MIXED MUSIC AS TRANSFORMATIONAL: ANALYSIS AND AUTO-ETHNOGRAPHY

Eric Maestri
CICM, Université Paris 8, France
CRUHL, Université de Lorraine, Metz, France
GREAM, Université de Strasbourg, France
eric.maestri@gmail.com

ABSTRACT

Mixed music is recent in the domain of music analysis. This musical practice, based on the contact of instrumental and electronic music, enhances both the traditional approaches, that are rooted in the study of the sources (philology and history), the written and phonographic traces (musical analysis) and the more recent ones, dedicated to the study of electroacoustic music starting from its perception. In completion of the existing approaches, this paper proposes a transformational paradigm. Through this approach, both instrumental and electronic dimensions are conceived as poles of reciprocal tensions. This proposition studies the interaction between instrument and electronics using the notion "functional repartition". Can this notion be applied as means of musical analysis and auto-ethnography? This article tries to answer. In doing that, it will reveal the repartition of the electronics and the instrument in a specific case study and will provide insights of the compositional act in relationship with the technical means.

1. INTRODUCTION

To approach the study of mixed music we must be careful. It is important to keep open a large field of study and at the same time to provide a clear and relevant perspective on it. We propose this definition: mixed music uses organically, in musical project, instruments and electronics. This definition has the advantage to be open-ended. It does define neither what kind of instrument nor the kind of device used, whether the instrument is a Digital Music Instrument (DMI) or if it is "acoustic" – traditional, mechanically activated. It does not define whether the electronics is played by a performer or realised by a computer, either if once for ever the performer is real or virtual, or if the sound agency is gestural or electrical. Rather it describes a state of things.

Instead of being ineffective, this definition includes, under a similar musical practice, all confrontations between electric devices, acoustic or electrical instruments. It is a positive and inclusive definition that responds well to the contemporary musical practice dissemination and hybridisation. Mixed music just *mixes*. As definitions such as "mixed ensemble" or "mixed choir", it explains that this music just superposes different sound sources, as in chamber music a piano and a string quartet in a piano quintet. Now, in our digital era, mixed music results from human-computer interaction [1] and must be conceived as a human-computer music-making practice [2] that stimulates the encounter of "acoustic" instruments and "electronics". This encounter has consequences in both practices. In mixed music's history, composers and performers have developed several approaches to realise a mix of the instruments and the electronics. Far from being limited to a form of coexistence, this contact transforms the instrumental and the electronic dimensions.

2. A TRANSFORMATIONAL PARADIGM FOR THE STUDY OF MIXED MUSIC

In the analytical literature, the tendency is to conceive mixed music from the point of view of its realisation and of its reception/perception. Few studies underline the importance of the reciprocal transformation that this contact enhances [3]. However, the idea of the transformation through the contact of instruments and electronics is probably one of the oldest and most fructuous contributions of this musical genre. Indeed, how the coexistence of instruments, voices and electronics impacts the conception of both dimensions? From a transformational perspective, the practice of mixed music can be seen through the lens of the contact of its instruments and sound morphologies, considering the compositional strategies as consequence of the mix. Such an approach has the ambition to start from the musical sense of the contact and to consider the compositional act as oriented to the resulting mixed sound. This transformational paradigm opposes to the notion of "sound object" a multimodal notion [4, p. 149], that is both acted ans perceived. It considers that the sounds of mixed music are both merging as sound types, as sound agents and as sources. To be clear, this approach employs an ecological hypothesis that considers action and perception as fundamentally linked. Thus, it focuses on the act of mixing, to consider the technical and sonic realisation as its articulation in practice. This article assumes the fact that artists develop techniques and knowledges in function of the artistical project, as highlighted in recent publications [5].

I think that the conception of the mix of electronic and instrumental sound types and sources has fallouts in the compositional elaboration. Electronics and instruments share the same sonic space. Thus, mixed sound, conceived as a whole, is a complex object. For the *Gestalt* theory, two types of emergent properties exist. The first one is *eliminative*: the elementary elements of the sound object are inaudible and cannot be perceived separately, the second one is *conservative*: the emerging property merge its constitutive elements, that rest audible [6, p. 108]. Similarly with the notion of sound stream proposed by Bregman [7], the mixed sound could be seen as a sound stream that is a conservative emergent property.

2.1 Rethink the analytical approaches

Currently, two kinds of analytical approaches exist: the analysis of the device, its conception and usage (i) and the analysis of its sonic output (ii) [8]. The first paradigm develops methodologies of reverse engineering, porting, transmission, documentation and in some cases ethnography [9]. This tendency is the mostly developed in continental Europe. It is characterised by field work analysis, interviews with the composer [10], the analysis of the digital instrument (patches, software and programming) [11], the tracking of the computer music designer's role and competences [12] or the performance practice [13]. The utilisation of the software and of the composer's choices are analysed as well [14]. The second paradigm develops aural approaches. It applies typo-morphological, spectro-morphological approaches [15] and narratological ones based on the notion of topic [16]. Interactive aural musical analysis is applied as well [17]. This last approach understands and analyses mixed music interactively, using the software and testing the sound effects directly. This last approach has the intelligence of considering both the acoustic and the sound production experience.

I think that the exposed approaches can be completed by a transformational one that focuses on the interrelation of both mixed music dimensions. In order to develop such an approach, I propose the notion of "functional repartition". This notion helps to look at the transformative aspect of the contact of instrumental and electronic sounds and sources. To test this notion, I will consider its application as an analytic tool and as means for auto-ethnography.

