musical creation, which is based on the unification of the whole musical material inside a large sphere of rhythm-sound, which Estrada refers to as "macro-timbre continuum". In this macro-timbre, the musical perception is integrated by all the physical variables of the sound—frequency, amplitude, and harmonic content (Salas 2017, 108). This methodology is developed in conjunction with the chrono-graphical methodology, which is based on the drawing of the rhythm-sound components within a macro-timbre. The combination of both methodologies allowed him to create around 28 musical works, among the most outstanding works can be mentioned: the *yuunohui* series (1983–2020), the String Quartet *ishini'ioni* (1984–1990), the Multi-opera *Murmullos del páramo* (1992–2006) and *Quotidianus* (2006) for string quartet and vocal.

Before going any further, it is important to highlight Peirce's last sentence from the above statement, and thus to stop reflecting on the relationship that exists between music and language—a reason that forces us to question whether music is a language if the idea of the musical work lands under a traditional model of notation. If the intention is to create a musical idea within the highest degree of resolution applying traditional notation,[5] the answer would be: yes, music is a language, but limited in what refers to the movement of sound in the imaginary. In contrast, following Peirce's statement related to pictorial thinking in a musical context, leads us to observe that music is no longer a language. Now intentionality forces the creator to operate in a different kind of musical reasoning. By using visual thinking as the main process of reasoning, the creator of music has the ability to communicate the movement of sound as he or she imagines it. Moreover, with the help of an analog representation, in this case graphicacy, it is possible to achieve musical textures that can clearly express and communicate the essence of the musical idea. This idea can be supported by Estrada's following statement: "Processes of an analogous order, such as executing, recording, narrating or drawing of musical fantasies, provide direct access to their objective register and open up a new space for the methods of musical creation. These processes question the idea of direct writing as an appropriate formula for representation of the imaginary, and place it among the concrete methods derived from transcription—or from the 'conversion'[6] of a type of writing" (Estrada, in press, 64).

3. Graphicacy of the Continuum in Music: the Cases of Xenakis and Estrada

Considering the essence of musical creativity from the continuum perspective runs the risk of treating any theory of music solely as a tool in the process of composing. At the moment of creating a musical work, analytical thinking can naturally reveal itself, dividing the musical material rich in detail and dynamic in its form into sequences. If the artist succumbs to analytical thinking and finds theoretical support in it, then the continuum becomes only one of the tools for developing sound effects, which has nothing to do with creative impulses coming from the artist's most subtle imagination. On the contrary, if the goal is to create musical matter as close as possible to musical fantasy, then, in the act of creation, it is necessary to eliminate any theoretical "filter" beyond the experience itself. Only then the musical matter manifests itself as the continuum that allows the artist to create a relationship between reality perceived by the sense of hearing and imagination. Here I would like to shed light on the compositional methodologies of two composers—Iannis Xenakis and Julio Estrada. The relevance of both is due to the fact that the application of drawing as an essential part of the composition process gives way to removing the theoretical filters that can hinder the communication between the musical imaginary and the reality of the musical work. In the first case, this liberation from theoretical filters is greatly accentuated by the implications it has in the area of musical pedagogy. The UPIC, at the time, was a revolutionary system that promoted new ways of understanding musical creation from spontaneity. In the second case, the chrono-graphic method gives the creator the facility to highlight all the components of the rhythm-sound in the continuum with a high degree of resolution.

