

Composing Understandings: music, motion, gesture and embodied cognition

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ABSTRACT

This paper focuses on ongoing research in music composition based on the study of cognitive research in musical meaning. As a method and result at the same time, we propose the creation of experiments related to key issues in composition and music cognition, such as music and movement, memory, expectation and metaphor in creative process. The theoretical reference approached is linked to the embodied cognition, with unfolding related to the cognitive semantics and the enactivist current of cognitive sciences, among other domains of contemporary sciences of mind and neuroscience. The experiments involve the relationship between music and movement, based on prior research using as a reference context in which it is not possible to establish a clear distinction between them: the Capoeira. Finally, we propose a discussion about the application of the theoretical approach in two compositions: *Boreal IV*, for Steel Drums and real time electronics, and *Converse*, collaborative multimedia piece for piano, real-time audio (Puredata) and video processing (GEM and live video) and a dancer.

Author Keywords

Music and motion, embodied cognition, composition

CCS Concepts

•Computing methodologies → Cognitive science; •Applied computing → Sound and music computing; •General and reference → Empirical studies;

1. INTRODUCTION

The interaction between music and movement is one of the most basic experiences of listening and composing music. Considering the idea that “the way we conceptualize music is not, in principle, different from the way we conceptualize the world” [19, p. 16], music and movement co-occur since our most basic and primary experiences. As a matter of fact, the music cognition is directly connected to our sensorimotor system, inasmuch as “movement is an intrinsic part of the music experience. Music and movement co-occur from the first musical relationship” [17, p. 293-4]. The metaphor of movement in music has concerned theorists and composers in several aesthetics and theoretical avenues since ancient times [19].

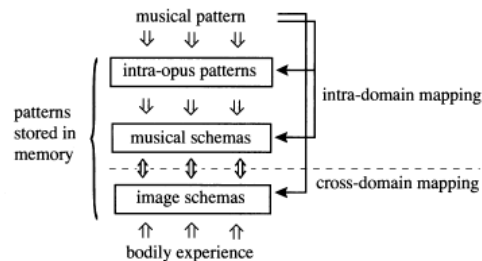


Figure 1: Brower's model for musical experience

In this sense, it is important to highlight the interesting articulation of conceptual metaphors [12, 11, 8, 9, 19, 13] to understand and compose music [3, 13, 16]. If we conceptualize music with our bodies, then bodily experience can be taken as model for understanding and reasoning, even prior to language. The collaborative processes in artistic works offer us uncountable examples of how music and movement interact to shape poetic universes mediated by technology.

This paper focuses on ongoing research in music composition based on the study of cognitive research in musical meaning. First, we shall briefly describe prior research about the relationship between music and movement, which take as reference a context in which it is not possible to establish a clear distinction between them: the Brazilian Capoeira. As a method and result at the same time, we propose the creation of experiments related to key issues in composition, such as music and movement, memory, expectation and metaphor in creative process.

2. THE THEORETICAL FIELD

Brower [3] was one of the first theorists to take the conceptual metaphors and the idea of image schemas [8] as reference to understand music. In Image 1 we present Brower's model for music experience.

Based on this model, Brower proposes six image schemas as context for musical analysis: container, cycle, verticality, balance, center-periphery e source-path-goal [3, p. 326]. These image schemas offer us a rich way to think composition and an interesting possibility for interaction between music and movement through embodied cognition.

The idea of gesture in music also represents a very important theoretical avenue. Composing, thinking and analyzing music through the conceptual metaphor of gesture implies consideration the physicality of music, to consider body movement, and the forces that act over our bodies as references. Gritten and King[6] proposes a well-informed survey about the intersection of music and gesture.

Larson's theory of musical forces [13] offers us a fruitful articulation between gesture and meaning, based on forces



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which act in our bodies: magnetism, gravity and inertia. According to LEMAN [14, p. 27] “there has been a growing awareness that gesture and motor-based processing of musical content play an important role in connecting musical mind and matter”. The importance of gesture is crucial in the embodied cognition mediated by technology:

Since the mid-1990s, research has been strongly motivated by a demand for new tools to examine the interactive possibilities offered by digital media technology. This stimulated the interest in gestural foundations of musical involvement, which form a core component of the embodied cognition approach [14, p. 45-46].