2.2 The "functional repartition"

The contact of instruments and electronics leaves traces in sounds, claimed Simon Emmerson [18, p. 51]. Indeed, the actions and the devices that generate the sounds of mixed music can be recognised. Thus, their contact can be analysed as creating a conservative emergent property. In this sense a notion such as the one of "*functional repartition*" can be helpful. By this notion, I propose to study the sound events of a mixed piece as units that are characterised by at least three types of internal relationships between instrument and electronics: the predominance of the gestural and instrumental aspect (gesture-carried); the predominance of the textural and electronics (texture-carried); their balance (Figure 1).

The predominant aspect of the mixed units is defined by both a *temporal functional repartition* and a *frequencial functional repartition*. The first one analyses the repartition in the units in the duration of the sound event. For instance, the instrumental part can predominate the beginning of the units and the electronics one its continuation and sustain. The second one analyses its repartition in the sound spectrum. In mixed music both dimensions occupy a specific "niche" in the spectrum. The notion of "functional repartition" understands the distribution of sound dimensions and their role in the mixed sound. It allows to develop a typology helping to organise the knowledge of the repertoire coming from the poietic and aural approaches. This notion[1] has the advantage to clarify the roles of both dimensions in the construction of the mixed sound and to highlight

---

[1] A similar approach is proposed, independently, by Laura Zattra. See [19].

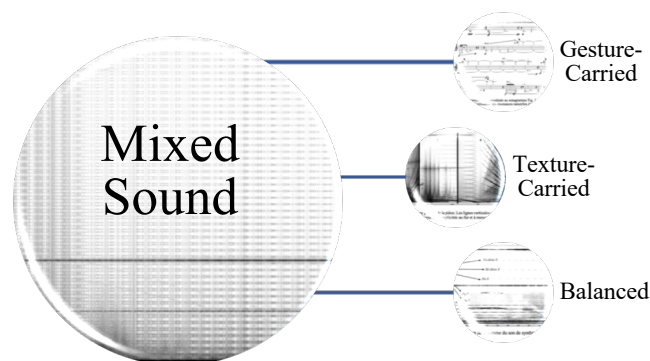their reciprocal transformations and interrelations form an orchestrational standpoint.

Figure 1. A mixed sound typology

3. A CASE STUDY: *ASINGLEWORDISNOTENOUGH III*

Pierre Alexandre Tremblay is a Canadian composer born in 1975. He represents very well the contemporary generation of electroacoustic music practitioners. He is, at the same time, composer, programmer, improviser, teacher and scholar. PA Tremblay defines himself a post-acousmatic composer. This kind of composers are defined by a "polyphony of activities which imply a variety of aesthetic or practical relationships with the acousmatic paradigm, but are not contained within it" [20]. For Tremblay, the composition is based on a pragmatic approach, "a polyphony of activities". It includes the improvisation in the studio, its recording, and focuses on the performance's result as the core of the compositional activity.
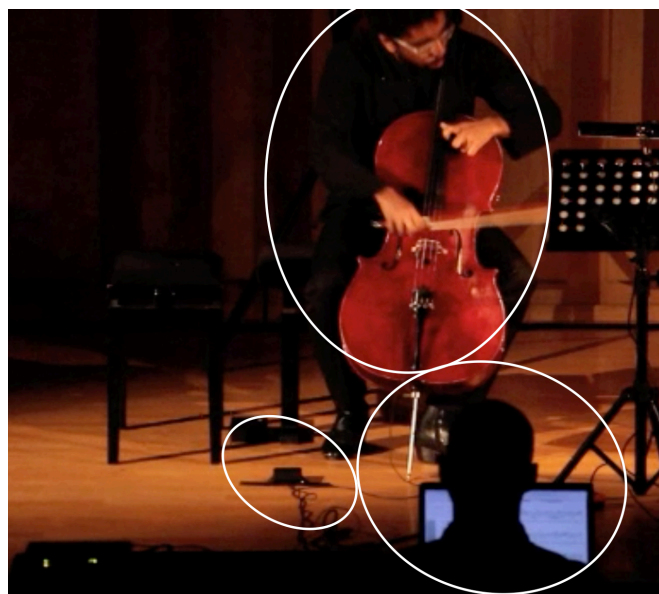

Figure 2. The concert scene

Asinglewordisnotenough iii is a piece for cello and multi-channel real-time interactive electronics composed in 2015. The piece was commissioned and premiered by cellist Seth Parker Woods III. I made a functional analysis of the piece and made a fieldwork of its performance, in order to collect materials such as the score, the sound files and the Max patches. A video and audio recording of the performance were done. The material of this analysis was collected during a performance in Strasbourg, following the composer and the performer during rehearsals and in a concert in 2016[2]. In the performance, the cellist triggers the events of the electronics using a sustain pedal on stage (circled in Figure 2). The composer, in front of the scene, controls the sound diffusion and follows the player, looking at the unfolding of the events in the Max patch and the score. I recorded the piece from the hall and documented the devices. The recorded sound represents the mix of the cello and the electronics. In this paper I focus on the functional repartition of the cello and the electronics. However, to complete the analysis a specific analytical work must be done on the Max patches and the diffusion technique, that is very important for this composer [21].

