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## Mixed Sound as a Tool for the Analysis of Mixed Music

### 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 traditional music analysis, based on the study of the sources and the scores, and the analysis of electroacoustic music. This paper proposes to conceive the analysis of mixed music as a specific domain with its own methodologies, knowledge and musicological skills as it is a performative and fixed musical meta-genre which shares gestural notations and programming. This paper proposes a specific methodology for the analysis of mixed music. Based on the original notion of *mixed sound*, it will analyse a case study, then discuss the findings and future research.

### 1. INTRODUCTION

Mixed music is the union of instruments and electronics. This definition is open-ended: it doesn't specify what kind of instrument or devices are used, if the instrument is a DMI (Digital Music Instrument) or if it is 'acoustic' — i.e. traditional, mechanically activated —, and if the electronic part is played by a performer or if it is realised by a computer — played or generated —; it does neither specify once forever if the performer is real or virtual, and if the sound agency is gestural or electrical. It describes a state of things. Rather than being ineffective, this definition includes, under a similar musical practice — mixed music —, all kinds of practices that confront different types of devices, acoustical or electrical. It is a positive and inclusive definition that responds to the contemporary musical practice dissemination and hybridisation. This practice just *mixes*: as mentioned by definitions of 'mixed ensemble' or 'mixed choir', this music superposes different sound sources, like a piano and a string quartet in a piano quintet. The distinctive aspect is that sound is not completely mechanically produced. This music confronts humans with computers, and results from this interaction (Maestri 2017). Mixed music is a human-computer music-making practice (Stowell and McLean 2013). Indeed, this music meta-genre stimulates the encounter of 'acoustic' instruments and 'electronics', which has consequences in both practices. In mixed music's history, composers and performers have developed aural and poetical strategies to mix the instruments and the electronics, to create a hybrid new sonority putting in contact the traditional sound devices — the instruments —, and the new devices — the computers and the interfaces for musical expressions. I think that the goal of this contact is the organisation of a sound that can't be reduced to the electronic or the instrumental part alone, and that the compositional strategies and technologies respond to this goal.

### 2. MIXED MUSIC AS TRANSFORMATIONAL

In the analytical literature, there is a tendency to conceive the practice of mixed music as the sum of two already existing

music genres, the instrumental-vocal and the electronic. I think that, on the contrary, mixed music is transformational (Dack 2017): it contributes to the transformation of both electronic and instrumental music, pointing their contact and their articulation in achieved musical works. Mixed music is an emerging musical practice that has an impact on both electronic and instrumental-vocal writing. The sign of this reciprocal articulation is the use of extended techniques in instrumental writing and the elaboration of strategies that adapt the time of electronics to the tempo of the performer. This musical practice tries to humanise the electronic sounds and to technomorphise the instrumental ones. Mixed music organises the human produced sound and the computer generated components. The organisation of mixed sound, that organises and orchestrates instrumental-vocal and electronic sounds, is part of the historical definition of mixed music as a specific practice (Dack 2017). This mix of the electronic and instrumental sound types and their sound sources is the most specific contribution of this musical genre, and has fallouts in both electronics and instrumental composition conceptions. Their contact defines the conjunction of two dimensions that share the same sonic space with different functions. This contact emerges as the segregation of two sound sources and sound generators. Mixed music is characterised by a sound that is a complex object based on instrumental and electronic sound sources, agents and types. This emerging object, the mixed sound, is the main objective of the mixed musical practice and programming and instrumental techniques are orchestration strategies acted to realise this mix.

For the *Gestalt* theory, two types of emergent properties exist. The first one is *eliminative*: the elements that compose the object are invisible or cannot be perceived separately; the second one is *conservative*: the emerging property conserves its constitutive elements (Di Bona and Santarcangelo 2018, 56). *Mixed-sound is a conservative emergent property*. Its parts are conserved as transformed. The instruments and the electronics collaborate to create a sound that is both, that transcends its elements and at the same time conserves them in a new dimension.

### 3. BEYOND THE TRADITIONAL APPROACHES

The traditional approaches in the analysis of mixed music can be divided into two paradigms: the analysis of the device, its conception and usage, and the analysis of the sonic output (Bonardi *et al.* 2017). The first paradigm develops methodologies of reverse engineering, porting and transmission. This tendency is most developed in continental Europe and is characterised by both field work analysis, interviews with the composer (Tiffon and Sprenger-Ohana 2011) and the tracking of the computer music designer's role and competences (Donin and Zattra 2016). The

analysis of the use of the software and the composer's choices concerning the programming are analysed as well (Bonardi and Dufeu 2013).

