Sonic Gestalts

Sound Articulations in the Continuum

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Introduction

Throughout history, music has been intimately linked to the human body, either by a physical interaction with an object or by the physical movement and contact with the body itself, music was generated with the same principle of sound production: the mechanic vibration of an elastic body. This long-term human conditioning has had an impact in music perception and conceptualization, and still does nowadays.

Nevertheless, the emergence of new technologies has deeply affected the socio-cultural music function besides the perception and creation model; The role of human movement and the mechanical interaction with an object as main sources of music making have been replaced by the movement of a speaker membrane, by music processes that are invisible or by intangible means of production. Moreover, the breach of tonality, the appearance of new systems and sound structures, the expansion of percussion instruments and the non-conventional instrumental techniques, reflect a necessity and an acceptance of an intrinsic musicality in all sounds. These conceptions and influences opened up an immense window for sound exploration, both in composition as in performance, allowing us to freely navigate into the musical universe having the possibility to deal with musical material as fluid moldable matter rather than concentrating in the possibilities of an small area such as the combination of discrete permutational units.

Although technological developments have influenced the expansion of musical panorama and are playing an increasing role in musical praxis, demanding new models and strategies of music perception and aural focalization; Anyhow, physical gestures as energy or kinetic inputs for articulation, temporal shaping, aural congruence and sound expression remain being important sources for music creation. Although traditional western instruments were affected by the development of music being designed to function in harmonic and melodic confines, they have also developed refined sound techniques grounded in centuries of tradition, hence becoming excellent transducers of gestural information and presenting an accurate interface for electro-acoustic sound control and expression. The challenge is now how to map them and incorporate this physical data into relevant information for digital processes.

In addition, music is a cross-modal experience, in other words, music appeals to more than just our sense of hearing, there is a constant cooperation and interaction of our senses in a listening experience, in which mechanic and dynamic motion play an important role to trigger gestual images and musical imagery, affecting the way we create and perceive music.
Thus, I propose to focus in both, the potential of physical gesture as a source for sound articulation, shaper of sound structures and expressional sound interface, as in the use of holistic energetic gestalts as sound objects for music composition. Besides exploring their psychological implications for sound perception.

In any case I am not trying to delimit what is or what is not a musical gesture, partly because no musical material is exclusively or merely a gesture, in this sense is more fruitful to assume that certain sound structures are more directed to have gestural characteristics, and hence being able to explore this aspects.

Gesture Signifies

Gesture is normally a loose term employed in traditional music that, in a narrow view, refers to a resemblance of a certain musical unit with human motion within harmonic considerations. But as soon as we escape tonal systems, and we start to deal with more complex musical parameters, gesture is basically an articulation of time.

In music composition we mentally articulate and organize sounds in time by a set of conscious and unconscious relationships and decisions, the instrumentalist (in case there is one) transforms this imaginary articulations into physical articulations within space and time based on his own interpretations and conceptions of the work and within his technical instrumental skills, and the listener "re-articulate" this data by decoding acoustic, and possibly, visual information, into personal meaningful relationships or/and emotional responses.

This, although heavily condensed and linear, model of musical communication infers that between compositional idea and the listener's emotion, there is a long path of interpretations and significations in which the term *gesture* seems to be more adequate than the more neutral and arid conception of articulation. In this way, articulation gains the status of gesture by the mediated function of musical significance. Hence, gesture is a representational musical unit, a musical idea translated by a physical action and decoded by the listener. This does not mean that I suggest the creation of stereotyped gestures to represent specific entities or emotions, but on the other hand representation and signification in music are aspects in which musical experience is based.

Thus, gesture, as an extremely condensed musical idea, represents flows of directional energy that become actual by body movement or sound processes, and that are of great potential as departing point for musical development. Nevertheless**,** as different definitions of the term gesture can be encountered over the general literature on the fields of communication and music, I find important to discuss some of them in order to clarify and define the common grounds with my own ideas of the topic.

Definition of gestures

Although there is a large variety of definitions and many of them are specific to their own fields or disciplines the common denominators seem to be *movement* and *expression (*even though there is also the concept of *posture* within the definition of gesture, being this a static form of representation, similar to a frame of a gesture).
It is also clear that there can be different categories and branches of gestures, but for the purpose of this text I will concentrate in what I consider to be the most important in music production:

1. Visual Gesture
2. Mental Gesture

In principle many of the definitions deal with the concept of gesture as human movement, from the very simple 'hand movement' to the complex physical technique, they can be a form of non-verbal communication or a fundamental aspect of speech, but both conceived as intentional human movements. Yet, I think that similar movements of physical objects or animals can be considered as gestures by applying the same communication ideal, hence extending the concept to everything that we can visually perceive, convey and understand with some meaning, an action or posture from any animate or inanimate body that occurs at specific time and space. Which in any case remains problematic is not so much the role of the performer, since the "intentional" and "human" parts of the definition have been discarded, but the role or attitude of the receiver, hence the role of meaning.

A common discussion in this field is the 'handwriting' and 'typewriting' gestures. Many of the definitions would not include as gestures the hand movements of a person writing nor typing:

> *"A gesture is a motion of the body that contains information. Waving goodbye is a gesture. Pressing the key on a keyboard is not a gesture because the motion of a finger on its way to hitting the key is neither observed nor significant; all that matters is which key was pressed. Handwriting is not a gesture because the motion of the hand expresses nothing; it is only the resultant words that convey the information. The same words could have been typed- the hand motion would not be the same but the meaning conveyed would be".* (Kurtenbach, Hulteen. 1990)

They do not include these movements as gestures with the premise that they are neither significant nor observed. In this assumption the role of the 'observer' is of great importance, it depends on him to evaluate the received information and decode it into meaningful movements, hence, based on the same definition, becoming gestures. Furthermore, the production of identifiable characters or of words is not absolutely separable from the graphical function in the case of handwriting or from the articulation/sequence of event characteristics, but these are essential to their realization. (Cadoz, Wanderley 2000).

Beyond movement considerations, one of the important features to convey meaning to movement is not just the movement itself, but also the moment before the movement and between the movement. These spaces allow the receptor to apply meaning or reflect over the meaning of a certain movement.

Every system, object or living body is in constant movement, it might be apparent or not, it might be extremely slow or so fast that is unperceivable for the human eye, it might be intentional or unintentional, it might want to express something or not, but every movement contains information about or from the emitter, it is up to the receiver to in first instance perceive the movement and secondly try to decode it applying meaning to it, closing then the communication paradigm.

Moving to the musical domain, a branch of the visual gestures, and a much more specific topic would be the instrumental gestures. Although they are performed as physical actions within specific time and space, and most of the times realized by humans, they are difficult to adapt in a standard definition of gesture.

Instrumental Gesture

Halfway between the visual gesture category and the Mental Gesture we find the Instrumental Gesture. It is a gesture that although consists of physical movements occurring in space, hence conveying visual information, their main objective is to convert physical energy applied to an object into sound, so they can be considered as to be the precedent of *mental gestures*.