I segment the recording following the spectromorphological principle of "structural functions" [22][3]. These structures are sound events characterised by three temporal phases, *onset*, *sustain* and *extinction*. The recognition of these phases determines relevant musical aspects, in particular the distribution of the predominance in the sense of its repartition. First of all, I understand which part is the most relevant, if it is the onset, the sustain or the extinction. I identify their characters and, then, I consider if these parts are realised by the instrument or the electronics. This analysis observes the temporal function repartition. Following the tripartition of the structural functions, I notice the distribution of the instrumental or electronic part using a sonogram. I identified thirty structural functions (see Figure 3).
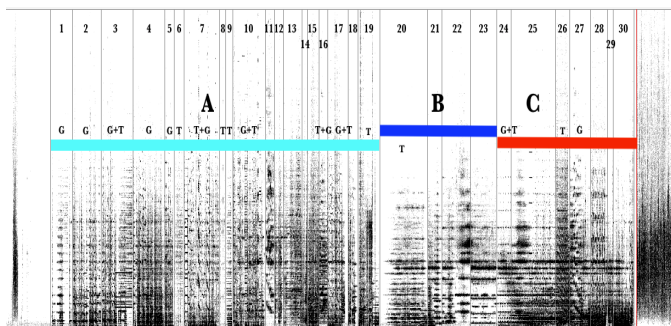

Figure 3. Segmentation of the piece

Once these units are identified, the analysis understands the interconnection of the instrumental and electronic parts. Following Smalley, I define the sound objects identifying the tensions between *gesture-carried* and *texture-carried* units. The analysis of time and frequency distributions highlights the predominance of instrumental sounds (defined by recognisable

gestures and efforts) and electronic ones (defined by specific movements that are not ascribed to human players). This distinction clarifies the predominance of the instrumental gesture or the one of the electronic texture. To clarify the heuristic potentiality of this method, I will analyse three events (the fourth, fifth and sixth), as represented in Figure 4.
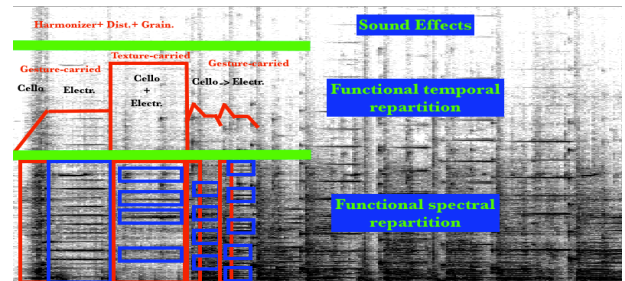

Figure 4. Event number 4 functional temporal and spectral repartitions

Functional temporal repartition. In the first sound event, as a resonance, the electronics follows the cello that occupies the *onset* while the electronics the *sustain*. There is a consequential relationship between the instrumental and the electronic part. The following sound event is defined by the equal superposition of both instrument and electronics. The cello crackles the bow's hair on the bridge and the electronics plays, at the same time, a noisy sound file. This superposition makes it difficult to separate both sound sources. The electronics and the instrument create a unique hybrid sound morphology. The mixed sound type is predominated by the sound's *sustain*. The next event is defined by the repartition of the time envelop, characterised by *onsets* played by the instrument and *sustains* played by the electronics. A consequential relationship between the instrument and the electronics characterises this excerpt as well.

Functional frequencial repartition. From the point of view of the spectral repartition, the first event is divided in two parts. The first one is defined by the cello's *crescendo*, while the second one is characterised by the oscillators' banks played by the electronics holding a fixed group of frequencies. This repartition highlights a causal relationship between the instrument and the electronics. The electronics exalts the frequency components of the cello, accompanies and add brilliance to the instrumental part. The second event is determined by the repartition of the spectrum energy towards the cello's noisy sounds and the electronics that highlights some emergent frequencies. Then, the piece presents a frequency repartition articulated in two plans. In the foreground, the cello plays a descending line of *pizzicato* notes with a *sforzando* on the fourth detuned string of the instrument (i), while the electronics holds frequencies bands and doubles the *pizzicato* of the cello (ii) (as appears clearly looking at the score, Figure 5). The analysis confirms the repartition. In the first event it is gesture carried, in the second it is textured carried with a balanced distribution of both the cello and the electronics, in the third it is gesture carried again.

---

[3] "Structural functions are concerned with expectation. […] During listening we attempt to predict the directionality implied in spectral change" [22, p. 114]
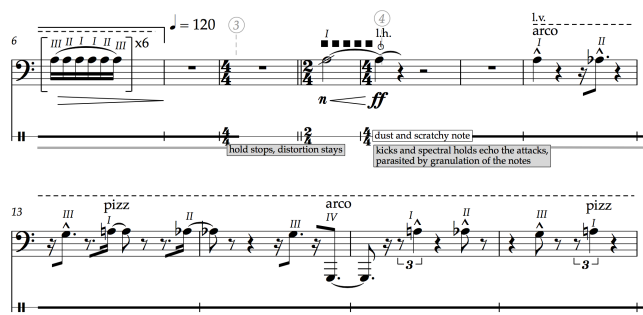
Figure 5. Event number 4 beginning of the instrumental part.

The development of such an approach allows to create a cartography of the piece and can provide a fundamental schema of the predominant gestural and textural aspects. Machine learning applied to instrument recognition can widen the possibilities of this approach. The "functional repartition" clarifies some common compositional elements among different pieces in terms of composition epoch and genre and can show orchestration strategies.

4. MIX, SIMULATION, CHOICES, ANXIETIES: AN AUTO-ETHNOGRAPHY

The previous example shows the application of the notion of "functional repartition" in music analysis. Heuristically, it is a helpful analytical tool having the advantage of pointing out the balance and the interconnection between the two dimensions involved in mixed music.

