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Instrumentalists on Solo Works with Live Electronics: Towards a Contemporary Form of Chamber Music?

François-Xavier Féron and Guillaume Boutard

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Introduction

Musique mixte has spawned multiple conceptual aesthetic forms. The first version of *Musica su due dimensioni* (1952) by Bruno Maderna, usually considered the first example of this type of music, confronted two instrumentalists (a flutist and a percussionist) and a tape. This work introduced a new paradigm into contemporary composition, one which then developed over the years and is now widespread. Our intention is to question the nature of the confrontation between instrumentalists and electronics within the technological and social context of performance. Tiffon (2005) distinguishes three potential configurations: in the first, the electronic segment is produced before the performance (and fixed on a media), in the second, the electronic segment is created in real-time during the performance, and in the last there is a combination of the previous configurations. The most current nowadays is the latter. Our study engages with live electronics and, specifically, solo works.¹ Our goal is to investigate the conceptualisation of this interaction from the point of view of professional instrumentalists. This conceptualisation does not relate to specific works but to a broader view, grounded in the experience these experts have compiled during their careers. Thus, we aim to provide a better understanding of the theoretical and practical impact of this repertoire on the musical practice of instrumentalists, from a piece's preparation to its performance in concert. A previously unheeded question emerged from our study: are solo pieces with live electronics a new archetypical form of chamber music?

Interviews and Participants

Using semi-structured face-to-face interviews, we systematically collected the discourse of instrumentalists pertaining to selected topics. Semi-structured interviews require a set of predetermined questions. Nonetheless, the interviewer may choose to further explore points raised by the interviewee, paying particular attention not to influence her/him (see Kvale & Brinkmann 2009 for considerations about interviews as a data collection technique). In a different context and with a different purpose, Rink (2011, 436) stated that, 'for too long there has been an implicit assumption within musicology that scholars have the upper hand in matters of knowledge and judgement, and that performers who do not seek out and eagerly assimilate the findings of scholarship in their interpretations run the risk of shallow, meaningless music-making which serves them as individuals rather than some higher ideal. Such a view is untenable and should be laid to rest once and for all.' Similarly, we argue that it is truly relevant to take into account the performers' ability to verbalise their own expertise in the context of music with live electronics.

Clarke (2004) details evaluative and qualitative methods in the study of performance stemming from psychotherapy in which performers are able to discuss their practice. In this context, the data collected comprises of performance recordings, as well as of *a posteriori* comments. We have sought to detach our research from a specific work, in order to question

instrumentalists' practice in relation to their perspectives on musical genre. Our specific goal was to collect their statements, 'asking questions and encouraging them to tell their own stories of their lived world' (Kvale and Brinkmann 2009, 48). The output of this method is an analytical grid, grounded in the systematically collected data, as opposed to using the collected statements to validate an existing theory. The methodological background and epistemological assumptions are detailed in Boutard and Féron (in press). The analytical process in grounded theory (Strauss and Corbin 1998, for a thorough explanation of the analysis process) is long and meticulous. It relies primarily on a continuous process and the diversity of the data. Through this process, the conceptual framework emerges and stabilizes. This research is qualitative rather than quantitative in nature (i.e. based on stabilization rather than the number of word occurrences).

We conducted interviews with twelve instrumentalists with multiple backgrounds. They are identified with the code I-xx (xx is the identification number). The interviewees included two saxophonists (I-03 and I-09), two flutists (I-01 and I-08), one trombonist (I-02), one trumpeter (I-04), two cellists (I-05 and I-12), three clarinetists (I-07, I-10 and I-11), and one percussionist (I-06). Several instrumentalists have played music with live electronics since the end of the 1970s. Some younger participants with relevant professional experience were also included in the survey, thus providing greater data variety in terms of practice and social context. Figure 5.1 shows the broad distribution of experience among interviewees, most of whom (eleven out of twelve) also have teaching experience. Seven out of twelve began before the year 2000. Five interviews took place in Quebec and seven in France; all of them were conducted in French, which is the researchers' native language.

Figure 5.1, Population distribution in terms of their first experience in musique mixte.

The questions, originally in French, were the following:

1. I would like to ask you to describe the similarities and differences that arise in preparing a musique mixte piece with live electronics on one hand, and a purely instrumental piece on the other.
2. During your experience with this repertoire, I would like you to describe what systematic work methods you enacted.
3. In the preparation stages, how invested are you in the electronic component (in terms of time and sound explorations)?
4. In the best-case scenario, what type of documentation pertaining to technological setup and electronic effects do you have access to?
5. Globally, with regard to available documentation, what do you feel might be lacking and what elements do you feel it would be wise to include?
6. What evidence of the electronic segment is visible in the score?
7. As an instrumental performer, does preparing musique mixte pieces with live electronics require any skills that might not be implied in instrumental music?
8. When preparing the piece, what type of outside experts do you call upon?
9. I would like you to describe any further problems you might have faced in preparing musique mixte pieces that have thus far gone unmentioned.
10. Do you believe that the performance of musique mixte has the potential to become a field of study in professional musical scholarship?

Categories

We collected a large amount of data from these interviews, which consisted of approximately 68000 words that we then segmented into roughly 1300 quotes.² Before we begin a broad presentation of the categories that emerged from our analysis, we must define a few terms used in this paper.

‘Agents’ represent the broad range of human and technological entities participating in an activity, that is to say, in our context, the production and creation of *musique mixte*. The range of agents in this definition matches the use of the term in Laura Zattra’s (2006) paper on the context of electroacoustic music. ‘Actors’ are defined as both human and institutional ‘agents’. They include composers, universities, music schools, performers but exclude technological entities. ‘Performers’ are human ‘actors’ participating in the live production of works. Performers are engaged in musical practice according to their domain of expertise. Musical practice ‘consists of a variety of different but interrelated activities including memorisation, the development of technical expertise and, ultimately, the formulation of interpretations’ (Reid 2002, 102). Performers include instrumentalists, as well as sound engineers and live electronic musicians. The term ‘instrumentalist’ refers to the human agent who plays a ‘traditional’ musical instrument.³ The term ‘live electronic musician’ designates the human agent in charge of electronics during the performance (Plessas and Boutard 2015).⁴ Figure 5.2 presents a broad description of the relations among the various human ‘actors’ in the context of *musique mixte*, including also the listener. Figure 5.2, Schematic depiction of the social interaction in *musique mixte* (adapted from Boutard and Féron, in press).