Classification of Instrumental Gestures

According to M. Wanderley and M. Battier there are three level classifications of Instrumental Gestures:

- *Effective Gestures*: Physical imprinted energy on an object in order to produce sound.
- *Accompanist Gesture*: Body theatrical movements simultaneous to effective gestures
- *Figurative Gestures*: Perceived sound movement with or without a clear correspondence to a physical movement. Related with the listener's sound image.

The particularity of the instrumental gesture is the use of an object to produce sound (Effective Gestures) that is why I find important to concentrate in the relation and interaction between human and instrument while the Figurative Gestures, being part of sound perception, are explored in the next chapter.

Effective Gestures

As I said, a singularity of instrumental gestures is what is called *gestural channel* (an instrument).
This gestural channel is an object with a double function, it is both a receptor and an emitter of gestural information, therefore the particularity of this gestural modality is the interactivity between the manipulation of an object that reacts to certain imprinted physical energy and the response of that reaction by the channel's manipulator (specially in the case of musical instruments).

Besides this singular physical interaction between the object and the subject there is an intrinsic *semiotic* component that plays a common role in the rest of gestural modalities and it is convey by the receiver.

Therefore the conditions and characteristics of instrumental gestures are the following:

- It is a gesture applied to an object that creates a certain physical interaction.
- The subject can master this interaction and its dynamic evolution.
- This interaction can be the support for communicational messages and/or the basis for the production of information

Gesture Typology

Considering these characteristics (Cadoz 1988) proposed the following Instrumental Gesture Typology:

-*Excitation Gesture:* Provides de energy that will finally be present in the perceived phenomena. This can be of two types:
-*Instantaneous*: percussive or picking
-*Continuous*: bowing, blowing

-*Modification Gesture*: Are small variations of the instrumental properties. It affects the relation between the excitation gesture and the produced sound. They can be:
-*Parametric*: A continuous variation of a parameter, such as vibrato.
-*Structural*: Modification such as insertions or removals of instrumental parts.

-*Selection Gesture*: A choice of different elements in an instrument, keys, frets, strings.
-*Sequential*: Two or more elements after each other.
-*Parallel*: Two ore more elements at the same time.

It is important to notice that in a complex instrument these elements can be combined and interrelated creating different relationships.

In order to clarify each of these points I will make a brief analysis of the flute in terms of its gestural typology.

Flute's gestrual characteristics

As it is known the flute consists of three basic parts: the headjoint, the body and the foot, the mechanism to produce a tone is by blowing a focused air stream over the

embouchure hole in the headjoint. Let us then analyze the flute by its gestural components.

Flute's Gestural Typology

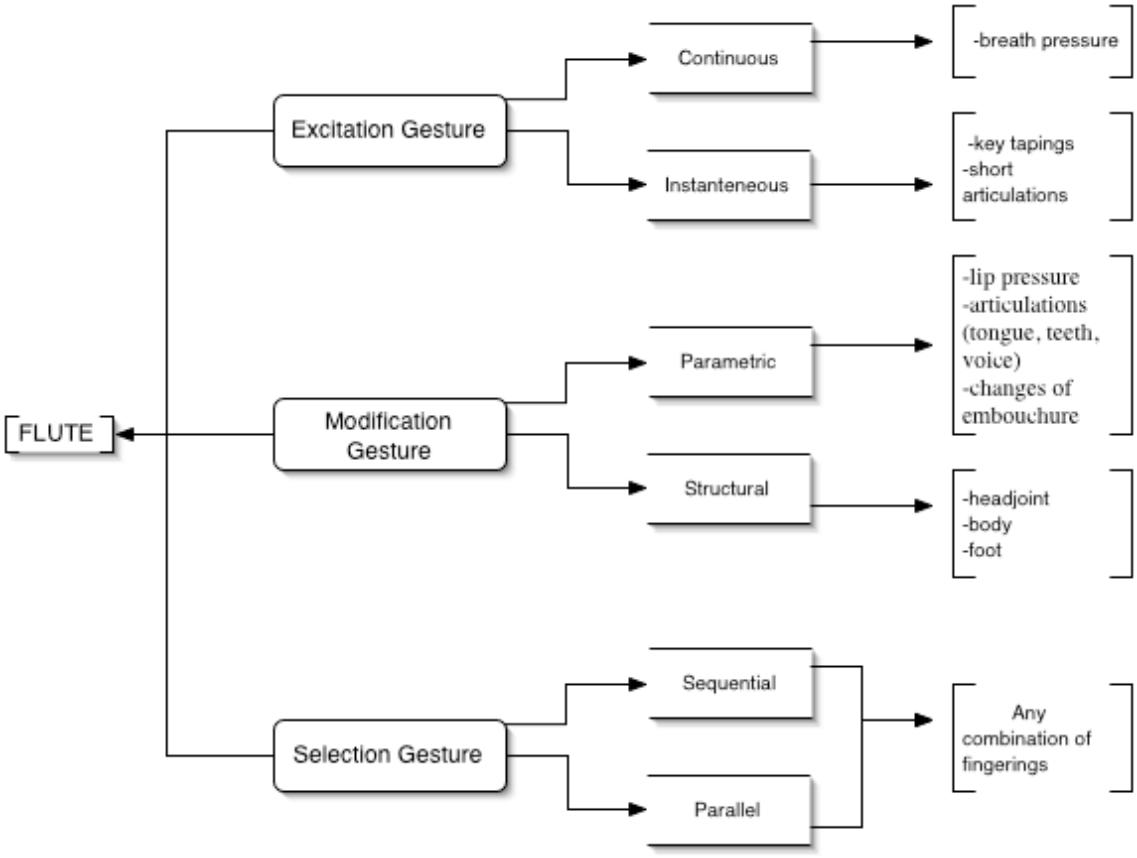

Fig.1

As mentioned before many of these elements are not self-dependent, in many cases they are complementary or they can collaborate to form part of the same gesture and musical functionality. In my piece Tú vo (2005) for flute headjoint and live electronics, I explore the flute by the reduction and expansion of some of these gestural categories.

Tú vo (2005) *for flute headjoint and live electronics*

In this piece, as in other works, I try to approach the instrument as an object by exploring its gestural possibilities while discarding traditional ones.
The object manipulation is based in the concentration of *modification gestures*. In one hand I reduce the instrument in its structure to the minimum by concentrating in just the use of the headjoint, that due to its size functions as a magnifying glass of vocal gestural capabilities allowing the exploration of different possibilities of subtle articulation, controlled air directionalities, embouchure angles and lip pressure.

Hence, enlarging the parametric gesture modifications and continuous gesture excitations by a structural reduction of the instrument.

The electronic process is mainly controlled by *gestural excitations* via amplitude mapping of breath pressure.

- List of used phonemes.