3.1. The UPIC system of Xenakis

Looking back to the second half of the 20th century, Iannis Xenakis (1922–2001) proposed perhaps the first and the most innovative method of electro-acoustic musical creation using drawing as a form of immediate representation of continuous musical fantasies: the UPIC (Unité Polyagogique Informatique CEMAMu) system. From a pedagogical perspective, "the UPIC is a device for anyone who wants to open up new pathways to music" (Frisus 2020, 163) allowing to instantly create sounds without the need to resort to traditional musical notation. Consistent with Peirce's assumptions about drawing as part of abductive reasoning, Xenakis's approach to musical creation provides similar results when he discovers "that not only architecture, but also music can emerge from precisely recorded designs: lines on the drawing surface as pictures of sustained or moving tones in the tonal space" (Frisus 2020, 163). In this way, abductive reasoning is activated through drawing, making it possible to combine intuition with musical creativity. As a result, the

[5] According to Estrada, traditional notation "is based on a limited code of symbols … with stereotyped verbal indications, as can be observed in much of the traditional European music—*espressivo, con anima, con passione,* … or others" (Estrada, in press, 48).

[6] This term is explained by Estrada as follows: "In the method of rendering musical data through drawing, musical writing is not a *transcription* since this would imply a change from one type of writing to another. Instead, the notion of *conversion* becomes more representative of the passage from graphical data to the code of music writing, and in turn leads us to the notion of a *resulting score*, established only *after* the graphical form" (Estrada 2020, 320).

musical structures that emerge from this specific way of creation would be impossible to obtain if they were considered only from a traditional method of graphic representation (strictly musical writing). In the following statement, Xenakis provides a clear explanation of what is meant by graphicacy in musical creation and how this method can be used to approach a new form of communication:

> If you draw lines on a blackboard, you can … create sounds and music…. Not just sounds, but also developments of rather complex sounds, that is to say, of music. … And drawing is an ability of every human with a hand and a brain; the hand is the organ closest to the brain. … Giving everyone the opportunity to compose music leads to a double result: you make the creative activity available to everyone, and on the other hand, there is no longer this abyss between any avant-garde (there are always avant-gardes) and the rest of the audience. Rather, it's about building bridges and being able to think music, meaning creating music with everything that comes with it. … For everyone. From the age when the child can hold a pencil and listen, to adulthood and until death. (As quoted in Frisus 2020, 174)

Xenakis's methodology confirms—without being the foundation of his thesis—that the abductive reasoning in the process of musical composition can be increased through drawing, resulting in a new form of communication between the creator and the recipient of any musical work. From a semiotic point of view, the UPIC system anticipated the use of drawing as an essential component to activate the musical imagination. Xenakis gave the possibility of instantly projecting the movement of an acoustic phenomenon through a graph. The importance of this simple but determining factor lies in the fact that the movement, depth and intensity of the sound object are expressed in detail by the graph, and this graph is no longer just a sign representing a sound that requires a musical instrument or human voice in order to be heard as an acoustic phenomenon, as it occurs in traditional musical notation. Although Xenakis had already ventured into drawing as an experimental method to obtain clouds of sound masses—*Metástasis* (1953–1954) and *Pithoprakta* (1955–1956)—the UPIC system presented a new discovery and, at the same time, a dilemma, as it was a computer system and not an acoustic instrument through which sound was created. In 1979 Xenakis, in an interview in *Le Monde*, is questioned as to how the UPIC system managed to combine technology with creative potential. Xenakis offered the following answer:

> The computer should not be used only for the synthesis of sounds, but also for macrostructures, large-scales constructions. … how to transmit to the machine a notation and concepts that the musician learns in the conservatories? The solution was the hand: let the musician give his order to the computers through drawings, not punch cards or programs. (Xenakis 1979, 96)

Xenakis's UPIC system freed music creation from the rules imposed by traditional music notation by applying drawing what is called a "sinsign," which is a type of "qualisign" named by Pierce.[7] For the first time, at least in the European musical culture of the 20th century, a new system of musical notation and musical creation provided certain artists, interested in this type of musical reasoning, the possibility to carry out experiments based on musical graphicacy with or without the use of external technologies, experiments that later gave a way to new theories and philosophies of musical creation as is the case of the second artist—Julio Estrada.