The bodily gestures can be thought as control for spatialization and synthesis systems as well, or even as source for analysis and composition [5]. In this sense, body movement and sound are connected in a computational environment and the interaction depends on the strategies preprogrammed on software.

The composer Zvonimir Nagy articulates cognition and performance in his discussion about the compositional creativity, proposing both modalities as plastic and physical:

Thus the central focus of my discussion of compositional creativity is the interrelationship between the mental and physical attributes of embodiment in music: two psychological aspects of creativity that I term the plasticity of cognitive modality and the physicality of performative modality of compositional creativity [16, p. 4].

Zagy’s premise plays an important role in the experiments I shall further describe, as we consider the implication between gesture and meaning, cognition and movement, creativity and performativity.

3. PRIOR RESEARCH

In my doctoral research ¹, I focused on the complex interactions between music and movement, and specially its uses and functions in the creation of compositional processes, taking as reference a context in which it is not possible to establish a clear distinction between them: the Brazilian Capoeira [2]. Capoeira is a combination of music, dance and martial arts that has been developed in Brazil by West African slaves and its descendants and has been exported all over the world. The combination of field work and a critique of existing literature on the interaction between music and movement led to the proposition of a conceptual framework², four concepts which are not mutually exclusive: Cyclicity, Sharpness, Circularity and Surpriseness.

The first concept of the framework is cyclicity, the idea of cycle. The rhythm, the melodic profiles, the movements and the play itself are cyclic characteristics of Capoeira. The idea of cycle is one of the most important schemas for time. The cycle organizes our sense of time. In music, cycle

¹For my PhD in Music Composition at Universidade Federal da Bahia (Federal University of Bahia – UFBA), earned in 2013.

²In order to propose effective dialogues between music and movement, we analyze the Capoeira movements through Laban/Bartenieff Movement Analysis, according to their body organizations, expressive characteristics, spatial structures and forms. These analysis were mediated by technology, especially through video and audio recordings. The Laban/Bartenieff Movement Analysis represents a powerful tool for movement analysis and a privileged way to establish strong connections between music and movement [10, 4].

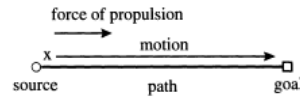


Figure 2: Source-path-goal image schema

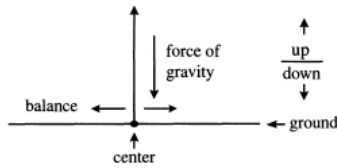


Figure 3: Center-verticity-balance

plays an important role: cycles of songs, cycles of fifths, interval cycles, and so on, are obvious examples. The cycle is one of the image schemas based on our body experience [3, p. 328].

The sharpness is related to the property of directed movement, the trajectory from a source to a goal. Several movements in Capoeira aim for the opponent and some Capoeira rhythms are strongly accented and straightforward. Here, we establish a dialogue to the source-path-goal image schema [3, p. 326]. In Image 2 we show the diagram for the schema according to Brower.

The circularity refers both to literal (geometrical) and metaphorical senses (center-periphery relationship, spirals). In Capoeira, the circularity is in the surface of the phenomenon: the roda, the circular movements, the circular aspects of the rhythm, and so on. Beyond these literal characteristics, it is important to mention the idea of circularity as a relationship between forces and weight transference, therefore, connected to center-periphery schema [3, p. 328]. The circular movements in Capoeira act on the edge, negotiating with the natural forces of gravity, verticality, balance, and connect to the idea of spirals in movement.

The forth concept is one of the most important and idiosyncratic for Capoeira: the surpriseness. The capacity to surprise someone else is a vital force in Capoeira³. Likely, the domain of expectation is also one of the more powerful strategies for composition in music. The surprise is a sudden break of a balance, in different senses. In Image 3 we show the diagram for the combination between center, verticality and balance (BROWER, 2000, p. 330).

The strategies of analyzing movement in connection to music have led us toward a collaborative work where several aspects of movement could be engendered in a poetic universe of music, dance and video. This conceptual framework allowed the composition of several works, performances and videos, as well as the experiments described in next section.