Stop/Plosives

Bilabial	p	Paw, apart, up
	b	bog, aboard, lob
Alveolar	t	top, at, bit
	d	Dan, Ida, bead
Velar	k	key, akin, dock

Nasals

Bilabial	m	Ma, e-mail, sham;
Alveolar	n	gnaw, Anna, on;

Fricatives

Labiodental	f	Far, awful, whiff
Alveolar	s	see, passing, base;
Postalveolar	ʃ	Shaw, ashore, mash;
Velar	x	Bach;
Glottal	h	hard, ahead

Affricates

Alveolar	tð	Chaps, itchy, botch;

Approximants

Alveolar	r	Red, awry, are;
Lateral	l	lewd, alive, coal, call;

-Notation.

Angles of the headjoint

- Normal playing
- Covering the hole with the mouth (completely).
- Turned out
- Turned in.

End Hole

- Open (normal).
- 1/4 covered.
- 1/2 covered.
- Fully covered.

*Use finger

Fig.2 Symbolic Use in Tu vo (2005)

The piece consists of three sections:

1. - *Modification of Parametric Gestures:* This first section is based on the exploration of 'phonetic articulations', rhythm, embouchure positions and dynamics. Dynamic range is notated in a vertical axis while the phonetic articulation has to be performed with the indicated rhythmical value and the right embouchure angle.

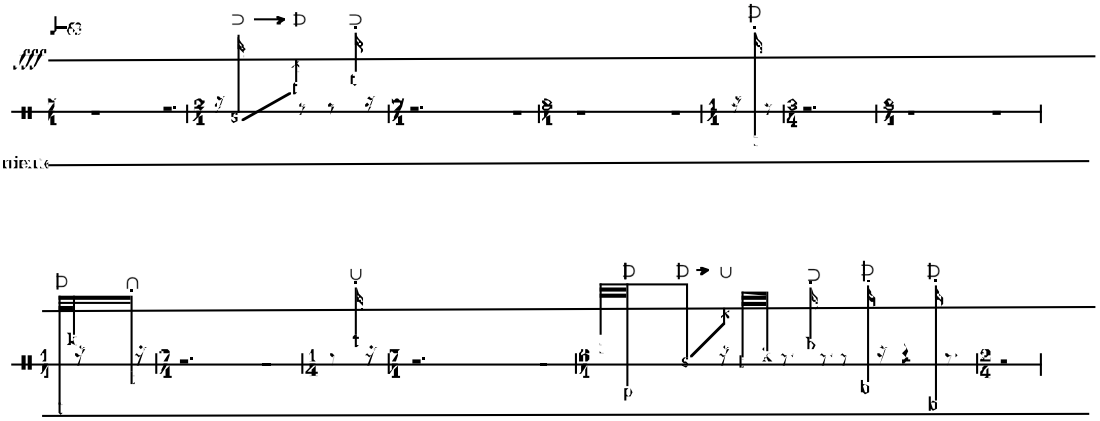

Fig. 3 Excerpt from the first section Tu vo (2005)

2. - *Continuous Excitation Gestures*: Although this section deals again with different embouchure angles the continuous excitation breath pressure plays a key role since the stream of air has to be carefully controlled to maintain a smooth modulation between air noise and the natural harmonics from the tube's resonance.

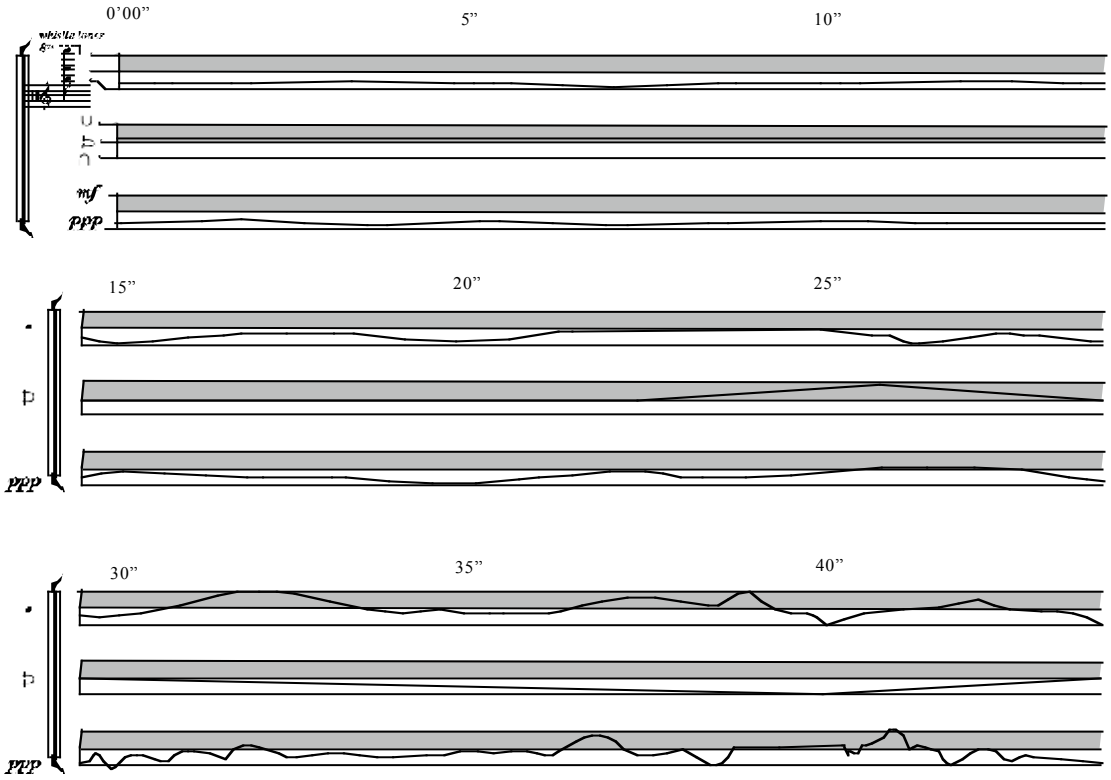

Fig. 4 Excerpt from the second section Tu vo (2005)

3. - *Excitation Gestures + Modification Gestures:* This third and last section explores the combinations of the two former sections by exploring different air trajectories interrupted or generated by phonetic articulations.