The analysis of the data collected provides us with a conceptual framework consisting of three broad categories divided into several levels of subcategories (for an example of such a framework, see Boutard and Guastavino 2012). A detailed presentation of these categories (grounded in the verbalisations of the participants) would be too lengthy a task for this paper. We will present the highest levels of the conceptual framework that support the discussion. The three main categories to emerge from the analysis are the following: production context; musical practice organisation; and *musique mixte* conceptualisation.

Production Context

The production context includes all factors related to the management of both human and technological resources at any given time during the production process, from the commission to the concert. To be specific, it requires the presence of several agents necessary to production, which span from the broadest (e.g. institutions such as music research centres) to the smallest units (e.g. microphones and speakers) via human actors. For example, I-01 emphasizes the importance of the microphone: ‘I think that the most important thing [...] is to learn a few things about microphones and amplification [...] If we have good knowledge of microphones, specifically our own, [...] it becomes part of our instrument’ (Q-107). As a matter of fact, Haller (1999, 12) states that ‘the function of the microphone in real time electronic sound transformation is completely different from that of normal studio operation: it represents a quasi-instrument of electronic sound extension, with which the interpreter can play’. The complexity of agencies in the context of music production with technologies has long been emphasized in the literature, for example in the work of Menger and Cullinane (1989). The production context of *musique mixte* also encompasses the management of various stages. As I-11 states: ‘often, in a piece without electronics, we come in

when the piece is finished. That is, when the composer is done writing, at which time he brings us the finished product [the score]. However, when we work with an electronic component, the writing takes place in stages' (Q-1097).

This specific context has an impact on the work strategies described in the following section on the organisation of musical practice. Additionally, as many instrumentalists highlighted, it affects the implication of actors, and the required musical and technological skills. 'Sometimes in order to handle the difficult cues, you need to develop a specific work technique' (Q-166), recalls I-02. Some instrumentalists improve their technological knowledge, for instance, I-01 explains: 'Since I have become more familiar with Max/MSP, I feel a lot more comfortable when something is not working, or if I have questions, I can take a look for myself' (Q-110). This situation is not one that all participants share, 'personally, says I-12, I have no idea how a Max patch works. I know more or less how it works but I am totally incapable of running it' (Q-1256).

Another important part of this context is the legibility and the comprehensiveness of the documentation pertaining to electronics (for the record, this point is explicitly raised in the questions). This topic, especially as it relates to the score, has long been discussed in the literature (see for example Stroppa 1984, Manoury 1999, or Emmerson 2006). Nonetheless, from the instrumentalist point of view, opinions are manifold on this topic. Most interviewees emphasized potential deficiencies in the electronic score. I-12 states that 'sometimes, but not always, there is a line that represents the electronic segment, but it is rarely very illustrative' (Q-1233), further describing the electronic notation as often 'exotic'. The same participant nevertheless suggests that this is not a priority for resolving the inherent difficulties of playing with live electronics.

The Organisation of Musical Practice

In the following statement, Dunsby (2002, 233) accurately describes the complexity of musical practice organisation: 'actual performance is the tip of an iceberg of performer's practice and rehearsal, which in countless different ways is the "analytical" level of music-making, the time when everything is put in place mentally and physically for the on-stage "calculation" that has but one opportunity to be right'. In our analysis, the organisation of musical practice relates to the description of all activities necessary to the production of the works and, at the collective level, the multiple interactions between various actors, most especially those between performers, which include collaboration, supervision and delegation. I-02 mentions that 'a skilful person is needed at the computer, to go either forward or backwards, if something has gone wrong' (Q-216). Activities that pertain to the transfer of knowledge at multiple levels, between multiple actors, also belong to that category. For example, I-11 is often sought out for his expertise on a specific work that he premiered and recorded. He further states: 'somehow we are the works' ambassadors' (Q-1075). Another important aspect that I-11 brought up, in terms of knowledge transfer, relates to annotation: 'we note the electronic elements on our own score as we go along because they are not in there' (Q-1123). Some participants place the emphasis on oral transmission, which is not limited to the relationship between the composer and the instrumentalist. As Berweck (2012, 209) noted, 'performers must acquire the skills to communicate their needs to the colleagues with whom they perform – the stage technicians and the sound engineers'.

An important part of this category is the conceptualisation of the multiple appropriation strategies developed by instrumentalists in the context of solo works with live electronics. Two subcategories emerged. The first one relates to various kinds of adaptations, including the aforementioned annotation activity but also in relation to the production context, especially with

regard to the technology. A funny example is provided by I-12, concerning a piece requiring many pedal cues: ‘I remember that I worked at home with a hole punch that I put on the floor just to have the feeling to press something with my foot at the right time’ (Q- 1195). The second one relates to investigation strategies, including sound investigation, which was important in the instrumentalists’ statements. I-07 describes his strategy in relation to live electronics: ‘often, we refine the dynamics, especially in the pianissimo range, to see what happens when we strengthen them’ (Q-751).

Beyond sound perception, these investigations are of particular importance in the process of apperception, that is to say, according to Vermersch (2011, 188), the ‘mental act through which the person becomes aware of his/her own representations’. It is important to figure out the piece’s original sound intention, or aesthetic. As I-03 underscores, ‘the instrumentalist needs [...] to be aware of the type of transformation at that specific point’ (Q-279).

Musique mixte: Conceptualisation

This specific category brings together all of the theoretical reflections on musique mixte from the instrumentalists’ point of view. The interviews spawned more abstract and context-independent enquiries about the nature of musique mixte and performance. These reflections bring into question the relation to electronics and the repertoire’s specificities. I-02 highlights the causal link: ‘the processing is live, the result depends on what I do’ (Q-157). I-05 describes this relationship as a symbiosis between instrumental sound and live electronics. He states that, in some cases, ‘one does not exist without the other [...] This is true musique mixte, it is almost hybrid’ (Q-591).