4. EXPERIMENTS

My ongoing research in music composition, in course at UFBA, focuses the relationship between music and movement through embodied cognition. We took the conceptual framework from the prior research as reference, proposing unfolding towards Nagy’s premise. The research has been developed in Composition and Culture Research Group, in collaboration with graduate scholars and students.

As a method and result at the same time, we propose the

³It is important to mention the discussion about memory and expectation, an important debate through which we could propose valuable insights [7, 18, 1]. Due to scopus’ issue, we shall not discuss these question here.

creation of experiments related to key issues in composition. These experiments were planned in three stages.

First, we created experiments as short musical excerpts, taking the conceptual framework as reference and proposing strategies for composition through the relationship between music and movement, memory, expectation and metaphor in creative process⁴. Two young composers and one young musician joined the experiments. After extensively discussing the results, we composed pieces for Bouzouki and electronics which were premiered and recorded. The material generated at this stage (the composition, tools for composition teaching, texts, information about interactive composition) are available in <https://fermataweb.wordpress.com/>⁵.

The second stage proposed the composition of didactic works for solo instruments and electronics. We aim to make available pieces for young musicians interested in interactive music and extended techniques. Five young composers collaborated at this stage. We composed short pieces for flute, guitar and cello, focused each in a specific technique. These pieces also considered the issues of embodied cognition and took the musician's gestures as questions for the compositional process.

The third part is our current stage. We took the didactic pieces as a context for research. According to Leman:

[A] number of interactive multimedia platforms have been developed (see, for example, Pure Data, Max/MSP, or EyesWeb) that have contributed to the study of the gestural and multimodal foundation of musical involvement. The platforms offer easy access to sensing devices and processing modules for rapid prototyping of experimental setups [14, p. 46].

In this sense, in this stage we extended the focus and proposed a study of music and movement which uses gesture and meaning in a powerful sense. We selected six young musicians from UFBA's School of Music and proposed to them experiments on meaning. The experiments consist of monitored sessions of study of the didactic pieces, one of each instrument. Two young musician are going to study the same piece and all the sessions has been recorded on video, audio, brain activity (EEG) and Motion Capture.

The EEG recording system is the Open BCI Ultracortex "Mark IV" EEG Headset⁶, with a 8-channel Cyton Board. The Motion Capture System is an OptiTrack, running Motive Software, with Upper Body Biomechanics Markersets⁷. Figure 4 shows one of the experiments with a young cellist.

These experiments were design considering Nagy's premise about the interrelationship between the mental and physical attributes of embodiment in music, as we discussed earlier in this paper. If we consider the two psychological aspects of

⁴It is important to mention that the experiments were mainly practical, as the musician played all the excerpts and we could record the sessions in order to get material to analysis.

⁵Unfortunately, it is a temporary platform for sharing the preliminary results, up to now just in Portuguese. The publication of the website in English, containing all the material is planned for the next year. Besides the interactive composition, the research also focused on extended techniques and tools for teaching composition. Due to scopus' issue, we shall not address these questions in this paper.

⁶The Ultracortex is an open-source, 3D-printable headset intended to work with any OpenBCI Board, which record brain activity in up to 16 channels. More information in <http://openbci.com/>.

⁷More information in <http://openbci.com/>



Figure 4: Experiment with a young cellist

creativity, plasticity of cognitive modality and the physicality of performative, we expect to get important information to discuss meaning and experience in music. Each pair of musicians study the same piece, one of them knowing from the beginning the articulation between gesture and material presented into the piece. In all cases, the other musician discover the correlation at some point. We track the musicians' gestures and brain activities, in order to find coincidences and discrepancies between each pair of musicians, and the possible change of brain activity according to the awareness of the importance of physical gesture in the composition process.

It is important to point out we are not suggesting that gesture can be represented as a mental state by EEG. As an enactivist point of view [15], we expect to recognize the dynamics [1] of EEG and Motion Capture, in order to compare significant changes. They are not intended to be conclusive nor to propose insights about the brain activity concerning music practice. For example, a composition in which the musician should play an excerpt in a circular movement of the right hand, in order to get sounds that has been written in the score. Is there a change of brain activity when the young musician notices this pattern? We seek to ask different questions about embodied cognition in music composition, once our focus is more on questions arising than the responses.