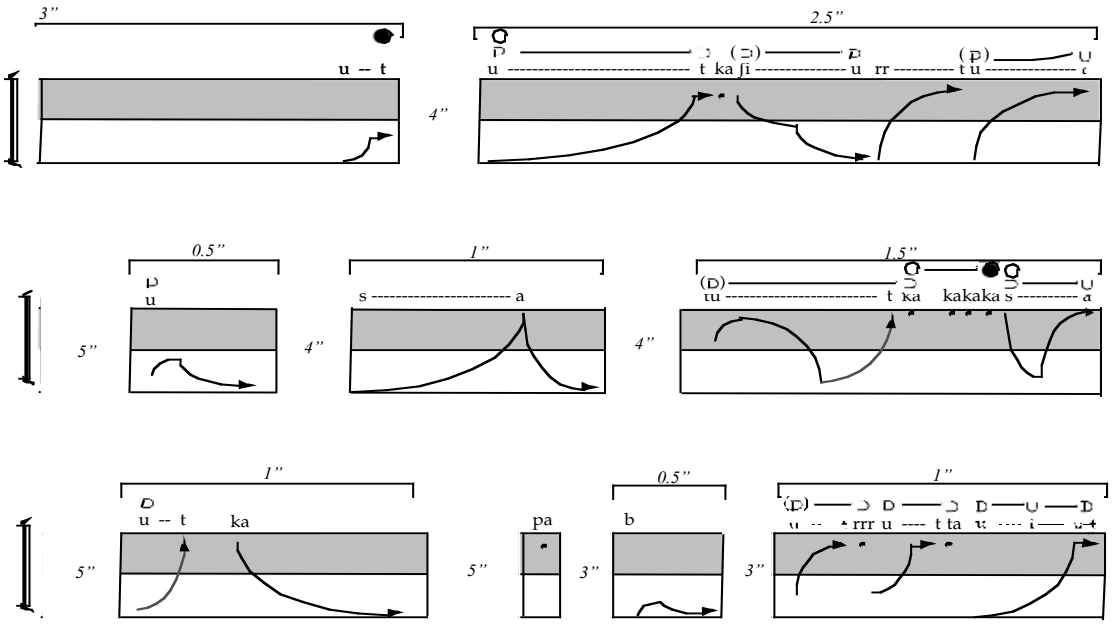

Fig. 4 Excerpt from the third section Tu vo (2005)

Extending Instrumental Gestures

Since the previous century, there has been an incessant exploration of non-conventional techniques of traditional instruments as a necessity to discover new sound possibilities or adding to the musical repertoire former aesthetically discarded sounds. Although these instruments were developed and created with a different aesthetic reference, to play certain kinds of musical repertoire and to function within melodic and harmonic confines, they have proofed to be adaptable to new sound aesthetics and new music genres, such as in jazz. Nonetheless, their construction was conceived as musical sources focused to maintain stable pitch control with a variety of articulations and note durations depending on the instrument and the human technical skills, but the accurate control and variation of timbre was not a priority for instrumental builders; Evidently, because it was not a priority for composers nor for sound aesthetics either.

Increasingly, timbre has become an important parameter in music, the technical possibilities and knowledge available nowadays provide us with accurate tools to explore internal sound structures, allowing us to manipulate them, store them and categorize them, which it could have been some of the problems deriving in a lack of interest in previous composers. Furthermore, human technical as well as ideological developments have brought a musical sound liberation by expanding our conception of musical sound to all possible artificial and natural existing sounds.

As mentioned before, traditional instrumental techniques have been expanded in order to explore these new sound aesthetical conceptions, stretching the sound palette of

instrumental possibilities. But as traditional instruments remain physically the same as in the Romantic period, and physical human technical skills will not dramatically change, this new set of possibilities will soon become exhausted and considered as pure additional "effects" deviating from the standard technique.

On the other hand, digital sound processes offer an immense set of possibilities to create rich and complex sound structures and transformations, which traditional instruments will never be capable to perform, but these are created by invisible processes that lack a physical causal relationship with the experienced sound in a real-time concert situation. New 'instruments' are being developed that try to maintain this cause-effect sound relationship while having a considerable degree of sound control.

In any case, human motion is still the ideal input for sound expression in the filed of live electronic music, if we are to build new instruments to control digital sound processes, these have to function as free channels for gestural expressive motion, not as barriers. Certainly, traditional instruments have little new to offer in terms of sound creation within the enormous world of digital sound synthesis. Furthermore, their sound is charged with very strong contextualized historical content, which can be problematic if we are to concentrate in sound processes avoiding any referential content. However, I believe in their potential as physical interfaces for sound control as they comprise a very long baggage of developed accurate technique accumulated over centuries of improvement as the result of new aesthetical necessities, could not be the case with this new aesthetical need? Anyhow, the remaining challenge is how to optimize the performer's space in order to gather valuable information and how to map these values to maintain the coherence between input and output.

Top your Buffer (2006) *for guitar and live electronics*

In my piece Top your Buffer for guitar and computer, I have tried to explore some of these notions by extending the gestural possibilities of the instrument in relation with its sound processes.

Instrumental Use
The guitar is used in a vertical way, rather than the conventional horizontal way, in this fashion is possible to:

- Articulate sounds by plucking the strings with both hands, hence being able to achieve a major concentration of attacks and better density control.
- There is a larger string control surface considering the extension of the string from the guitar's head to the bridge, allowing a better control of continuous sound (by scratching the strings with the use of a plectrum).
- There is a better degree of control and variety wood sounds (over the guitar body).
- The use of both hands on the instrument and the enlarged distance of control surface over the whole guitar body, enhance the movements of the performer and create a better connection between bodily motion and the sound produced.
- Furthermore, all the traditional possibilities of the instrument remain possible by plucking the string with the right hand while controlling pitch with the left hand over the fingerboard.

Digital Sound Processing and Structuring Processes
The sound activity form the guitar is recorded in real-time and stored in a buffer of flexible duration. Subsequently, the computer performer selects a portion of it, which is then processed-controlled over the entire piece in 13 blocks as follows:

Blocks	**Duration**	**DSP control**	**Guitar articulation (technique)**
1	*10''*	Computer	Scratch
2	*70''*	Guitar	Bartok Pizz.
3	*56''*	Computer	Scratch
4	*35''*	Tape	
5	*43''*	Guitar	Bartok Pizz.
6	*60''*	Computer	Bartok Pizz. /Wood sounds
7	*32''*	Guitar	Scratch
8	*23''*	Computer	Bartok Pizz.
9	*15''*	Guitar	Scratch / Bartok Pizz.
10	*10''*	Computer	Bartok Pizz.
11	*60''*	Guitar	Scratch/ Wood/ Bartok
12	*10''*	Tape	
13		Comp/Guit	All

Fig. 5 Block structure Top your Buffer (2006)

The method of score notation.
The piece is written in a proportional fashion, each block is notated in a bi-dimensional plane in which y= dynamic range and x= time.
Inside this plane are represented densities or curves of guitar actions (techniques).