The second paradigm is characterised by aural approaches. It is defined by traditional typo-morphological approaches of analysis, spectro-morphological approaches (Bachratà 2011) and narratological approaches based on the notion of topic (Lalitte 2006). Interactive aural musical analysis is applied as well (Clarke, Dufeu, and Manning 2017). This approach proposes to understand and analyse mixed music using the software and testing the sound effects.

The analysis of the interaction of the sound dimensions of mixed music allows it to go beyond these traditional approaches. The study of the organisation of mixed sound allows one to understand the interaction of the instrumental and the electronic part, to highlight their reciprocal interrelations and transformations, and to show the musical sense of their contact. It opposes to the notion of 'sound object' a multi-modal notion that is based on both the recognition of the sound's morphological components and the agents involved in sound production. It is both an analysis of the sound and an analysis of the sources. It is based on an ecological hypothesis of listening, that segregates the sounds produced by the instruments and the electronics and, at the same time, recognises the sound agents. Starting from the point of view of the functional organisation of both the instruments and the electronics in the mixed sound, the writing strategies and the morphological considerations are hierarchically ordered and oriented. The sound sources — instrumental or electrical — and the sound types have a function in this complex object. Considering mixed sound as an emergent property is an innovation in the existing analytical perspectives, allowing us to consider the interaction of the maintained elements of the perceived whole from the point of view of the sound and the agents.

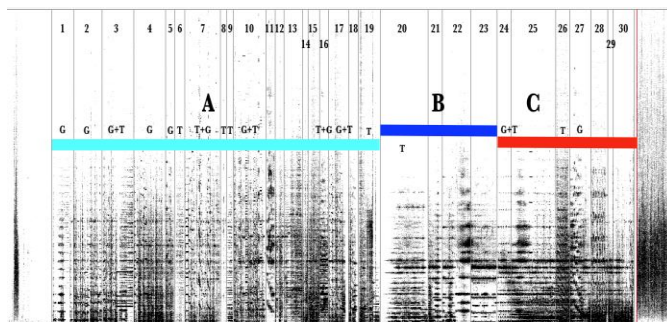
#### 4. ANALYSING MIXED SOUND

The contact of instruments and electronics leaves traces in sounds (Emmerson 2007, 51). I propose to analyse mixed sound as a conservative emergent property through the notion of *functional repartition*. This notion means the organisation of the instrumental and electronic sound in the spectrum, harmonically and temporally. The elements are divided and have a function in the resulting sonic whole. There is a *temporal functional repartition*, which means the organisation in the horizontal axis of both components, electronic and instrument; there is a *spectral functional repartition* on the vertical axis as well. This methodology allows understanding the repartition and role of both sound dimensions. A similar approach is proposed by Zattra (2016).

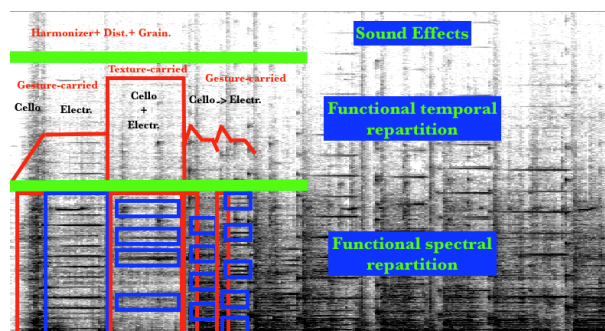
##### 4.1 A Case Study: Tremblay's *A singlewordisnotenough3*

Pierre Alexandre Tremblay is a Canadian composer born in 1975. He represents very well the contemporary generation of electroacoustic music practitioners. He is a composer, a programmer, an improviser, a teacher and a renowned scholar. Tremblay defines himself as *post-acousmatic*, that is a 'polyphony of activities which imply a variety of aesthetic or practical relationships with the acousmatic paradigm, but are not contained within it. It is not one direction but many: a series of trajectories perhaps only sharing a few, but significant,

common factors with the acousmatic paradigm' (Adkins, Scott and Tremblay 2016). For Tremblay, there are just qualitative differences between the scene and the studio, writing and improvisation. Electronic music is a manner to render the compositional thought.



Ex. 1. Segmentation of the piece in 30 events.



Ex. 2. Event number 4 functional temporal and spectral repartitions.