Can this notion be used to conduct an analysis of the "compositional act" from a qualitative standpoint? I think that the notion of "functional repartition" applied to the study of a singular case study completes the existing tendencies, broadly characterised by genetic or aural approaches and helps to integrate the compositional choices in the musicological perspective. I will conduct an auto-ethnography using the notion of "functional repartition". I will examine my individual compositional practice illustrating how I conceive the "functional repartition" and how its conception can provide insights of the compositional act. I think that the in-depth comprehension of the musical practice related to the composition of a mixed piece provides new insights of this specific musical practice pointing the general through the particular case. Thus, the nuances and the artistic assumptions are considered. This approach highlights the living aspect of the musical practice, showing the delicateness of the compositional act. Such an analysis solicits an hermeneutical attitude [23], based on the comprehension of the act itself, considered in resonance with the musical practice in general.

In doing so, I suspend the traditional and delicate methodological distance between the composer and the musicologist. I provide an in deep knowledge of the compositional act and clarify some aspects of the mixed compositional acts, but this knowledge is totally biased by my intentionality. For this reason, the utilisation of an external criterion as the one of "functional repartition" can help in limiting the auto-ethnography.

The notion of "functional repartition" is conceived here as a listening behaviour [*conduite d'écoute*] [24]. The sound is

considered as a "text" that expresses the steps of my compositional choices. This text is interpreted focusing at the explanations and the examples. In this sense, I can finally study the compositional act as transformational: it is considered as an action oriented towards an artistic project. It is not a descriptive analytical approach but, rather, an engaged auto-analytical study. Such an analysis helps the understanding of the compositional act and frees my words as composer using them as material for the comprehension of the mixed music practice. Questioning the manner through which I construct a functional repartition, I comprehend the way I have adapted the means to an artistic expression.

This auto-ethnography is conducted on my compositional acts during the writing of *Trans*, a piece for tenor saxophone and electronics. In January 2019 I'm finishing its composition. The premier of the piece is held in March 2019. As auto-ethnographer, I know that such approach requires a very rigorous attitude. The researcher is expected to be transparent and clear, meanwhile, he has to act as an artistic and epistemological subject [25]. The auto-ethnography that I have conducted is based on the notion of "functional repartition". Starting from the mix, I focus on the compositional strategies. I am aware that the utilisation of the notion of "functional repartition" is delicate, because it creates a circularity with my practice. One can say that, finally, it represents my compositional idea. Indeed, I admit, it emerges from my practice and is used to describe my practice. However, this circularity is positive. It must be intended as a virtuous circle, that provides a hermeneutic perspective on my work. It includes my perspective in the analysis and declare that it is biased by my musical practice. Following this hermeneutic principle, it allows to understand under the light of a concrete project, the mixed music practice *tout court*. This auto-ethnography impacts my compositional act and, inevitably, its narrative, while during the composition I started to take notes about my procedures and thought. I forced myself to indicate a starting point and to explicate some aesthetical assumptions, as for instance the importance for me to "live the sound" and to "project" myself in the listener position. Thus, the auto-ethnography has an auto-analytical effect that helps the auto-comprehension and the auto-situation. This approach impacts the future works as well, while the auto-ethnography is potentially never ending.

4.1. Auto-ethnography

To conduct this auto-ethnography I asked myself how I organise the "functional repartition" in a piece of mine. In composing the electronic part of this piece, I develop a limited number of sound types. I fixed four types based on four sound synthesis and sampling techniques. These types are chosen because of their variability and timbral complexity. I am searching an electronic sound that is, at the same time, explicitly synthetic and expressive able to be manipulated in terms of pitch's linear transformations, amplitude and harmonic density. The electronic sound is conceived in contrast with the instrumental one. I search to superpose two clearly distinct sound types in order to search a contact point. Thus, the electronics has to be radically different from the instrumental part.

The sound synthesis, realised with software *csound*, develops three models: the additive (i), the subtractive (ii) and the wave terrain (iii). I use three standard *opcodes*. The first one [*adsynth2*] develops complex spectra using the phasing of the

partials and of their amplitudes; the second one applies resonant filters [*reson*] to white noise generators. This technique provides complex and disordered sounds around chosen frequency structures; the third one develops wave table terrain synthesis [*wterrain*]. This technique generates mobile and dense textures throughout the crossing of two wave tables (x, y) to obtain a "terrain" (z), which is crossed through a defined elliptic trajectory. These sounds are complementary from the point of view of the timbre. The first one has rich sounds related to a fundamental pitch, from chords to timbres. The resonant aspect of this sound is the most used in this piece; the second one, similarly, highlights the frequency elements of complex sounds like noises and windy sounds. However, the timbre is spurious and allows, i.e., the contact with airy instrumental sounds; the third one is linked with the emergence of some frequency aspects. The trajectory of the terrain and the curve of the table construct complex spectra. These synthetic *csound* instruments are accompanied by a sampler instrument that plays and stretches the recorded sounds of the saxophone and deforms some environmental sounds.

I appreciate the sound of *csound* and its synthetic non-natural aspect. In my opinion, it represents the "nature" of the electronic sound. The utilisation of such techniques allows to create utopic sound morphologies soliciting the overcoming of the instrumental techniques. The choice for these sound morphologies is due to a deliberate aesthetical choice that points, since the beginning, at the instrument involved. The idea is to force the performer to listen at the electronics, in order to ask him to metamorphose his playing and interpretation. Thus, these electronic sounds are conceived for affecting the nature of the instrumental ones.