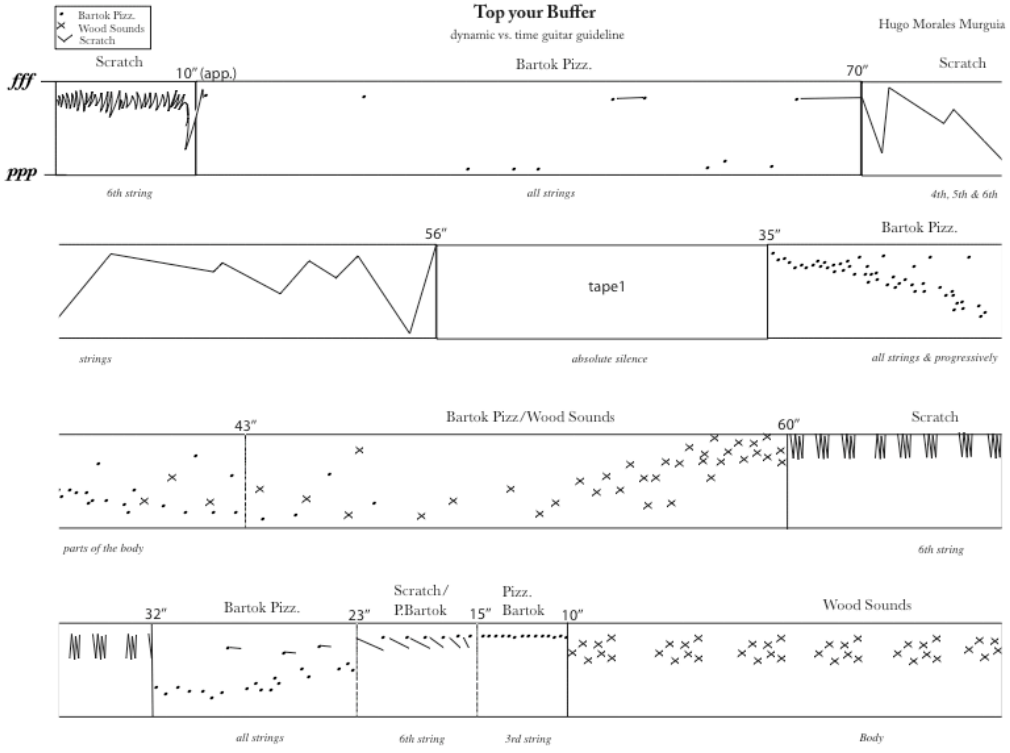

Fig. 6 Score excerpt from Top your Buffer (2006)

Human perception is in constant shaping and averaging of stimulus by comparison and constant fitting into relatively simple shapes that can help us to grasp, categorize and organize stimulus material. Sound as a complex physical phenomenon is bound up to the same principles of perception, the human ear extract structural sound features as shapes depending on their spectro-dynamic evolution over time. I would refer to these shapes as *mental images* as they trigger complex mental images of movement.

Mental images of motion are the main ingredients of music composition, music performance and music understanding; they are the abstract matter of musical imagination. If the composer of instrumental music goes from mental gesture to graphic representation, the performer goes from graphic representation to physical gesture and the listener re-codes the sound stimuli, once more, into mental gestures. Evidently, this chain of events is not that simple and this communication paradigm can be subjected to multiple interpretations and misunderstandings, but in this relay the subjective beauty of music, and the way in which the composer deals with it is part of the efficacy of a work.

Musical imagery was for centuries linked to musical instruments that share the same principle of sound production (the mechanic vibration of an elastic body), and musical aesthetics were partly defined by the possibilities of these instruments. This created an intimate relation between music composition, human movement, physical instrumental characteristics and ultimately, music perception and understanding. In the past, in order to have a musical experience one had to attend to a musical performance or to play an instrument. Moreover, musical motion was restricted by tonal confines (at least in Western culture), predetermining our musical response by the relationships of a learned language. These aspects created a parallel long-term human conditioning of the musical experience and conceptualization of music, which still resonates nowadays.

However, the appearance of new structural pitch systems as a result of the exhausting limits of tonality in the 20th century, together with the appearance of the tape recorder and electronic devices (originally not even intended for musical proposes) clearly affected this listening and creative human conditioning.

The use of electronic devices, with a different principle of sound production and with no connection with physical human energy, breaks with any reference of musical tradition. This radical change opened up new possibilities allowing the composer to have total control of the musical result, by eliminating intermediaries between musical idea and product, as well as finding new means of musical expression.

Nowadays, the massive means of music reproduction and the constant increasing use of electronic sounds (in all kinds and genres of music), have influenced musical experience; The very well learned cause-effect movement from a live performance or a self interaction with an instrument has to be replaced from a speaker membrane movement in a playback situation, or the electronic generated sounds have to be

understand differently than sounds from traditional instruments since they are created by electricity or invisible computer programs that have no physical causal relation with the perceived sound.

It is important to notice how much this propagation of music reproduction has affected musical experience, music is no longer created to be played or sung but mainly to be listen to. (Iazzetta 1997)

This new model of music reception forces the listener to mentally reconstruct and recreate the musical and physical experience based on his own knowledge and musical context with no use of reference learned system as tonality. In this way the role of human performance was replaced by an *"inner-self"* performance in which *mental gestures* help to reconstruct the actual musical experience.

Mental gesture in music then, is not a simple representation of sound movement, but an ambiguous and multifaceted brain activity related to aspects of human cognition and linked to emotional stimuli.

Tape Music and Mental Gestures

The electronic field in which mental gestures find their peek is in fixed-media music or tape music, since it allows the listener to open the window to a subjective world of different musical relations, interpretations and fantasy. However, the vast majority of 'standard' listeners create all kind of symbolisms and associations, by the possible visual evocative properties of the sound objects in their relation with the real world, deviating in their inability to correlate the stimulus with their own concept of music and as a result, disdaining the received stimuli as pure sound effects, others claim that the problem is the lack of visual performance in a concert situation. The causes of this kind of reactions are multiple, complex and beyond the scope of this text. Anyhow, a considerable understanding of this music is based on receptivity and attitude from the listener.

In the so called principle of *Reduced Listening*, as first mentioned by Pierre Schaeffer, the listener is encouraged to make this causal detachment of sound by concentrating in its abstract spectro-morphological qualities. This has created quite a lot of polemic arguments questioning if it is even possible at all to perceivably isolate sound from the causes that could have been produce it. Arguments that gain force in the increasingly visual and multi media world in which we live and by ecologically based theories, which state that human senses have evolved in interaction with the environment in service of our orientation and survival, hence stating that we cannot completely separate art perception from our experience with the real world.

Anything that we can imagine is in some way or other based on reality, we cannot create anything that is not composed by elements that already exist out there, and likewise, we cannot understand anything if it is not, at least partially, through our relation and experience with the physical world. In that case, the core of creativity is then how to organize and mould these elements. Nevertheless, I think that the human perception and creation of art implies different and more complex factors that the perception of stimuli in our daily experience with the real world, but I will treat this subject further in this text.

Composers that have dealt with tape music have been very much aware of this fact, some by avoiding any kind of referential sound properties and others by playing with the possibilities of evocative sound materials as a point of reference or contextualization of a piece.

Simon Emmerson in his article "*The Relation of Language to Materials"*, has made a categorization of some of this works depending in their use of sound material in relation with their language.

He divides the works into two dimensions; in one angle he categorizes the works by their use of musical discourse: aural or mimetic. On the other angle by their syntax: abstract or abstracted.

Musical Discourse
Mimetic: imitation not only of nature but also of aspects of human culture no usually associated to music.
Aural: The refusal of references to the real world by the concentration of interactions of sound and their patterns.