How one relates to space as well as to the instrument is greatly modified. I-07, for instance, tries to convey to the students that: ‘the fact that we work with speakers, with live sound processing, all of a sudden, [...] the room disappears, everything is transformed’ (Q-753). Similarly, I-05 describes the implications of live processing for the virtual extensions of the instrumental capabilities: ‘The electronic element supplements the instrumentalist such that he becomes a super-performer. It allows him to play faster, higher, lower, all those things he cannot do because no matter what, he *is* limited, even if he is the best in the world’ (Q-586).

On a large scale, the different perspectives of these reflections match Elena Ungeheuer’s conceptualisation of live electronic music, which she organises in three stages or types: 1) the opposition between human and machine actions (which relates, historically, to fixed media) as a dramaturgic concept; 2) the instrument’s time-space transgression, in which ‘the scope of the possibilities of action of the instrumentalist transgresses the usual frames of time and space’ (2013, 1369) and 3) the interaction, which ‘starts where the gesture of the instrumentalist ceases to trigger mechanical processes’ (2013, 1372). The latter relates to the notion of chamber music and the fluid conceptualisation of the partnership in the context of solo works with live electronics, which is the focus of the next section.

A Contemporary Form of Chamber Music: Primary Characteristics

In order to establish a meaningful relationship with electronics, the instrumentalists must collaborate closely with their partners who need to have a great expertise in the field of computer music and sound engineering. Most of the instrumentalists we interviewed spontaneously describe

solo pieces with live electronics as chamber music. Whether this statement relates to human collaboration or the interaction with electronics, this is an issue that emerged from this study.

According to I-08, chamber music relies on the interaction ‘with both the electronic segment and the person with whom we work’ (Q-900). Once you have discovered the instrumental score, ‘it is useless to work alone’, explains I-03 (Q-273). I-02 also underlines the need to ‘rehearse with electronics as you [would] rehearse with a piano, just like chamber music’ (Q-199). According to I-07, ‘you are not working on a solo piece, you are really working in a chamber music context’ (Q-738). I-12 goes as far as to compare the situation to that of a string quartet, usually considered the paragon of chamber music. This participant argues that, during rehearsals or concert, ‘we will never play the same way twice and we will all interact with each other’ (Q-1222). Playing in a string quartet or playing a solo piece with live electronics requires collaboration between actors but in a very different production context. A string quartet is a well-defined and fixed ensemble of four instrumentalists who share a common background in terms of education and profession. They are literally colleagues since they play instruments belonging to the same family. They also share the same vocabulary and face similar issues. Solo pieces with live electronics raise several questions: How many partners are required? Does it include the live electronic musician, the sound engineer and so on? What is expected from them and how do they interact? Do instrumentalists have shared expectations concerning the role of their partners? Before getting to the heart of the matter and discussing the relevance of the term ‘chamber music’, we will provide a brief state of the literature on chamber music.

In current usage, a chamber music piece is defined as a composition traditionally written for a small instrumental ensemble with no more than one player to a part; it is historically intended for a performance in a private room or small concert hall before an audience of limited size (Bashford 2001). Three main aspects seem to determine what a chamber music piece is: the number of musicians, the notion of interaction between the instrumental parts and finally, room types where this repertoire should be performed.

The usual definition of chamber music, in terms of number of musicians, is relatively constant and secure but remains arbitrary. Traditionally, chamber music is performed by a small group of players between two and ten in number (Tranchefort 1989, vii). From our perspective, the maximum number of musicians is not the issue. In fact, the question is rather: may a solo piece (with live electronics or not) be considered a chamber music piece? Several authors have examined this issue and answers tend to differ from one to another. Although it is often defined as involving more than two players, ‘much solo repertory such as Renaissance lute music, Bach’s violin sonatas and partitas and cello suites and several of Beethoven’s piano sonatas fulfils many of the functions and conditions of chamber music’ (Bashford 2001, 434). Tranchefort (1989) ignores the repertoire for solo piano but includes all solo pieces written for solo strings or winds, explaining that this seemingly arbitrary choice is in fact a historical artefact. McCalla (1996) notes that chamber music is performed by a group of players normally numbering between two and nine. Nevertheless, he includes solo percussion piece such as *Zyklus* by Stockhausen and also mentions a few examples of solo pieces with tape. As for Baron (1987, 2010, xv), he believes that chamber music is classical European instrumental ensemble music for anywhere from two to approximately twelve performers. He does not include ‘music for two or more keyboard instruments without additional, non-keyboard instruments, and percussion music’. From these multiple and conflicting points of view emerges a subjective definition of chamber music, including solo pieces or not. From this perspective, it is relevant to consider a solo piece with live electronics as belonging to this genre.

Another aspect that usually characterises a chamber music piece is interaction. ‘In essence, the term implies intimate, carefully constructed music, written and played for its own sake; and one of the most important elements in chamber music is the social and musical pleasure for musicians of playing together’ (Bashford 2001, 434). In a solo instrumental piece, such as Bach’s violin sonatas, the instrumentalist need not interact with other performers. S/he is responsible for the sound production as a whole. In a solo piece with live electronics, the instrumentalist must work with an individual or a group of people in charge of diffusing the electronic segment. There is an interaction in terms of sound, between the instrumental and the electronic segments; consequently there exists a social and musical interaction with other agents.

Finally, the term ‘chamber music’ indicates the type of rooms where this music should be played. This repertoire emphasises subtlety and intimacy: it is not originally meant to be performed in symphony halls or opera houses but rather in ‘a domestic environment with or without listeners, or in public in a small concert hall before an audience of limited size’ (Bashford 2001, 434).⁵ This architectural aspect is also present in the case of solo works with live electronics. Such pieces require the installation of an important technical setup in the concert room and may transform the relation to space. Electronics aims to create virtual spaces that have to be perceived homogeneously in the room; however in most cases, the solo instrument is an acoustic one. In order to respect the natural instrumental sound and the localisation of the source, engineers try to not amplify it too much. For these different reasons, this repertoire should be played in rooms of limited size.