The electronic part is mixed on a sequencer and organised in musical morphologies that develop the expressive potentialities of the synthetic sounds. In this environment I'm focusing in the possibilities of interaction among the sound themselves, organised in the musical form. The sounds are rapidly generated in function of the composition. The mix on the sequencer is conducted freely and the possibility to generate synthetic sound rapidly. Thanks to the rendering technique of *csound*, it creates a very interactive environment for the composition, near to a reflexive improvisation. I then start the composition of the electronic choosing to include the performer in the writing of its part. I invite him to listen at the electronics and to propose some sounds in similarity and contrast with the electronics.
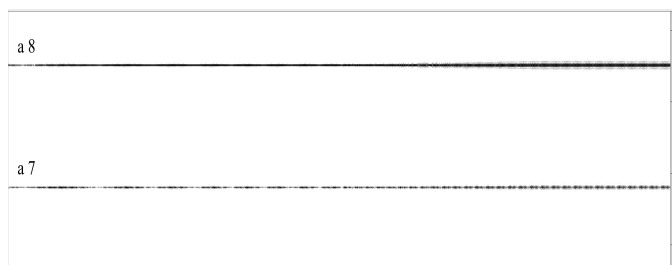

Figure 6. First electronic sound of *Trans*.
https://www.dropbox.com/s/unw2uwqv6xl9u4c/noise_wind_pan_01.wav?dl=0

In *Trans*, starting from the trace given by the electronics, I deduced the instrumental part collaborating with the performer. This approach asked to develop a shared sonic vocabulary based on the description of the sound perception in acoustic co-interaction with the performer. Listening at the electronic part, our common vocabulary describes the sound using metaphors related to the fields of the energy distribution in the registers, the completion of the electronic sound by the saxophone, the similarity of the sound and the resulting sound of the superposition[4].

In the electronics, the beginning of the piece is defined by a sound composed with a subtractive synthesis technique. This sound develops around a range of five octaves (Figure 6). The resonant frequencies of this excerpt are used by the performer. Starting from the same frequencies, the saxophonist plays a note at the unison with the electronics. As a consequence, he realises a sound that is similar with the electronic one. The saxophone plays airy sounds that make resonate the fundamental frequency, *a3*, through the emergence of higher resonances in the sound spectra. The resulting sonorities are realised with a specific instrumental technique, using the vowels [hu] and [hi] to exalt the lower or the highest frequency bands of the fundamental note (Figure 7).
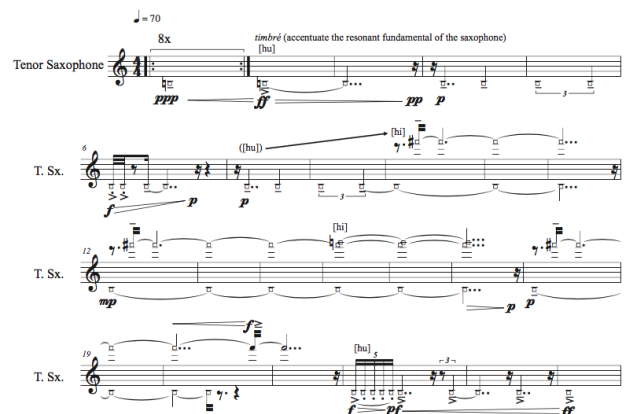

Figure 7. Beginning of the instrumental part. In the score are indicated with the squared notes the air sounds and the harmonics of the fundamental, played with the modulation of the vowels pronounced in the mouth by the saxophonist.

Together with the performer, I wrote an instrumental sound that enters in contact with the electronics, completing its registers. The instrumental sound balances the electronic one and enrich its middle frequencies. The timbre of the saxophone, with the electronics, creates an emerging complex and unstable sonority. They mix together. The resulting sound is dense. In terms of functional repartition, this superposition concerns both the vertical and horizontal aspects. Horizontally, they occupy the same duration. Vertically, the instrumental and electronic sound's distribution defines a complex timbre in which the resonances of the electronics seem to be instrumental resonances. The

---

[4] To listen to the piece click on this link:
https://www.youtube.com/watch?v=-09cW3to_68

saxophone superposes with the electronics between 200 Hz and 3000 Hz (Figures 8 and 9).
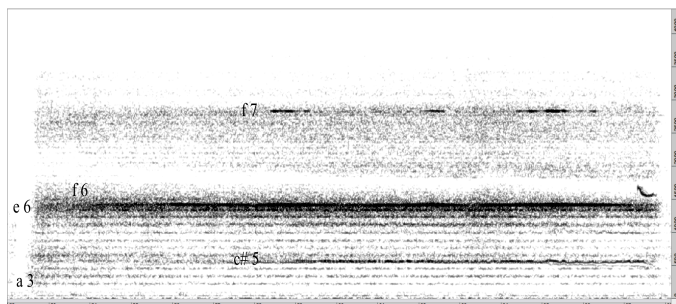

Figure 8. Sonogram of measure 8 of the saxophone (look at Figure 7).

After that mix, I sum another electronic sound to the former configuration. An additive sound generated from the fundamental note of *f3* is superposed. The resulting sound defines a continuum between the instrumental sound the resonant and the additive (Figure 10).
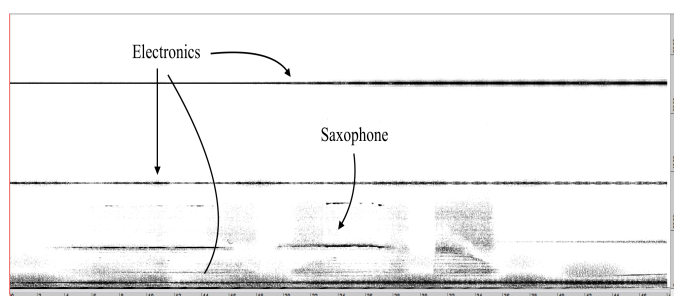

Figure 9. Sonogram of the superposition of the first electronic sound and the saxophone.