Musical Syntax
Abstracted: Preserving the natural relationships of the sound objects in a recording.
Abstract: Breaking the relationships of sound materials in a way not usually encountered in the real world.

Subsequently, he divides these categories in to a grid adding an extra category created by the combination of the former ones (abstract + abstracted and aural + mimetic). Then he analyzes some works in terms of the degree in which each composer has decided to use these elements in particular pieces. All these categories represent a conscious involvement of the composer intentions to work with sound material. Nevertheless, this intentions beard no guarantee that the listener will perceive those intentions in the same manner, or that he will perceive them at all.

As I mentioned before, tape music is one of the most powerful means for trigger imagery in the listener. The more that the composer intends to use concrete (mimetic) sound references in order to guide the confused listener as a compensation for the lack of visual stimuli or disorientation for being confronted with complex synthetic sound structures, the more that we are imposing a certain interpretation. Then, this medium, partially, looses its expressive power. Conversely, if the composer uses his own musical perception as to verify its musical processes and be able to make adjustments from this, in other words, being a critical listener of his own music, likewise, is creating references for other listeners as well.

In my opinion, tape music more than a challenge for the listener is an invitation through a musical suggestion. Personally, I am not interested in dealing with how specific musical material may evoke certain images in the mind of the listener, but in the mixture and interaction of these aspects, controlled by the listener, and more abstract compositional creative structures, departing from my own perception as a listener rather than being concerned with the unpredictable interpretations and associations of others.

Summing up, the decisions of using certain kind of musical material, being they concrete (mimetic) or abstract (aural), have to be made under *aesthetical assumptions*, the use of certain musical material for the sake of better public accessibility, seems to confine this medium to pedagogical purposes while wasting its expressive potential.

As mentioned before, the way in which a receptor approaches or understands a particular work of art is a complex question of attitude, socio-cultural background and openness. Nevertheless, attentive listening is the primordial element of musical experience and I believe that it should be for creation as well.

_____Environment, Perception and Electronic Music

"Perception is not representation: it is an action simulated and projected upon the world"
Alain Berthoz

It seems that issues of perception in regards to music have gained a considerable importance from the previous century on. Possibly due to the abolition of musical praxis and established systems that started to create in music a "language" capable of creating conventions around sounds and emotions, an even more reinforced communication in the field of mainstream music and film. But, without any structural systematic reference, or visual input, one has to dig into human perception to understand musical materials and to generate musical awareness.

However, in the little available texts that reflect about the issues of music perception and electronic music, there seems to be a common concern about the perception of standard, non-trained listeners, derived as a distress for the lack of popularity and understanding of "academic" electronic music by the majority of people. They refer more on how to make electronic music more accessible, or how to entertain and teach the listener with referential material in order to get his attention and involvedness. But they refer very little to real human psychology and perception in relation with processes involved in the creation of electronic music and how our brain cope with its compositional relationships. (Keane 1986, McNabb 1986)

Although in the past century music achieved an over-rationalization of musical material, composers have learned that numbers and structural processes do not produce music by themselves, that music is more than intricate structures and permutations and that human perception is still much more refined to be driven by complex numerical relationships. *On the other hand, a common confusion between some psychologists and musicologist is to deny numerical or visual relationships in music (like the serialistic procedures) as to be out of any auditory musical validity, but these systems have proofed to be efficient tools for musical coherence and development,* furthermore, even traditional music theory is based on numbers and their relations, and musical systems could not have been produced without mathematical proportions and music rationalization.

Nevertheless, music composition can greatly benefit by the study of human perception, Numerical, visual, geometrical or any other structural processes of

musical material have to be musically verified by our own perception, and knowing more about it would help us to establish a better connection between idea, material and musical result. On the other hand, an absolute focus of human perception or 'intuition' as a seed of music creation, more than avoiding rational processes for the sake of adding "freshness" and "spontaneity" to the music; as some composers claim, is to follow a set of, although unconscious, processes that would eventually lead to similar musical results and a lack of self- development.

Perceptual Mechanisms

The human brain works with data coming from the environment, it first gathers information through our senses and then processes it forming concepts. Without the function of our senses there is nothing that the brain can process, likewise, without the brain interpretation, the stimuli from the senses becomes useless raw data. Hence, we cannot fell without thinking and with no thinking feelings mean nothing.

"…artistic activity is a form of reasoning, in which perceiving and thinking are indivisibly intertwined. A person who paints, writes, composes, dances, I felt compelled to say, thinks with his senses (…) art cannot exist unless it is a property of everything perceivable" (Arnheim 1971)

In this way, there should be some sort of brain representation and categorization during a musical experience in order to translate acoustic data into emotion. But, how does the brain extracts this data and how is this data transformed into meaningful information, is a relevant question concerning electronic music and its complex sound material.

Considerable research has been done on how the brain makes segmentations from the complex natural sound environment. In this field Albert S. Bregman has made important contributions with the *Auditory Scene Analysis*. The approach that Bregman takes from this subject is an ecological one; he states that our perception has evolved to create a useful representation of reality, in this sense the primary task of the auditory system is to organize the chaos that surrounds us in to meaningful information. It is concerned with the perceptual questions of: How many? What are the characteristics? And where is it? But the world is not purely a succession of discrete events, e.g. a series of footsteps are caused by an on-going activity, the way in how perception groups this arrays of sound he calls it *auditory streaming*. Since the brain organizes sounds depending on the source that produce them. Consequently, auditory streaming comprehends two categories: *stream fusion,* which refers on how the sounds blend in order to have a sense of continuation. And *stream segregation,* which refers on how sounds remain independent even if occurring simultaneously. These streams are formed by a set of factors such as: pitch, timbre, proximity, harmonicity, intensity and spatial information. Moreover, Bregman refers to the Gestalt principle of *common fate* to explain how the streams can share similarities experimenting related changes synchronously over time. In fact, many of the ideas of the ASA can be found in the conceptions of Gestalt.

The Gestalt theory explains how we perceive elements as unified wholes in a set of principles that are mainly applied to visual perception, although they can also be transferred to sound perception. They state that perception tends to group elements with the following characteristics in five principles:

Similarity: Elements similar in physical characteristics
Proximity: Elements that are close together in space and time.
Continuity: Elements that follow the same direction
Common Fate: Elements that move together
Closure: Elements that form symmetrical orders

Anyhow, Bregman concentrates his work in *Primitive Segregation,* where streams are grouped depending on the correlations of acoustic cues, and *Schema-Based* segregation, which is learned or involves attention.

In this sense the human brain constructs by segmentation and segregation representational gestalts, or aural images, of the experienced sounds. In the same way, when we are confronted with complex sound structures in music, our brain averages this acoustic data; subsequently, molding it into musical gestalts or mental gestures.

These perceptual characteristics formalized a great set of possibilities for compositional manipulation by integrating sound materials creating a complex amalgamation of sound elements. In this regard we are able to create and transform sound objects and emerge relationships from them. After all, these relationships define the frame of reference for music perception and appreciation.