*A singlewordisnotenough3* is a piece for cello and multi-channel real-time interactive electronics composed in 2015. The piece was commissioned and premiered by the cellist Seth Parker Woods III. The material of this analysis was collected during the performance made in Strasbourg by the composer and the performer in 2016.<sup>1</sup> During the concert, I recorded the piece from the hall and documented the devices. The recorded sound represents the mix of the cello and the electronics. The recording was then segmented following the principle of *gesture recognition* based on the functional structures proposed by Denis Smalley (Example 1). These structures are sound events characterized by three temporal phases, onset, sustain and extinction (Smalley 1997). This method allows to segment the piece and to concentrate the analysis on each segment. To clarify this approach, the next analysis will show the interconnection of the instrumental and electronic part in the spectral and temporal domain (Example 2). In this analysis, I distinguish the elements of the events between *gesture-carried units* and *texture-carried units*, the temporal and spectral parts, and highlight the predominance of the instrumental or electronic part, the presence of the performer agency or a textural non-identified sound agency. This distinction is based on the predominance of the instrumental gesture or the electronic texture. In every event I determine the repartition of the func-

<sup>1</sup> This performance was possible thanks to the GREAM research centre (*Groupe de Recherches Expérimentales sur l'Acte Musical*), University of Strasbourg.

tions. In the next paragraph I describe the functional repartition in the fourth event as shown in Example 2.

*Functional temporal repartition.* In the first sound event, the cello anticipates the electronics. The cello and the electronics fill two functions of the envelope, they are divided between the *onset*, the cello, and the *sustain*, the electronics. There is a consequential relationship between the instrumental and the electronic part. The second event is defined by the equal superposition of both the instrument and the 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 the sound sources. The electronics and the instrument create a unique noisy sound morphology in which both are very closed. The third part is characterised by the repartition of the temporal envelop with *onsets* played by the instrument and *sustains* played by the electronics. This functional repartition defines a consequential relationship between the instrument and the electronics.

*Functional spectral repartition.* From the point of view of spectral repartition, the first event is determined by two sound types. The first one is the *crescendo* note played by the cello and the second is constituted by oscillators bank played by the electronic that holds a fixed group of frequencies. This repartition follows the temporal one and highlights the consequential relationship of the instrument and the electronics. The second part of the event is determined by the repartition of the spectrum's energy towards the noisy sounds of the cello and the electronics that highlights emergent frequencies, as we can see in Example 2. The third event presents a spectral repartition of two plans: the cello in the foreground plays a descending line of pizzicato and low notes while the electronics holds frequencies banks and doubles the *pizzicato* of the cello.

## 5. DISCUSSION

Both the cello and the electronics create a dense sonic whole in which the instrument is followed by the electronics and the sound is exalted by the richness of the instrumental part. I tried to analyse the sonic output of a mixed piece considering the hypothesis of a mixed sound that emerges from the contact of the instrument and the electronics without erasing its elements. I propose to analyse this emerging object from the point of view of the functional repartition of its elements. In the example, the cello and the electronics create a repartition of both temporal and spectral dimension. 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 more static sound morphology. These two types of functional temporal repartition can be 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 characterise this phenomenon (Smalley 1997, 119).

The spectral functional repartition highlights a subdivision of the roles of the instrument and the electronics. In the first event, the instrument is fixed in a given register and the electronics plays a large bank of frequencies that contrast with the instrumental part; in the second event, they share the same space. This coexistence makes it difficult to clearly listen to the two dimensions. However, it is possible to identify their rep-

artition thanks to the division of the spectrum between both dimensions. The cello plays noisy and disordered sounds, the electronics 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 they occupy contrasting bands of the spectrum. The electronics and the instrument thus collaborate to create a rich and unique sound morphology.

## 6. CONCLUSION AND FUTURE WORK

Mixed music is usually studied from the point of view of its devices or from aural perspectives. Interactive aural analysis presents an alternative methodology able to link the poetic and the aesthetic aspects of this practice. In this paper, I propose to consider the sound resulting from the contact of instrument and electronics as a global whole. Inspired by the *Gestalt* psychology concept of emergence, I proposed to consider the sound result of the contact of the elementary dimensions of mixed music as an emergent conservative property. This notion is at the basis of the proposed analytical perspective.

The instrument and the electronics are analysed as interacting in the sound event. The analysis makes it possible to understand this interaction and the functional repartition of both dimensions. The temporal 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 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 requires further research in this domain. Indeed, this analysis shows that the organisation of the temporal and spectral space of the instrument and electronics implies the use 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. Such an analysis is highly time consuming. For this reason, further developments of this methodology will include machine learning and automatic sound extraction in order to visualise the interaction of the instrument and the electronics in a larger number of case studies. This approach will allow to compare a wider number of examples and to define a complete typology of the interaction from the point of view of the devices and the sound morphologies.

## KEYWORDS

Mixed Music, Functional Analysis, Mixed Sound.

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