The superposition of instrumental and electronic sounds creates a complex output in which the electronics and the instrumental are closely related, as if it is a third type encounter [26]. The synthesis techniques solicit the creativity of the performer, who proposes a sound that melt with the electronics. This sound repartition has the function to realise a complex mixed sound that is both electronic and instrumental. Thus, the repartition is open, while it is interpreted in concert.

Such a compositional work demands the immediate interaction with the resulting sounds of the electronic and the instrument. I need to listen to their mix during the compositional act. My technical environment is consequential with this assumption. During the rehearsal with the musician and the studio work, to listen to the sounds results in real time, I constitute an interactive environment capable to furnish the desired sound experience to the performer and to interact with him. It is an open environment that allows to scour the sonic possibilities of the sonic interaction, to test them and to open unattended possibilities. I need to choose the sound I'm composing.

This active and shared compositional act is made possible by the utilisation of the most recent musical technologies. The

simulation of the piece provides a dynamic environment in which I anticipate the performance and project myself in the future, at the moment of the concert. I work with a model of the final result. It is a projective effort of construction of a sound event. Musical choices are taken in function of the projectability of the compositional act. The simulation allows to play with the result and to think the contact of the instrument and electronics through its experience.

The simulation is realised thanks to the recording of the instrumental part. Every rehearsal and exchange between the saxophonist and myself were recorded and integrated in my compositional environment. The instrumental part is superposed to the electronic one in the sequencer. The electronics is modified in function of the instrumental part and vice-versa. The instrumental part is simplified and enriched sonically thanks to the possibility of pre-hearing the global sound result.

This pre-hearing provides information for the musical choices. The choice of a sound instead of another; the necessity of a new sound positioned in a particular moment of the piece; the anticipation of the mixing problems, of the concert hall and of the interaction between the sax and the electronics are part of the choice. The repartition of the energy of the instrument and electronics is the central part of the composition. This environment integrates the performer in the compositional act. He can listen to the global result, assists at the writing of the piece. He is not obliged to wait for the moment of the concert to discover the electronics. This aspect amplifies the possibilities of the interrelation of the electronics and the sonic mimesis of his playing. The pre-hearing helps to prepare the best materials for the performances, that is a problem for me. The best material allows to have more time for rehearsal and to think at the music with the performer and the sound engineer. The "functional repartition" is the realised progressively.
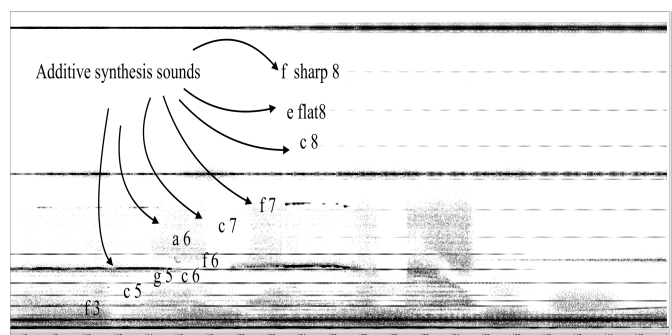

Figure 10. Sonogram of the final mixed sound. It results from the superposition of two sound syntheses, the subtractive and the additive with the saxophone.

The preparation of the materials for the performances gives a particular status to the simulation. This possibility relaxes my anxiety for the final result that I wait for the concert and orients my compositional choices, while the mix, the sound types and the pitches are conceived in relationship with the quality of the timbre. The utilisation of the simulation makes me aware of the importance of the interpretation of the electronics in concert. Indeed, some choices rest open at the end of the composition. As the mixed sound is mobile, because it must be reconstructed at each performance, it is necessary to push the limits of the composition until the performance itself. As a consequence, the

concert interface must be programmed to provide this possibility. A device for the performance is developed in Max. This device defines the volumes of both parts and the sound equalisation. This environment defines a circularity between the technical means employed (Figure 11).
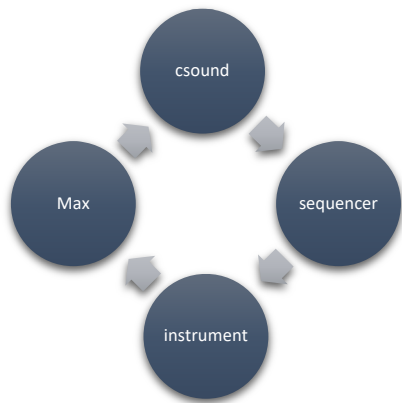

Figure 11. Performative circularity between the means employed for the composition and the concert.

4.2. Discussion

The superposition of the instrument and the electronics provide an example of vertical repartition in which they determine together a sonic emergent property. The analysis conducted under this notion reveals the poietic of the compositional act and gives sense to the compositional choices that lie behind the technological ones. It takes in consideration the specific transformative aspect of the mixed music practice. The contact is shown as an emergent object that has implications in both its constitutive elements. The writing technologies are considered. The sound is conceived as an organism, in which its elements determine tensions that are interpreted through their organisation and balance. The *csound* instruments, the mixing techniques and the performance interface are explained. The aspect that appears clearly looking at the musical practice expressed in this piece is the act of mixing. This act realises the coexistence the sound sources involved. This act emerges as open: the mix at the centre of the writing continues in the performance.

The simulation used for the composition provides an enlargement of the notion of "score". This personal practice can be generalised. Indeed, it characterises a current paradigm which uses computers to project and test the results of the compositional choices. This kind of score, among the aspects of recording and transmission that traditionally is associated with it, provides means for projection in the future. Scores, in this sense, are signs, traces, that can be realised in every moment after their realisation [27]. The notion of score as simulation operates as a dynamic foundation of my compositional practice, that tends to synthesise the operational aspects and the perceptive ones as a "studio performance". The auto-ethnography points out the aspect of choice, that is strengthen by the utilisation of the simulation. This element is related with the evocation of the anxiety. This one is connected with the concrete realisation of the piece. These psychological or existential aspects condition the

compositional act and clarify the constitution of the technical environment.