But once the features of sounds are extracted, and segmentation or segregation of acoustic information has occurred, they are still in its raw state, a more interesting an intriguing perceptual mechanism is to take place, the conferring of meaning to such acoustical data.

Interpreting Acoustical Data

Music is related to human experience. We have learned to understand the world around us by acting and handling rather than by passive contemplation. At the same time, there is a constant cooperation and employment of our senses in the comprehension and interpretation of external stimulus. Our senses work intimately related to provide feasible environmental information to the brain. Therefore, it seems that there should be a sort of internal cross-modal action when we listen attentively or contemplate a work of art.

Memory plays also an important role, we have enough knowledge about the features associated with certain sound producing actions and resonating objects. Furthermore, we have an empirical familiarity with the certain modulatory and excitatory gestures to produce a certain sound as a result of our daily interactions with objects and systems in the physical world.

Thus, it seems coherent to think that we make sense of the sounds around us because we imagine how these sounds were produced, by associating them with sounds that

we have produced ourselves. But this imaginative process more than a pure representational image is the connection of our auditory stimulus with sensations of effort, speed, tension, relaxation etc. based on an incessant simulation and re-enactment of our impressions from the external world.

All these theories find their roots in various fields of investigation but especially in Embodied philosophy, which assumes that what happens in the mind is dependent of the body. And in embodied music cognition, which understands music perception as based on action. One hypothesis that seeks to explain the process of learning in relation with perception is the Mimetic-Hypothesis.

The Mimetic Hypothesis
Imitation as a Basis for Understanding

The Greek translation of the word *mimesis* is *imitation,* which is together with *representation* the core of the Mimetic Hypothesis, meaning a constant simulation or imaginary musical re-enactment by comparing the sounds that we listen with sounds that we have produced ourselves. This constant imitation takes place as a cross-modal phenomenon indicating that music perception is not only based on sound stimuli perception but is a sensory integrated experience.
Imagination, hence, plays a key role in this hypothesis; when we imagine we are actually creating mental images as representations of the sounds that we are listening to.
It is clear that infants, in their attempt to take part in the environment, constantly and sometimes unconsciously, imitate all around them as a way of understanding, but imitation is not only a children activity for discovering the world but in fact a human way of mutual understanding; Arnie Cox (2001) states that not only children imitate their parents but parents also imitate infants, adults behave in certain ways when they are interacting with kids. Therefore, imitation is mutual understanding, overt imitation we use as children remains a part on how we participate with and understand others in the world, and that, rather than, outgrowing imitation as adults, mimesis instead becomes generally more convert (Walton 1997, Cox 2001). Furthermore, evidence from clinical studies on *mirror neurons* (Gallese 2005) show that corresponding neural activity in a specific part of the brain that is activated when we perform an action is the same brain area when we observe someone performing the same action, in other words, we imagine what it most be like to perform the same action by comparing our empiric knowledge of performing the same action. Taking these observations as correct, this cognitive model can be hold for music creation and perception.

Our images of actions, be they singular or complex, are called *motor-programs* (Godøy 2003). A motor program is an image of the necessary actions to perform a task; they can be of different resolutions and speed. An image of the physical energy to create a sound on an instrument, an image of the fingers movements to perform a particular music piece, an image of the different steps necessary to arrive to another place are all motor programs. The images that we have of sound production influence

our perception of sound (*motor theory*[1]), this means that we hear sounds in relation with the sources that could have been produced them, we imagine the necessary energy to produce a specific sound, and we can imagine vocal and instrumental sound because they are products of physical human behavior.

Voice plays an important role in the mimesis of the world around us since it is our most organic and flexible source of sound production and we learn to use it since birth. Therefore voice becomes our primary source for understanding sounds made by others and is primordial for language comprehension. Voice also takes a part in music understanding, when recalling a melody or an extract of a tonal piece, humans often do it by *subvocalization* (internal singing), in vocal music as in instrumental music we are recognizing human-made sounds and recognizing human-physical behavior by the energy of an instrumentalist imprinted in his instrument.

This hypothesis has found its evidence in different fields; one deeply investigated is grounded in language by the use of musical metaphors, or in the comparison between human perception and artificial systems.

In the use of some musical metaphorical terms as spatial verticality, meaning, "high and low", the tones and sounds do not ascend nor descend in reality, yet this assumption is taken for granted by many musicians, and seems to have an effect on musical experience triggering images of motion by pitch contour. But this analogy seems to be grounded in natural phenomena if we consider that a rising in pitch is normally produced by an increment of energy. In that way pitch contours can suggest energy contours triggering not just sensations of motion but of **effort**. Hence, evidencing a multi-modal connection between a pure sound stimulus and the activation of other brain mechanisms such as visual stimuli and bodily activity in the form of muscular tension.

Gesture as a Compositional Object

Up until now I have considered gesture as a physical action undertaken in a particular space and time affecting our mental response to sound in terms of these physical characteristics and our experience through the real world. But in compositional terms, as mentioned in the beginning of this text, gesture is basically an articulation of time.

I like to conceive time articulation as formed of distinctive gestalts, which can be manipulated as musical material, and create an important base for musical motion and tension. These moldable gestalts are profiles of physical energy that shape sound objects and permit a constant variation of the perceptive qualities in the morphology of sound objects.

[1] This theory was first used in linguistics as it became clear that a pure signal based model of perception for recognition tasks was not going to work since the listeners also create an internal image of how the sounds were assumed to be produced.

In the field of traditional music, musical gestalts are defined and perceived into single objects by the use of pitch, rhythm or dynamics, where *phrase and motif* can be the equivalent of gesture, since they can be considered as to be groups of musical information with certain characteristics that make them cohere into single objects. Anyhow, these terms refer to entities that function within tonal and notational systems in which formal considerations play an important, if not, a unique role.

The development of Western music has been affected over the centuries by the constraints of musical notation (Wishart 1996). The creation of a notational system in the 14th century (which is almost the one that is still in use nowadays) was the reflection of a musical praxis and a mnemonic medium to code and decode a work that fulfilled a particular musical aesthetic by taking advantage of the available techniques and acoustic spaces in those days. This system, that due its nature emphasized certain musical parameters, such as pitch-level and rhythm, has directed musical conceptions in a certain direction,[2] generating treatises, theories, methods and instruments based on its advantages and impossibilities.

This system leads to the conception of musical material as discrete sound units, forming categories and idealizations of acoustic phenomena, such as dynamic values. The use of discrete pitches gave birth to combinatorial systems, the use of discrete durational values simplify the notion of time articulation to an addition of rhythmical units and the use of timbre was confined to the use of discrete families of instruments.

All these notions were explored and expanded over the history of musical development, from a more flexible conception of rhythmic interpretation and uses of different time divisions to an expansion of functional possibilities of tonality and an extreme categorization of musical parameters with serialism, reaching their limits in the 20th century with the explosion of different notational systems and non-notation based music composition.