How do the instrumentalists that we interviewed approach these three aspects? What arguments are brought up when they naturally describe the performance of solo pieces with live electronics in terms of chamber music? What is the best framework for practicing and performing such a repertoire?

Sound interaction

Before focusing on the number, skills or role of the partners working with instrumentalists during rehearsals and concerts, let us begin by questioning the interaction between the instrumental and the electronic segments. How do the instrumentalists understand this interaction? What are the similarities and differences in comparison to a traditional piece of chamber music?

Even though it is now common to consider the instrumental and electronic segments as two parts of the same whole, this is not necessarily reflected in the preparation of the performance. It is not always possible for the instrumentalists to work with the electronics right from the beginning. I-11 underlines the importance of understanding the musical language of the instrumental segment by deciphering the score and also states ‘if you are lucky to work directly with electronics, it is better’. The correlation between the instrumental and electronic segments implies that ‘there is a constant back and forth between what I put forth and what electronics do’, continues I-11 (Q-1106). I-03 holds a similar view. In any kind of *musique mixte* (with tapes or live processing), the instrumentalist must adapt to ‘working with another partner, with a sound generator other than a traditional music instrument’ (Q-377).

Musique mixte is often described in terms of dialogue, confrontation or symbiosis between the instrumental segment on the one hand and the electronic segment on the other. I-11 assimilates the electronic segment to a second person. ‘Thus, it is similar to two strangers. They will get to know each other, it is once we are properly acquainted that the piece is ready to be performed in public. It is exactly the same as any relationship with another instrumentalist’ (Q-1121). The same

participant also argues that this is a form of chamber music since there is a need to listen carefully to the sound diffused by speakers. This is not another building block – ‘a second Lego’ (Q-1122) – added by the composer to the instrumental segment. I-07 compares the context to the performance of a piano trio, in which you have ‘to find a sound space’ (Q-735). For most of the instrumentalists, it is critical to really play with electronics, to develop, according to I-09, a ‘form of connivance with the speakers [...] as it is with a pianist’ (Q-955). I-07 points out the importance of modulating the performance, ‘to vary the intensities, the articulation and the tempo’ (Q-748) and observing the outcome with respect to electronics. In comparison to traditional chamber pieces, this causal relationship is often stronger. A musical pattern can be memorised by the computer and replayed with a delay in order to build a canon with the live instrumentalist. In this common case, preparatory tasks are similar to the work done with another musician, but ‘to play with oneself [...] is really a new chamber music experience’ (Q-1005), specifies I-10. ‘You have to work as if you were in the presence of other instrumentalists’, insists I-12 before concluding: ‘It is the rehearsal process of chamber music, but with electronics’ (Q-1211).

The symbiosis with electronics is fundamental to most pieces of *musique mixte*. Nevertheless, sometimes, the instrumentalist must content herself/himself with a focus on the instrumental segment and leave the control of electronics to the other human actors of the performance. ‘In some cases, it is better to play almost as though one were autistic, paying no mind to the electronics’, explains I-12, who makes an explicit comparison to an orchestra ensemble: ‘we play the score, we follow the lead of the conductor, we trust the conductor’ (Q-1218). I-05 remarks that, for pieces belonging to certain specific aesthetic categories, such as Boulez’s music, ‘the role of the instrumentalist is strictly defined, or even confined to a precise definition’ (Q-585). In these particular cases, the degree of interaction is limited.

In general, instrumentalists underscore the interaction they need to have with electronics, and compare this experience to that of chamber music. Nevertheless, the identification of partners varies significantly from one instrumentalist to another and from one context to another. The partner may be associated with the electronic segment (in terms of sound), with devices (such as laptop, speakers, microphone and so on) or with human actors in charge of electronics during the performance.

Social interaction

In this section we will discuss the social interactions taking place during the multiple phases of the production of this repertoire. How many partners does the instrumentalist need to perform a solo piece with live electronics? What role does each human actor play? Could these relationships be compared to those in the context of instrumental chamber music?

Confidence among performers

‘We are alone on stage, but in the case of a piece with electronics, we are not even alone. At the very least, we work as a duo and I find that very pleasant. According to me, it is similar to chamber music’ (Q-1284). These words, coming from I-12, are quite explicit: although ‘solo’ is generally mentioned to describe a piece for one instrument with live electronics, it is obviously not a solo piece. Even if the instrumentalist is alone on stage, s/he is not single-handedly responsible for the sound. S/he performs the music alongside her/his partners in charge of

electronics. I-07 insists that when performing *musique mixte* ‘you are not alone’, people ‘who are playing with us, are generally present in the performance hall’ (Q-761 & 762).

Performing a solo piece with live electronics implies working with other actors you can rely on. ‘Confidence’ is a word instrumentalists often employ to describe their relationship with other performers. If possible, I-12 prefers to work with the same people at every concert: ‘I know them; they know how I work. The partnership, the trust, is the same as with an instrumentalist’ (Q-1290). During their education, musicians learn to be an element of a group, whether it is an orchestra or a chamber ensemble. As a consequence they learn to rely upon each other, observes I-04. In *musique mixte*, the same situation applies, but the configuration is quite different: the instrumentalist, who is on stage, often has to work with partners positioned at the back of the console placed in the audience. I-07 acknowledges that the instrumentalist is usually ‘totally incompetent when it comes to operating the technical equipment’, and must therefore trust the partners (Q-784). I-12 delegates all technical aspects to them (Q-1204). Furthermore, the instrumentalist cannot control the sound balance inside the audience: ‘You have to relinquish the idea of an absolute control over the music you are producing’, I-03 understandably remarks (Q-247).

Performers in charge of electronics have to make sure that the technical set-up is efficient. They need to constantly adjust the electronic segment with regard to the instrumental sound. The instrumentalist then ‘begins to understand the electroacoustic phenomena that occur around him and it will completely change his work’, explains I-04 (Q-403). According to this participant, this specificity of *musique mixte* may seem slightly disturbing at the beginning: ‘You must trust the sound engineer. Quite simply, you cannot manage your own sound in the mix with a real-time treatment. You are compelled place your entire trust in the person who will be in charge of this balance’ (Q-394 & 395). I-07 observes the same thing in explaining that the instrumentalist needs people in the audience to provide some of the feedback to her/him (Q-761).