3.2. Chrono-graphical methodology of Estrada

Back in 1980, Julio Estrada[8] came into contact with the UPIC system. Estrada intended to approach and compose his first and only electroacoustic musical work *euo-on* (1980). It was an entirely experimental

[7] "'Qualisigns' are attributes abstractable from any number of instances, for example, the qualities of roughness, or depth, which can occur in different forms and contexts. Actual instances (objects or events) in which qualities such as these can occur are called 'sinsigns,' the 'sin' referring to 'single' or 'simple,' or, as Peirce puts it, 'being only once'" (Simmons III 2017, 120).

[8] Julio Estrada, a Mexican-Spanish artist, born in Mexico City in 1943, is one of the most prominent music creators of the last decades. He is also a theorist, a creator of new, original theory of musical creation. Among his most outstanding works there are: the electro-acoustic music *eua'on* UPIC (1980), the String Quartet *ishini'ioni* (1984–1990), *eolo'oolin* for a sextet of percussionists (1984–1998) the series *yuunohui* (1983–2020) for strings, wood-wind, noisemaker, keyboard and vocal, and the Multi-opera *Murmullos del páramo* (1992–2006). The compositional output of Estrada is complemented and shaped by the research from the field of theory and philosophy of music, done during his scientific research at the Instituo de Investigaciones Estéticas (IIE) UNAM. The reception of Estrada's theoretical postulates, as well as the musical work itself, can be observed not only in the artist's home country—Mexico, but also in countries of the European continent such as England, France, Spain, Germany, Portugal, Poland, Norway, Switzerland, Sweden, and Italy; on the Asian continent in China and Japan; on the American continent in Brazil, Chile, Canada, Cuba, Peru, the United States, and Uruguay. While in these countries the resonance of Julio Estrada's

form of using drawing as a medium to spontaneously link the musical reasoning with the imagination. In his own words, Estrada described the experience as follows: "My intention was to observe the link between the dynamic and psychic potentials through the inflections given to the drawing within the continuous medium and to create, with massive transformations, a texture that evokes the mental environment of the imaginary" (Estrada, in press, 64).

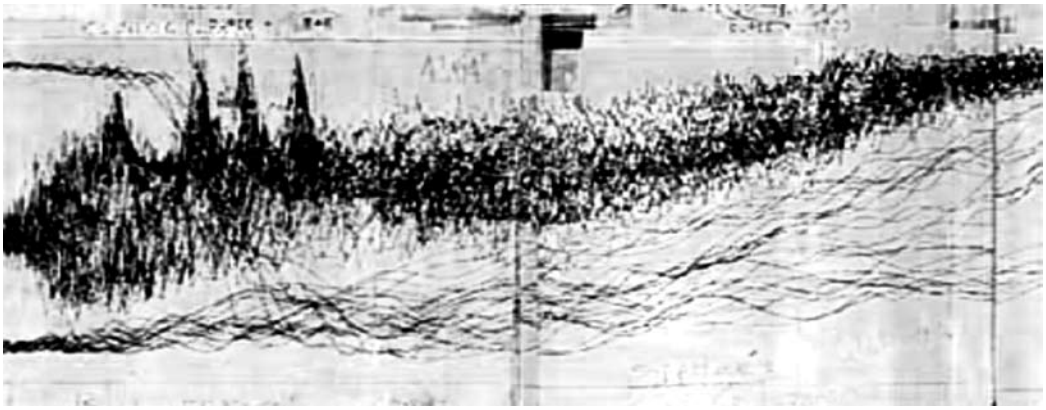

Figure 1. Julio Estrada *eua'on* (UPIC).