The notion of "functional repartition" was heuristically helpful to describe the mixing act. It points some crucial aspects of the contact between instrument and electronics and helps in the conduction of the auto-ethnography, while it allows to define a mobile an inclusive compositional vocabulary. In my specific case, it defines the compositional act and gives strength to the description of the technical approach. This auto-ethnography has limits while it could be judged as too specific. However, it has the advantage to disclose and organise the description of my personal practice and to enlarge the field of the existing analysis.

5. FINDINGS

In this paper, two findings are determined. Both are related with the proposed notion of "functional repartition". The first one concerns the general topic of the analysis of mixed music; the second one provides an original insight in the compositional act through an auto-ethnography. These two approaches are complementary. While the first one is oriented to the mixed sound objects, ambitioning to provide a sharable approach that can be useful for poietic and perceptive analysis, using in the future machine learning as well, the second provides a very singular defective description of the compositional experience.

While the first approach is analytical and descriptive, the second one is hermeneutic. This last one imposes the interpretation of the individual practice and to point the most general through its comprehension, in resonance with the particular. In the first part I show that in the analysed piece, *asinglewordisnotenough III*, for cello and electronics, both the instruments and the electronics create a dense sonic whole in which the cello is followed by the electronics and the sound is exalted by the richness of the instrumental play. I tried to analyse the sonic output of this mixed piece envisaging the hypothesis that its mixed sound can be conceived as a conservative emergent property. I propose to analyse this emerging object from the point of view of its "functional repartition".

In the example the cello and the electronics create a repartition of both temporal and spectral dimensions. The first one is characterised by two types of repartition. The first one is *consequential*, the instrument anticipates the electronics. There is a causal relationship between the two elements. The second is characterised by their *superposition*. They coexist in the same event creating a static sound morphology. These two types of "functional temporal repartition" are well described by the notion of spectromorphological behaviour. Smalley proposes the notions of "*horizontal-causal*" and the "*vertical-togetherness*" of the spectral behaviour of the spectromorphologies to indicate this phenomenon [22, p. 119]. The spectral functional repartition highlights a subdivision of the roles of the instrument and the electronics. In the analysed first event, the instrument is fixed in a register and the electronics plays a large bank of oscillators that contrast with the instrumental precedent part; in the second event they share the same space. This coexistence makes it difficult to listen to the two dimensions. It is possible to identify their repartition thanks to the subdivision of the spectrum between both dimensions. The cello plays noisy and disordered sounds, while the electronics play a noisy sound in the background and fixed granularized frequencies in the

higher register. The instrument and the electronics share the same spectral space but occupy contrasting frequency bands. They collaborate creating a rich and unique sound morphology.

In the auto-ethnography I show my personal construction of a mixed sound's "functional repartition". I highlight the fact that, in my case, the electronics leads the compositional act. The "functional repartition" that directed this auto-ethnography reveals the compositional choices under the light of the notions of simulation, expectation, mix and projection. Among the words that define my auto-ethnography, the one of anxiety emerges frequently. This anxiety is related with the projectability: as composer, when I write, I think at the final result of my act, the concert. This projection founds the compositional act and the choice of the technical means. The notion of performance is present as well. This projectability of the compositional act conducts its performance. Indeed, I programmed an interface for the live performance of the piece. This interface allows to mix the sound of the instrument and of the electronics using amplitude controllers and equalisers. This approach comprehends the existential aspect of the compositional practice and links the specific mixed music approach to the larger musical context.

A comparison of these two approaches shows their complementarity. While the "functional repartition" applied to the musicological analysis helps to understand the contact of the instruments and electronics, in the second sense, applied to an auto-ethnography, highlights the most intimate parts of the compositional act, revealing some personal aspects related to this practice. Both methods can be applied and show the interest in an interrelation between musicology and social sciences approaches. Future work will be done using both methodologies applied to the analysis of mixed music works.

6. CONCLUSIONS

Mixed music is usually studied from the point of view of the devices or from aural perspectives. In this paper, I proposed to consider the sound result of the contact of the instrument and electronics as a global whole. Inspired by the *Gestalt* psychology concept of emergence, I proposed to think the sound result of the contact of the elementary dimensions of mixed music as an emergent conservative property. The instrument and the electronics are analysed as interacting in the sound event. Thus, the transformational aspect of the contact, considered under the light of the artistic project, is highlighted.

The analysis allows to understand this interaction and the functional repartition of both dimensions. The time repartition highlights the consequential and the togetherness of the mixed sound organisation. The spectral repartition shows the differences of the two parts in terms of the spectral energy in the whole spectrum and the repartition in the vertical domain. The organisation of the temporal and spectral aspects of the mixed sound highlights the orchestration strategies implemented by the composer and solicit further researches in this domain. This analysis shows that the organisation of the time and spectral spaces of the instrument and of the electronics imply the utilisation of specific instrumental techniques and the conception of specific sound morphologies in the electronics. The organisation of the mixed sound is transformational in this sense.

The auto-ethnographical approach shows the specific and embodied transformation that happens in the compositional act. It points the fact that a generalisation cannot be done until the practice itself is not understood and described. The study of the individual musical practice allows to understand the general aspects of the mixed music composition under the light of the particular. This paper wants to point out the necessity of a balanced methodological perspective of quantitative and qualitative approaches. They reveal different aspects of similar phenomena. For this reason, further developments of this methodology will be done, both thanks to machine learning and in deep ethnography and auto-ethnography. This approach will be comparative and will highlight the relationship, progressively and modestly, of the general and the particular in the mixed music practice.