Team Configuration

In figure 5.2, we have simplified the social interaction between human actors during the composition and the performance of a solo piece with live electronics. This schematic representation is not static. On the one hand, the instrumentalist could collaborate with the composer and the computer music designer during the creative process: as noted above, when you work on the premiere of a piece with live electronics, I-11 observes that, as opposed to an instrumental piece, you are not in the presence of the final product (Q-1097).

Most of the instrumentalists we interviewed were involved in premieres and are accustomed to working with the composer. In the case of a solo instrumental piece, the only interaction is between the instrumentalist and the composer. In the case of a solo *musique mixte* piece, the electronic segment is generally supervised by: the composer, the computer music designer – who puts on the live electronic musician’s hat – and the sound engineer. It is not a ‘dialogue’ but a ‘quadrilogue’ (Q-1137), insists I-11, before concluding: ‘according to me, it is a quartet, even if I am alone on stage. Nevertheless, I carry approximately twenty five per cent of the work’ (Q-1134). I-12 considers the composer the main piece of the puzzle. S/he should have a powerful creative idea and use the skills of the instrumentalist, the computer music designer and the sound engineer (Q-1269). Ideally, s/he should always be present to avoid deviations during the performance, explains I-03 (Q-340). In fact, ‘it is quite rare that composers are not present’, in the specific case of this repertoire (Q-276).

Once the piece has been performed several times in concert, the composer's presence is not required but the patch must be available and up-to-date. Thus, the team may be reduced. According to I-07 or I-02, you have to work with a sound engineer who is responsible for the entire audio set-up (speakers, pedals...) and a person 'who follows the music (the computer music designer or the composer) at the very least' (Q-169). The social context has undergone a profound mutation via the democratization of technology and training in the use of audio and real time software in music schools. Indeed, many composers create the electronic segment and might appear to be the instrumentalist's primary and single partner during a performance. André Richard observes that, for the performance, composers come with the patch and are in charge of electronics (Boutard 2013). If they are not on site, the piece cannot be performed. However, depending on the availability and reliability of the patch, it also happens that the instrumentalist works with just a live electronic musician, who is not necessarily the composer, notes I-12 (Q-1271).

Performers' Roles and Skills

Playing *musique mixte* requires a specific framework that consists of a complex technical set-up managed by multiple human actors. I-03 compares this framework to the situation in dance and theatre productions: the rehearsal is not strictly musical in these cases since 'you have to take into account a specific environment and its technical contingencies' (Q-263). During the first steps of the preparation, both the instrumentalist and the technical staff have to work on their respective parts. The tasks are clearly separated. I-05 insists that: 'you need to know that each person has their own specific role' (Q-662). Each actor has to resolve technical issues before working together. There is no real collaboration during this stage, explains I-12: 'just as the musical assistant or the composer does not come to look over my shoulder when I am playing scales; I am not behind his/her laptop when s/he is opening a file that has not been read in four years' (Q-1285). Instrumentalists do not generally know much about software such as Max/MSP, which is often used in pieces with live electronics. This aspect is left to competent individuals. In addition, during the performance, the instrumentalist on stage does not have to care about the correct processing of the electronic segment, explains I-05: 'We are on stage. The show must go on. But it is very complicated' (Q-662).

As previously mentioned, it sometimes happens that a single person, with multiple skills, oversees both the computer and audio aspects (Q-482, Q-825 & 826, Q-1271). I-12 has often played solo pieces with live electronics with the same partner and underlines: 'I am playing as a duo in the same way I would play with a pianist', since his partner 'behaves like a musician, that is to say: who listens' (Q-1275). I-12 also notices that in case of a healthy and stable patch, partners must have particularly good competence in sound engineering. S/he must be able to 'produce a specific sound in the room' (Q-1274). This consideration is shared by I-04, who explains that 'the sound engineer plays a very important part, almost as important as that of the performer' (Q-407). Instrumentalists insist on the fact that at least one of the partners must be a trained musician. 'You have to trust and respect him/her', explains I-03 before adding: 'We are in presence of a real musician and, if it is not the case, it can be dramatic. S/he should not limit her/himself to mere sound projection. S/he must perform. In the end, the context is similar to that of chamber music' (Q-248 & 249). I-05 underlines the collective nature of the work and explains that 'there is a chamber music approach, in the classical sense of the term that emerges among the partners' (Q-572). According to I-04, it is essential to know the partners well: 'For example, I cannot imagine playing a piece of *musique mixte* without knowing who will be carrying out the mixing' (Q-405).

I-03 explains that one of the partners must act like a performer, choosing the microphones, positioning the speakers in the room, adjusting the sound in relation to the acoustics. If the electronic performer does not guarantee a real interpretation ‘loyal to the score, but supplemented with an artistic sensibility, then the instrumentalist is screwed’ (Q-353).

Instrumentalists claim that pieces with live electronics require the expertise of a music technology partner who would then interpret the electronic segment just like the performer of an acoustic instrument. Höller and Richard both share this type of assessment. According to the former, in case of *musique mixte* with tape, instrumentalists have to familiarise themselves with the instrumental score and the tape simultaneously. If the composer is not present ‘a qualified musician must pilot the balance between the orchestra and sounds on the tape’ (Höller 1972, 26). The latter experienced surprising issues during the performance of an instrument piece with live electronics when technicians or developers were not accomplished musicians. When he became the artistic director of the Experimental Studio of the Heinrich-Strobel-Stiftung of the Südwestfunk (SWR, Freiburg im Breisgau) in 1989, Richard aimed to create a sort of small troupe to perform the works with live electronics, ‘like a string quartet’. This company was made of very close collaborators with an expert knowledge in the use of new media but who were also musicians. ‘According to me, these technicians were not mere technicians. They had strong technology skills but also had very good notions in music’ (Boutard 2013, 28).