It is certainly true that with no notational system, the refinement of some musical forms could not have been achieved. On the other hand, as mentioned before, the rationalization of Western music evolved within the limitations of this system, concentrating its expressive power in the relationships of discrete components and the illusory creation of movement by an addition of discrete values within a ‘grid’ of low resolution created by the nature of notation. In this sense traditional notation represents a barrier for gestural conception and representation. As it has been demonstrated over the course of the previous century, there are possible ways to represent and code gestural information in which the flow of musical information is

[2] It is important to notice that although a vast majority of ancient music was vocal, and voice can be consider as the primordial instrument for molding, transforming, creating and shaping sound, all this potential remained very much unexplored. Beyond aesthetical reasons, one possibility could have been that the use of voice was usually intimately related to text, which can be contributed to the notion of pitch-level as isolated unities, as are syllables or letters in language.

not subverted to the notational system. Furthermore, technology permits to compose and store music in a variety of ways that not involve a two-dimensional music paper representation in which our music conceptions could be constrained and that have no clear connection with music perception.

To conceive and compose music gestures as fluid flexible matter of musical material rather than create them by a concentration of finite permutational events, allows a multi-dimensional exploration of musical sound and a free articulation in the continuum, while, in the same way, permits the performer to have a better understanding and de-codification of musical gestural expression.

Gesture and Texture

Although they can be seen as opposites, gesture and texture are music elements that play a collaborative role in music cognition. In the temporal unfolding of a musical piece, the perception of these two structural levels is in function of our aural focalization and mental capabilities to scan a particular sound structure.

"While gesture is more concerned with energy, shape and linked to causality, texture is concerned with the internal behavior and motion of a sound. Where gesture is interventionist, texture is laissez-faire; where gesture is occupied with growth and progress, texture is rapt in contemplation; where gesture presses forward, texture marks time; where gesture is carried by external shape, texture turns to internal activity; where gesture encourages high-level focus, texture encourages low-level focus". (Smalley 1986)

An increasing density of gestures can create texture, where the human brain can no longer recognize individual events, but a static sound concatenation. Or we can stretch a single gesture in a way that the human brain is focused in the internal motion and spectral characteristics. On the other hand we can make gestures emerge from texture by a decreasing amount of information or by dynamic control over the different events that take part in a textural structure, foregrounding gestural information.

In this direction we can interact with sound and our own perception, switching and playing with our focus of temporal structures.

Gestural-Sonorous Objects

The Gestural Sonorous Object is a term developed by the musicologist Rolf I. Godøy (2000) as an extension of Schaeffer's conceptual apparatus. His theory departs from the concept of the sonorous object as the focus of musical research.

Briefly stated, the sonorous object is a fragment of sound typically in the range of a few seconds (or often less) but most importantly, the sonorous object enables us to have an overview of the entire fragment of sound as a shape, hence as an object with

gestural information. Scaeffer believed that these sonorous objects have to be perceived in the sense that sequentially presented acoustic information would influence the perception of the sonorous object as a whole. Thus, for Schaeffer a sonorous object is an *intentional unit* constituted in our consciousness by our mental activity (Schaeffer 1966). Godøy hypotheses then that there are gestural components in the recoding of musical sounds in our minds.

…there is a continuous process of mentally tracing sound in music perception (and in musical imagery as well) i.e. mentally tracing the onsets, contours, textures, envelopes, etc., by hands fingers, arms, or other effectors, when we listen to or merely imagine music. (Godøy 2006)

The way to create a sonorous object is in principle by an arbitrary cut from the stream of sound. By cutting out a fragment of sound we create a new entity that gains its own independence and gestural features, Schaeffer states that any new fragment after cutting it would have a head a body and a tail, comparable to a magnet after cutting it in several parts, each of the new parts will have their own polarizations. (Schaeffer 1998). In this case **articulation** is defined as "breaking up the sonorous continuum by successive distinct energetic events". But cutting out a certain fragment of sound would result in certain artifacts, like clippings, that would not be originally intended as part of the sound and that would anyhow greatly affect our perception of it. To avoid these artifacts Schaeffer suggested to cut the fragment as what could be considered as its "natural discontinuities" and called this technique as *stress articulation*. (Schaeffer 1996).

In this way we can create extremely short, and still well shaped, independent sonorous objects with specific motional and directional characteristics. It is interesting to notice that in relation with Schaeffer's principle of *Reduced Listening*, if we are to detached everyday symbolic meaning to sounds, basic schemata of perception, such as energy and motional directionalities are clearly not to be ignored. Moreover, Schaeffer remarks the importance of the perception of these objects holistically, although, as a mental image a sonorous object may vary form one listening to the other, allowing the possibility to encounter newer nuances depending on its complexity, yet remaining identifiable. (Schaeffer 1998). In this sense, the sonorous object is an'intentional unit' meaning that the perception of the sonorous objects enables us to progressively be aware of its many features.

The holistic perception of sonorous objects enables a significant level of analysis resolution. After defining a sonorous object the next step for its analysis is to divide them by their overall envelopes of duration (Schaeffer 1998)

- Impulsive Types
- Sustained Types
- Iterative Types

In addition Schaeffer couple this typologies with what he calls *'facture gestuelle'* (executive gesture).

- Punctual Gesture
- Continuous Gesture

- Iterative Gesture

Some of the morphological features are illustrated in the *Solfége de l'objet Sonore* (Schaeffer 1998, CD2, tracks 90-5)

- Shape
- Grain
- Mass
- Harmonic timbre
- Motion

Godøy's purpose is to show the relations between Scheffer's categories of sonorous objects and sound-producing gestures as in the gestural categories of Wanderley and Cadoz (formerly analyzed in this text), to demonstrate that there is a gesture component embedded in Schaeffer's conceptual apparatus, and that these conceptions can be also applied to rather different sounds. In other words, that we can perceive and analyze any sound in terms of its gestural components.

Conclusions

Human physical movement and energy have been the translators of musical ideas for most of the human history. But electronic means offer new possibilities of expression specific of its field, they are artificial and to escape this assumption could easily result in an imitation of mechanical instruments rather than exploiting the potential of the medium. On the other hand, an effort to combine the best of both worlds can be of great benefit for development, communication and interaction between them.

In regards to physical gestures or electronic means as the creators of musical gestalts we can conclude that:

Musical gestalts are not bricks of permutational orders, as are notes, but they represent units of plastic nature, that as fluid matter have the property of a multi-parametrical expansion over the time continuum.

They are condensed energetic units that are in close perceptual relation with the physical reality, and then they embrace a close communication with our bodies.

In summary, from this brief research over the musical concept of gestures I can conclude that, gesture is not just energy applied to physical objects but this energy is evidenced into the sound itself, is an action with symbolic status in which the capacity for generating multiple streams of sound directionality forces the attention to accelerate or retard scanning operations promoting the projection of multiple and ambiguous perspectives in the prioritizing of the sonic events themselves, thus, creating the foundations for a musical experience. Gesture, thus, represents a way of producing, perceiving, categorizing and manipulating acoustical data, reflecting all its properties as a "sound physicality".

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