REFERENCES

[1] E. Maestri, 'A Typo-Morphological Approach to Human-Machine Interaction Analysis in Music', *Organised Sound*, vol. 22, no. 3, pp. 315–323, 2017.

[2] D. Stowell and A. McLean, 'Live Music-Making: A Rich Open Task Requires a Rich Open Interface', in *Music and Human-Computer Interaction*, Simon Holland, Katie Wilkie, Paul Mulholland, Allan Seago., S. Holland, K. Wilkie, P. Mulholland, and A. Seago, Eds. London: Springer, 2013, pp. 139–154.

[3] J. Dack, 'The mediating role of the piano in Karlheinz Stockhausen' Kontakte fur Elektronishe Klange, Klavier und Schlagzeug', in *Analyser la musique mixte*, A. Bonardi, B. Bossis, P. Couprie, and V. Tiffon, Eds. Sampzon: Delatour, 2017, pp. 155–161.

[4] R. I. Godøy, 'Gestural-Sonorous Objects: embodied extensions of Schaeffer's conceptual apparatus', *Organised Sound*, vol. 2, no. 2, pp. 149–156, 2006.

[5] T. Zembylas and M. Niederauer, *Composing Processes and Artistic Agency Tacit Knowledge in Composing*. London New York: Routledge, 2018.

[6] M. Kubovy and D. Van Valkenburg, 'Auditory and visual perception', *Cognition*, vol. 80, pp. 97–126, 2001.

[7] A. S. Bregman, *Auditory Scene Analysis. The perceptual organisation of sound*. MIT Press, 1994.

[8] A. Bonardi, B. Bossis, P. Couprie, and V. Tiffon, Eds., *Analyser la musique mixte*. Sampzon: Delatour, 2017.

[9] G. Boutard and F.-X. Féron, 'La pratique interprétative des musiques mixtes avec électronique temps réel: positionnement et méthodologie pour étudier le travail des instrumentistes', in *Analyser la musique mixte*, Bonardi, A., Bossis, B., Couprie, P., Tiffon, Vi., Sampzon: Delatour, 2017, pp. 39–60.

[10] V. Tiffon and N. Sprenger-Ohana, 'Marco Stroppa's compositionnal process and scientific knowledge

between 1980-1991', presented at the Sound and Music Computing Conference, 2011.

[11] A. Bonardi, 'Analyser l'orchestre numérique interactif chez Manoury', in *Analyser la musique mixte*, Paris: Delatour, 2017.

[12] N. Donin and L. Zattra, 'A questionnaire-based investigation of the skills and roles of Computer Music Designers', *Music. Sci.*, vol. 20, no. 3, pp. 436–456, 2016.

[13] L. Pottier, 'Les musiques mixtes temps réel: pour une interprétation du son électronique en concert', presented at the Soixante ans de musique mixte, Paris, 2012.

[14] A. Bonardi and F. Dufeu, 'How Can We Model Behaviours of Digital Instruments? Propositions in fuzzy logic from Philippe Manoury's works', in *EMS 2013 Proceedings*, Lisbone, 2013.

[15] P. Bachratà, 'Modèles musicaux interactifs basés sur le geste pour l'analyse et la composition de musique mixte', *RFIM*, vol. 1, 2011.

[16] P. Lalitte, 'Towards a Semiotic Model of Mixed Music Analysis', *Organised Sound*, vol. 11, no. 2, pp. 99–106, 2006.

[17] M. Clarke, F. Dufeu, and P. Manning, 'Interactive Tools for the Study of Electroacoustic Music Composition Methods: Resources for teaching and learning from the TaCEM software', in *Innovative Tools and Methods for Teaching Music and Signal Processing*, Laurent Pottier., Paris: Presses des Mines, 2017, pp. 27–35.

[18] S. Emmerson, *Living Electronic Music*. Aldershot: Ashgate, 2007.

[19] L. Zattra, 'Les écritures des musiques informatiques mixtes à la lueur des sources documentaires', in *Regards sur les musiques mixtes*, Marc Battier., Paris: INA-GRM, 2016, pp. 195–230.

[20] M. Adkins, R. Scott, and P. A. Tremblay, 'Post-Acousmatic Practice: Re-evaluating Schaeffer's heritage', *Organised Sound*, vol. 21, no. 2, pp. 106–116, 2016.

[21] A. Harker and P. A. Tremblay, 'Rethinking the Box: Approaches to the Reality of Electronic Music Performance', presented at the IRCAM Forum, Paris, 2013.

[22] D. Smalley, 'Spectromorphology: explaining sound-shapes', *Organised Sound*, vol. 2, no. 2, pp. 107–26, 1997.

[23] H.-G. Gadamer, *Wahrheit und Methode*. Tuebingen: J.C.B: Mohr, 1960.

[24] F. Delalande, *Analyser la musique, pourquoi, comment ?* Paris: INA, 2013.

[25] Y. Laflamme, 'La science de l'art/l'art de la science : une synergie propre à un nouvel esprit scientifique en recherche création', in *La recherche création Pour une compréhension de la recherche en pratique artistique*, Gosselin P. et Le Coguiec É., Montréal: PUQ, 2006, pp. 65–76.

[26] J.-C. Risset, 'Discours CNRS'. 1999.

[27] H.-J. Rheinberger, 'From Traces through Data to Models and Simulations', in *Transpositions: Aesthetico-Epistemic Operators in Artistic Research*, M. Schwab, Ed. Leuven: Leuven University Press, 2018, pp. 215–225.