Room and Set-Up Characteristics

Chamber music pieces were historically destined for performance in domestic environments, private in nature; solo pieces with live electronics also require appropriate rooms but for different reasons. When preparing live electronic works, instrumentalists face a number of unconventional situations. Specifically, they must deal with both a technological and a social context that are outside the normal scope of an acoustic music performance. This repertoire ‘requires a certain constellation [in terms of equipment and human actors] we do not always have easy access to’ says I-02 (Q-147), be it during the rehearsal process or the actual performance. According to I-11, many students would like to access this ‘constellation’ but cannot, due of its high cost (Q-1131). Before incorporating a piece of *musique mixte* in a recital, instrumentalists, such as I-10 or I-12, first find out about the room where the concert will occur. I-12 integrates these pieces as soon as it is possible, in terms of technology: ‘If I have the means to play pieces of *musique mixte*, if it is possible to have access to a sound engineer, a musical assistant and all the required set-up to make things work? Well, then I will do it’ (Q-1168). The room has to be configured to welcome the audio set-up and this is not always the case. If it is possible to install speakers and the audio equipment, explains I-10, ‘I try to add a piece [of *musique mixte*]’ (Q-991).

The technical environment implies that this repertoire often relies on specific studios or concert halls. During the rehearsal process, instrumentalists must access audio-equipped studios, which are generally located in research centres or music schools with a specific department dedicated to acousmatic and electroacoustic music. Consequently, this repertoire is often closely related to those institutions that can provide instrumentalists with both the technical and human logistics. For example, I-04 has worked essentially at the Institut de Recherche et Coordination Acoustique/Musique (IRCAM) where a sound engineer was always present to manage the set-up (Q-431). I-08, who has worked at the Centre for Interdisciplinary Research in Music Media and Technology (CIRMMT, McGill University), explains that musicians ‘are pampered when they practice there’ (Q-902). There are more and more music centres around the world with the relevant

infrastructure and staff to perform music with live electronics, but instrumentalists do not yet have easy access to them. Working in such centres remains a privilege, explains I-11 (Q-1131). Unfortunately, in music schools, I-02 notices, conditions are not yet optimal as specific courses dedicated to musique mixte rarely exist (Q-221). I-08 regrets that students in sound engineering are trained to record concerts, not to perform musique mixte, 'which is completely different' (Q-911).

Playing solo pieces with live electronics 'is like playing with another instrument', explains I-09, 'except that we have more common references when we are working with a pianist, for example. When we are playing a piece with electronics, we usually begin work on this segment later in the process. There are many things to assimilate in order to be familiar with electronic effects, just as there are with a pianist, a flutist or anything else' (Q-925). Access to a well-equipped studio and working with good partners are the first issues that instrumentalists face. Rehearsing in the concert hall is another problem. 'The reality is that most concerts are held in a setting where the musician on stage will meet the house technician on the day of the concert' (Berweck 2012, 187). This assessment does not entirely apply when instrumentalists have the opportunity to collaborate with institutions devoted to the dissemination of musique mixte, though, as mentioned above, this situation remains an exception. Even when instrumentalists have access to these agents, the amount of time spent rehearsing in the concert hall is important. It is only in situ that the instrumentalist 'can truly seize the sound aspect of the electronic segment' notices I-05 (Q-603). This repertoire 'truly requires rehearsals in the [concert] room, even if only for positioning microphones or testing speakers, both of which are very important', indicates I-09 (Q-936). According to I-07, the reverberation and fold back sensations on stage differ entirely from sensations in the audience (Q-780). Generally, there are not enough practice sessions available in situ to properly adjust interpretation with regard to the room acoustics. Moreover, such sessions generally occur too late in the practice schedule.

In studio, the artistic conditions are similar to those of a concert but on a different scale. 'We can recreate live conditions, explains I-09, but on a smaller scale. It is like playing in a fish bowl' (Q-934). Working in studio is fundamental to becoming familiar with both the technological and human agents. Once the technology is functioning, I-02 sometimes works alone in the studio (Q-207). A few musicians we interviewed try to have their own studio at home where they could rehearse pieces of musique mixte autonomously. However, most of them cannot work at home as they do not possess the necessary equipment, as notices I-04 (Q-432). I-11, who is an exception in this regard, wishes to have a studio at home but is restricted by the equipment's cost. 'I have created my own studio at home [...] I prepared it carefully because ideally I would like a tiny IRCAM at home, but it is not that easy. It requires at least one mixing table with a dedicated laptop, if not two, because the files are very heavy. You need two or even four loudspeakers. This equipment has a price but it is possible. [...] I am still hoping to make it happen' (Q-1155-1156). If we set the issue of money aside, it is possible today to recreate work situations at home similar to studio ones, underlines I-05 but 'it is still difficult to rehearse alone at home with adequate listening conditions if nobody is here to help' (Q-543). The question of the musical partner remains relevant.

Conclusion

In this paper, we have investigated the expertise of instrumentalists, who perform musique mixte, as it relates to acts of apperception, appropriation, and interaction with live electronics.

Ravet (2005, 5) reminds us that ‘if interpretation is considered performance, in that it is a process of (re)creation in acts that is supported/initiated/driven by musical bodies, then it would seem necessary to embrace sociological and musicological perspectives. [...] Both of the interested disciplines, musicology and sociology are examined here with regard to their methods and potential points of convergence and cooperation’. With a qualitative analysis grounded in instrumentalists’ discourses, we provided a conceptualisation of the multiple factors in play during the production process of solo works of *musique mixte* with live electronics. Several notions that help us understand performance from a musicological perspective have emerged from this conceptualisation. The complexity of the relationship between partners as it relates to the appropriation act and the convergence of this type of contemporary music with chamber music are two of the notions that broaden our understanding of the genre.

A chamber music piece is defined as a composition written for a small instrumental ensemble with one player to each part. Interaction, in sound and human terms, is one of its main characteristics. Although solo instrumental pieces do not lead to the same interaction present in traditional chamber music, they might nevertheless be considered as belonging to the chamber music repertoire. Combining acoustic instruments with tape or with live electronics has led this repertoire in a new direction. Such pieces are definitively not viewed as solo pieces. They invite instrumentalists to work with different partners who will be in charge of electronics. The instrumentalists we interviewed seem unanimous in comparing the performance of a solo piece with live electronics to that of an instrumental chamber music piece. They must develop a close relationship with the electronic segment in order to refine the sound interaction between the electronics and the instrumental. This requires collaborating with at least one partner, who will have his/her own musical sensibility and knowledge.