After completing his experience with the UPIC system, in 1983 Estrada began to develop his own chrono-graphic recording methodology presented in a graphic design, made by hand or using a digital transcription system, the so-called *euao'oolin* system.[9] The first design created by the system was called the *yuunohui'* cycle,[10] which currently consists of eight series of compositions for solo instruments and two series for chamber music, all based on the same graphic composition. The total set of ten *yuunohui* series, composed for solo instruments or chamber ensemble and vocal parts, is as follows:

- *yuunohui'yei* (1983) for solo cello,
- *yuunohui' nahui* (1985) for double bass solo,
- *yuunohui'ome* (1989) for solo viola,
- *yuunohui'se* (1990) for solo violin,
- *yuunohui'se'ome'yei'nahui* (1994) for string quartet,
- *yuunohui'tlapoa* (1999) for any keyboard instrument, e.g., piano, organ, harpsichord,
- *yuunohui'wah* (2008) for noisemakers,
- *yuunohui'ehecatl* (2010–2012) for solo or ensemble of any woodwind or brass instruments,
- *yuunohui'sa* (2017–2020) for solo voice,
- *yuunohui concertante*, which integrates each of the series created between 1983 and 2020.

This last series can function as a chamber orchestra piece with any number of performers, without the need for a conductor, because the piece is arranged so that each instrumentalist functions as a soloist.

This method proposes to establish a new technique for transcribing rhythm-sound components by means of drawings. The musical material intuitively perceived by the composer is presented in the form of a graphic design, made by hand or using a computerized *euao'oolin* transcription system.[11] The interpretation of a large amount of information to be processed into a graphic image requires a high degree of auditory involvement on the part of the composer and his ability to translate the parameters of sound images into the language

theory and musical works is noticeable and confirmed by concerts, phonographic recordings and scientific and critical texts, so far in Lithuania it has been minimal.

9 It was created by Estrada himself at the Instituto de Matemáticas, UNAM, México.

10 From the Zapotec language, *yuunohui*—fresh clay.

11 Estrada explains his method as follows: "Transcription from the sound-rhythm continuum is certainly one of the most revolutionary techniques in new music composition … The musical imaginary can be understood as a private inner world, consisting of intuitions, impulses, free associations, internal representations, memories, fantasies or reverie-induced aural perceptions. The imaginary can be translated into music through a method of chrono-graphic recording, in which the musical matter is divided into numerous chrono-acoustic categories" (Estrada 2002, 70–71).

of graphics. To achieve this goal, Estrada uses four stages of transcription. Each of them contributes to the transformation of the auditory imagination into the graphic one. The method of translation is explained by Estrada in the following four steps: "I. A chrono-graphic recording—an exact copy—of any musical material. II. The assignment of a set of reference scales to selected parameters in order to obtain the conversion of chrono-graphic data. III. A set of alternatives for transcribing data into a multidimensional musical score. IV. A musical performance that is a new version of the original material (I) based on the resulting score" (Estrada 2002, 80).

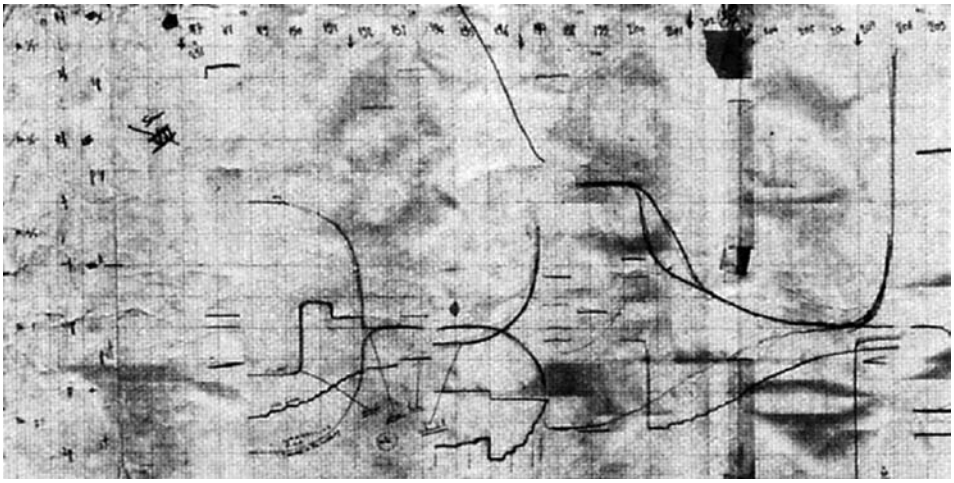

Figure 2. Julio Estrada *yuunohui'* (1983). Original chrono-graphical notation.