The results are still inconclusive, but they suggest us interesting discussion about the dynamics of brain activity and gesture patterns, and how they play together in the way we understand music. Currently, we are analyzing data, and discussing the results with the participants, in order to propose a conceptual framework.

Finally, it is important to point that we expect to publish the experiment protocol and discuss the results, in order to propose understandings for creative processes in Composition.

5. APPLICATION IN TWO COMPOSITIONS

The interaction between music, motion, gesture and embodied cognition represents an interesting avenue to understanding and especially to create music. Two works may offer themselves as examples and preliminary results of the experiments and its application in creative process.

First, *Boreal IV* is an interactive piece for Steel Drums and electronics composed in 2015⁸. The expressive intent is related to an explosion, but a beautiful and sensitive ex-

⁸Boreal is a series of five electronic works I wrote for my daughter, from two months before her birth until she completed one year old. The first piece is acousmatic in four channels, the second is for flute and electronics, the third is for percussion (Brazilian shakers) and electronics, the fourth is for Steel Drums and electronics and the last one is for Bouzouki and electronics

plosion. The wonder from an inexplicably strong and full enthusiasm experience. The *Boreal* series approaches at the same time the force and delicacy present in hidden caches of human existence. The work was written for (and with collaboration of) Humberto Monteiro and the main material derives from the experiments realized in the first stage of the research.

The timbral richness and the instigating results from movement patterns on the instrument led me to the formal and gestural designs. The electronics take the instrument's input both as control and source of material for real-time processing. An algorithm based on Markov Chains extracted from a repertoire of works allow the patch to react to the performance in real-time, according to a specific intended behavior. The main process of transformation is based on a resynthesis process, where I get new sounds from the instrument through spectral manipulations such as transpositions (part or total), time alterations, and so on. All the materials were derived from the musician's gestures on the instrument, and the composition process take as reference the performativity, both in the score and live electronics⁹.

On the other hand, *Converse* is a collaborative work created by Guilherme Bertissolo, Lia Sfoggia and Luciane Cardassi in 2018. It is a 12 minute piece for piano, real-time audio (Puredata) and video processing (GEM and live video) and a dancer. The collaboration took place in biweekly meetings throughout the first semester of 2018. Initial sessions included brainstorming of ideas among the three collaborators¹⁰.

The starting point for the creative process was the idea of "state of readiness". This notion was inferred in Brazilian Capoeira, observing the way through which a player must be constantly prepared for immediate response to change within the context and constraints of Capoeira. This is a key concept for Surpriseness, as described earlier.

Once the "state of readiness" was chosen, performer and composer worked towards investigating the music with this concept. Meanwhile the dancer (who is also responsible for the photos and video) interacted with the others via improvisatory movement sessions. The result of this work is a performance embracing the unpredictable at its core, within constraints created and practiced during rehearsal. The collaborators create on stage a unique performance that dialogues with notions inferred in this Afro-Brazilian cultural staple.

In *Converse*, the performative modality is a key for the creative process. For example, figure 5 shows the very beginning of the piece. The gesture is written in a way to keep itself open to the logic of the pianist's fingers. The accents are notated in a separated staff, in order to point notes, accordingly to state of readiness of the musician during the performance.

This gesture is presented in *Converse* as a cycle, engendering form through sharpness, in progressive development. Circularity, on the other hand, plays an important role in the central section of the piece, where time is non-linear, exploiting texture and different timbristic combinations between regular and prepared piano notes.

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⁹Score and recording are available in FERMATA Website <https://fermataweb.wordpress.com/>.

¹⁰Score, audio and video recordings are available in <https://guilhermibertissolo.wordpress.com/>.

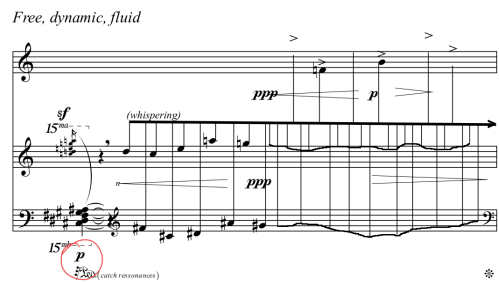


Figure 5: *Converse*: first gesture

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