The main differences with instrumental chamber music pieces lie in the production context. Until the 1970s, few concert halls had adequate playback and amplification equipment to perform music with tape. ‘A performer would find it difficult to cart around equipment of his or her own, and the cost of renting it for a single performance might be prohibitive’ (McCalla 1996, 138). We can mitigate these particular points today but the technological environment is still an issue for the practice of *musique mixte*. The environment is itself responsible for the critical modification of rehearsal processes and relationships with partners. First, instrumentalists preparing new music with live electronics face new problems because of the various profiles of their partners, who are no longer solely considered technicians. These partners, who range in number from one (a live electronic musician only) to three (which includes the composer and a sound engineer), must manage a complex technical environment in order to ensure the electronic segment is properly projected and interacts correctly with the instrumental sound. They do not share the stage with the instrumentalist but act as his/her ears in the audience. Second, the notation of electronics in the score is often approximate, sometimes even non-existent. Apperception of electronics is only possible through essentially ear-based work. Thus, it is essential for instrumentalists to rehearse sufficiently with his/her partners in an adequate studio and in the concert hall.

In France, the computer music designer (*réalisateur en informatique musicale*) is officially recognized as a profession, of which Zattra (2013) has traced the evolution. Specific academic courses are emerging in music schools and universities to promote this professional activity.⁶ In the case of a piece of *musique mixte*, computer music designers assist the composers in their work with technologic medium. They also take part in the premiere and consequently appear as live electronic musicians. Many pieces are performed only a few times before fading from memory or becoming unplayable due to the obsolescence of technological tools. On the other hand, others

become classics, performed around the world. Neither the composer nor the computer music designer can be present each time the piece is performed. We may wonder who will be entrusted with the electronic segment. As Richard underlines, instrumentalists' partners in charge of electronics should not be viewed as technicians but as 'performers of electronic medium' (Boutard 2013, 34). Plessas and Boutard (2015) define the role of this performer in comparison to the role of computer music designers. Unfortunately, this new kind of performer is not yet widespread. 'If we take a look at classically trained instrumentalists in their entirety, we find that relatively few musicians specialize in the performance of music with electronics' (Berweck 2012, 190). This situation is destined to change in the coming years. Hopefully, we will witness the advent of new interpretive courses in schools of music or cultural and academic institutions, dedicated to training electronic performers who will then progress to become multi-skilled actors.

1. They would possess significant knowledge of repertoire involving live electronics.
2. They would be classically trained musicians, in order to perfectly understand the instrumental score and develop a true complicity with the instrumentalist.
3. They should have a great expertise in sound technology.
4. They should have organizational skills allowing them to manage the necessary equipment and coordinate rehearsals in studios and concert hall.

Beyond the complex interactions among the multiple performers, this study revealed a broad range of work strategies that instrumentalists implement in their appropriation of this repertoire. These strategies can scarcely be generalised; nevertheless, they are significantly different from those of traditional instrumental music. Both the technological and the human requirements, specific to this repertoire, critically transform the production context. If, in the context of this chapter, we focused on the notion of chamber music, the study also pointed to several recurring issues that may impede practice and, moreover, disseminate the repertoire. Compositions with live electronics are developing a new paradigm for chamber music and shaking up the codes of instrumental practice. In doing so, works for solo instrumentalists and live electronics are participating to the redefinition of chamber music, as well its transformation.⁷