4. Reality and Imagination in Estrada's Theory of Composition

In Estrada's philosophy of composition, imagination encompasses everything that appears to the creator's mind:[12] it is a product of his individuality, manifesting itself through dreams, fantasies, memories, recollections, acts and states, etc. In music, it is more of a mnemonic process. Estrada explains that in order to experience the musical imagination, certain conditions are needed that are only available in the space and time of solitude, similar to those we find during sleep. At the same time, the material that appears in the state of imagination is not always identical to what appears in musical reality. The composer expresses it as follows: "The inner experience of the imagined occurs in states of solitude…. Objects of the imagination are in some cases not identical to how they are concretized because they often disappear from the control of those who perceive them" (Estrada 1994, 42). Estrada emphasizes the importance of a dialogue between two factors: musical irrationality (which is based on imagination and auditory perception) and musical rationality (which is based on the acoustic reality). Musical creation becomes more authentic when the following areas are combined in the act of creation: imagination and musical reality. The study of these processes makes it possible to base a new musical language on the relationships that develop between auditory perception and empirical reasoning. Estrada proposes to study three components: (1) mental atmosphere; (2) perceptual tendencies; and (3) movement. According to Estrada (2020),[13] (1) "the concept of mental atmosphere refers to the mental state that accompanies the imagination during the intense emotional experience in the process of creating music." Estrada defines this aspect of imagination with the help of the human instinct to recognize phonetic structures with different levels of expression and the associated sense of the pitch of a musical object.

[12] In his own words, Estrada explains this idea as follows: "This aspect has characterized my work ever since, where the structure of dreamlike—even delirious—messages should be the liberating material explained through the theory. Through this, my notion of music theory continued to grow, in order to understand the imagination with categories similar to those of the physical reality of musical material. From there I could see that the nebulous or almost real qualities of the imaginary cannot escape the qualities of the world of physics, which demands that fantasies be confronted with an attitude of full awareness" (Estrada 2001, 222).

[13] Interview by the author.

(2) Perceptual tendencies are "the ability to actively combine the senses with rational organization for the purposes of composition" (Estrada 1994, 51). Music is created through the combination of imaginary musical content and the process of rational organization of musical material. Given that each composer uses the possibilities in different ways, the results are endless. Estrada cites three cases in which different strategies for organizing musical material emerge. He illustrates them with the music of three composers from the second half of the 20th century: a) György Ligeti's micropolyphony, where the organization of the sounds is the result of the interweaving of different layers of repetitive melodic modules related to the natural sense of harmonic sounds; b) the evolution of music in Conlon Nancarrow's organization of time, where auditory illusions are created by manipulating time with "canonical imitations" of poly-tempo; c) the sonic masses of Iannis Xenakis, which eliminate any sense of pulse and enhance the sense of sonic space, which Estrada describes as cloud formations of sound.

(3) The explanation of movement is that "the sensations associated with the perception of movement coming from the musical imagination allow us to obtain somewhat more objective descriptions [of these processes] due to their similarity with reality" (Estrada 1994, 53–54). Analogous to Xenakis's methodology within the UPIC system, sound movement occurs naturally and instantaneously. The act of drawing allows the musical object to be represented by a "sinsign" providing its qualities: pitch, amplitude, color, and movement of sound in space-time. Besides these similitudes, the idea of representing the movement of the sound in Estrada's philosophy is related to the concept of the movement in music characteristic of the view of the indigenous Mexicans,[14] who express the movement observed in nature or in the imagination in songs and rhythms that are not based on the mathematical division of tones or pulses, as in the case of the European tradition of art music.

This last extended process theory of composition was shaped by Julio Estrada from the early 1980s until 1994. Its practical application in the creative process is linked to the search for new methods of interpreting his musical ideas. It is the result of a long period of research and creative work based on the findings of the humanities and social sciences (psychology). For example, the perceptual processes through which various forms of auditory and graphic representation are manifested inspired the composer to analyze the process of transforming imagination into musical notation. On the other hand, the value of Estrada's research into the physics of sound should be emphasized, using the technological advances necessary to experiment with UPIC and, later, with his own digital program *eua'oolin*. The conjugation of these two branches of research has made it possible to create a comprehensive theory of the creative process, describing every aspect of it in detail. This leads to the exploration of the external universe—its sounds, colors, aromas, and textures—to express the artist's inner world through them, with his fantasies, memories, emotions, in order to present the in vitro state of musical matter in the continuum as accurately as possible.

Conclusion

The type of reasoning presented in Xenakis's methodology and in Estrada's musical works shows connections with abductive reasoning, the essence of which was explained in the writings of Charles S. Peirce. Although both the Greek and the Mexican composers were unfamiliar with the American philosopher's theory, they applied a similar type of reasoning. In their statements, both artists emphasized the importance of the creative role of the mind which can be stimulated by both subjective (inspiration) and objective (influence) factors. In both cases, Peirce's theory of scientific reasoning together with the implication of graphicacy are presented in a similar way for what graphicacy means, but each case presents an independent value for what concerns the form of communication of the musical work. On the one hand, in the case of Xenakis, it breaks down the barrier that exists between the recipient and the creator, activating musical thought in a free and more spontaneous process. On the other hand, Estrada's graphicacy communicates the reality and the imagination of the sound phenomena in the act of musical creation with a high resolution of the rhythm-sound components. Although Peirce has never used the abduction procedure to explain the complex and hardly empirically verifiable processes of musical creation, the methodology presented in this paper confirms the value of the philosophical assumptions of Xenakis's approach to graphicacy and Estrada's theory of composition.

[14] These communities still live in northern Mexico and the southern United States.

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Grafiškumas: muzikos kūrinio įsivaizdavimas, kūrimas ir interpretavimas pasitelkiant vaizdus

Santrauka

Anot filosofo Charleso Sanderso Pierce'o, bet kuris vizualiai ir erdviškai mąstantis žmogus geba idėjas perteikti pasitelkdamas *grafiškumą*. Tai būdas interpretuoti erdvinę informaciją nevartojant kalbos, bet integruojant suvokimą, intuiciją ir vaizduotę. Muzikiniame kontekste grafiškumas susijęs pirmiausia su kompozitoriaus vaizduotėje sukurtos muzikos grafine reprezentacija. Šis faktas vaizdines priemones leidžia traktuoti kaip vieną esminių ontologinių muzikos kūrinio aspektų. Ir nors grafiškumas tradiciškai siejamas su muzikine notacija, Peirce'o filosofiniai postulatai apie mokslinį samprotavimą ir su juo susijusią piešimo reikšmę atveria platesnių šio aspekto traktavimo galimybių. Pavyzdžiui, netradicinis grafinio muzikos užrašymo būdas geba integruoti įvairias suvokimo, intelekto ir emocijų formas ir užtikrina platesnį komunikacijos tarp vaizduotės ir muzikinės materijos diapazoną.

Straipsnyje pristatomos dvi alternatyvios grafinio užrašymo formos: 1) XX a. II pusėje Iannio Xenakio pasiūlytas bene pirmasis novatoriškas elektroakustinės muzikos kūrybos metodas, kuriame piešinys buvo naudojamas kaip tęstinių muzikinių fantazijų vaizdavimo forma (*UPIC* sistema); 2) antras atvejis – Julio Estrada'os sukurta chronografinio įrašymo metodika ir *eau'oolin* sistema. Abiem atvejais muzikinė vaizduotė lemia skirtingus rezultatus, susijusius su muzikine realizacija galutinėje partitūroje ir su muzikos kūrinio interpretacija kaip nauja pirminės idėjos forma.