Annex: Statements of interviewees quoted in English in this chapter

Instrumentalist	Quotes number	Quotation
I-01	Q-107	Je pense que la chose la plus importante que je conseille toujours aux gens qui me demande "qu'est ce que je dois faire en premier?": c'est apprendre quelque chose sur les microphones et sur le renforcement sonore. Ça, c'est très important puis c'est pas... c'est impossible de juste laisser ça à quelqu'un d'autre parce que si on a une bonne connaissance des microphones, au moins de son propre microphone, c'est... ça devient une partie de son instrument. Alors ça c'est, c'est extrêmement important.
	Q-110	[...] c'est sur que depuis que je connais un peu mieux Max/MSP, tout ça est devenu... je suis beaucoup plus confortable parce que s'il y a quelque chose qui marche pas ou si j'ai des questions, je peux regarder.
I-02	Q-147	Ce répertoire dans la totalité de mon répertoire soliste, c'est quand même un peu limité. Par le nombre, et par la difficulté d'exécution qui demande toujours une installation. L'ingénieur du son, l'informaticien, qu'ils soient dans la salle ou derrière la console. Ça nécessite a priori... une certaine constellation qu'on a pas toujours facilement.
	Q-157	C'est du traitement en temps réel, le résultat dépend de ce que je sors moi.
	Q-166	Parfois il y a des déclenchements très difficiles à faire qui nécessitent de développer une certaine technique de travail pour justement gérer ça.
	Q-169	Comme je le disais tout à l'heure, la répétition nécessite au moins deux personnes, voire trois personnes supplémentaires, une installation dans une salle même, et même si ce n'est pas la salle de concert, une petite salle de répétition, avec un retour suffisant, avec un micro. C'est toujours compliqué.
	Q-199	De bien répéter avec électronique, comme on répète avec le piano, comme on répète avec la musique de chambre.
	Q-207	En répétition, quelqu'un peut me mettre en studio, tout branché et me laisser tranquille pendant une heure ou deux pour que je travaille.
	Q-216	Et donc il faut aussi une personne compétente pour faire avancer ou reculer la machine si jamais il y a des choses qui n'ont pas marché.
Q-221	Normalement dans les conservatoires, déjà beaucoup de disciplines ne font pas travailler la musique actuelle, alors on ne va pas compliquer et demander aussi de la musique mixte... Ça ne fait pas partie du cursus.	
I-03	Q-247	Et là, il y a nécessairement un abandon d'une partie de son plein pouvoir quant au rayonnement de la musique qu'on produit. Parce que il y a quelqu'un qui travaille en lien avec le compositeur et l'interprète, une interface, et cela, évidemment, si on n'accepte pas de rentrer dans ce jeu-là, ça peut être très frustrant. Parce qu'on ne maîtrise plus les choses en fait. Et là pour le coup, à la charge du compositeur ou de l'assistant de dire « attention, on sort totalement des clous » en termes de dynamique.
	Q-248	Évidemment ce tiers joue un rôle. Il faut une confiance absolue. Une confiance, un respect et, comment dire, il faut savoir qu'on a affaire à un vrai musicien et si ce n'est pas le cas c'est dramatique.
	Q-249	Ce n'est pas seulement quelqu'un qui diffuse. Il faut qu'il est, lui aussi, un rapport d'interprétation. Et/ou de fond, on est dans une situation un peu comme dans une musique de chambre.
	Q-263	[...] Au fond, ce n'est pas tellement différent de l'expérience de travailler avec des danseurs ou avec des gens du théâtre où une répétition, au lieu d'être purement musical, est à 10 ou 20 ou 30 ou 50 % maximum musical. Et l'on va perdre, entre guillemets, beaucoup de temps parce qu'il faut tenir compte d'un environnement, de contingences techniques qui ne sont pas de notre fait et cela, c'est le cas avec électronique.
	Q-273	Alors qu'avec l'électronique, je dirais qu'au fond, une fois l'étape « une » de découverte du matériau, ça ne sert à rien de travailler seul. Ça ne sert à rien.
	Q-276	C'est que, quand en général on joue ces œuvres, c'est assez rare que ce soit des œuvres du répertoire avec des compositeurs qui ne sont pas là, en général on travaille avec les compositeurs.
	Q-279	Il faut que l'instrumentiste [...] ait conscience du type de transformation à cet endroit-là, quels sont les sons fixés qui interviennent, car il y a souvent une part de sons fixés. Tout n'est pas transformé en temps réel, enfin ça peut arriver mais c'est relativement rare. Il faut donc prendre conscience tout de suite de la dimension du contexte.
	Q-377	Mais déjà l'habitude de travailler avec un autre partenaire, avec un générateur de son autre qu'un instrument traditionnel.
I-04	Q-340	Il faut que le compositeur soit là. C'est vraiment l'idéal. Ça évite de dévier. C'est quand même lui qui a conçu la pièce.
	Q-353	S'il ne fait pas une vraie interprétation avec cette proximité avec le texte et en même temps de sens artistique, on va dire tout bêtement, l'interprète tout seul est cuit.
	Q-394	L'autre aspect qui est au départ un petit peu dérangent: on est obligé de faire confiance à l'ingénieur du son. Tout simplement parce qu'on ne gère pas la place qu'on prend dans le volume acoustique que peut présenter une transformation temps réel.
	Q-395	Et donc on est obligé un moment de faire complètement confiance à l'ingénieur du son, ou en tout cas à celui qui va gérer cet équilibre là.
	Q-403	[...] La capacité à mon avis d'un instrumentiste, dans ces pièces, a en tout cas, c'est de pouvoir se déconnecter de cela, de dire « je joue mon truc », aux nuances que j'ai envie de donner et en faisant confiance, comme je le disais à l'instant, à ce qui va être mixé derrière. Cela, c'est la petite difficulté. C'est-à-dire que l'assistant musical va s'adapter ou adapter l'électronique par rapport à la situation avec l'instrument etc. et l'interprète va comprendre, commencer à comprendre en tout cas, les phénomènes électroacoustiques qui vont se produire autour de lui. Et ça va complètement changer son travail.
	Q-405	Ah oui. Ah oui. Ça me paraît essentiel. Je me vois mal par exemple jouer seul une pièce de musique mixte, sans savoir qui va mixer, c'est quelque chose qui pourrait m'embêter un peu.

	Q-407	Dans ces musiques mixtes, à mon avis l'ingénieur du son a un rôle très important, très très important, au moins presque aussi important que celui de l'exécutant.
	Q-431	Oui. Oui. Moi à chaque fois, j'ai travaillé avec l'Ircam. Il y avait toujours un ingénieur du son pour cela.
	Q-432	Forcément à domicile, je n'ai pas le matériel.
I-05	Q-482	Mais si vraiment on veut travailler de manière plus ouverte sur la question de la sonorité, enfin des traitements du son, des langages vraiment électroacoustiques, il faut travailler avec le compositeur, un technicien, un assistant musical ou type assistant musical qui peut être d'ailleurs le plus souvent la même personne.
	Q-543	Alors ensuite, c'est un peu moins le cas maintenant, mais quand même pour pouvoir répéter en situation réelle ou proche de la réalité l'œuvre mixte il faut pouvoir le faire avec l'aide de quelqu'un si possible dans un studio. C'est quand même difficile de répéter chez soi tout seul avec une écoute convenable s'il n'y pas quelqu'un qui est là pour aider.
	Q-572	C'est-à-dire qu'en fait c'est un travail collectif. L'assistant musical ou la personne qui va s'occuper de la diffusion de l'œuvre, il est finalement dans la même situation de l'interprète qui n'a pas encore totalement validé son apprentissage sur la partition et il y a un travail de musique de chambre, de musique de chambre pour reprendre le terme classique qui va s'établir entre les partenaires.
	Q-585	Mais là on n'est pas dans une situation très favorable à l'éclosion aboutie d'une symbiose entre l'instrument et l'électronique. Il se trouve que c'est en général les meilleurs instrumentistes du monde qui sont à l'EIC et qu'ils jouent extrêmement bien la partition qui est demandée. Ça ça colle quand on est dans une esthétique particulière comme celle de Pierre Boulez où le rôle de l'interprète est strictement défini, voire cantonné à une définition précise. Et c'est cette définition précise qui justifie d'ailleurs par rapport au travail de Boulez – c'est ma vision – par rapport à ces œuvres qui justifie l'électronique.
	Q-586	L'électronique va s'ajouter à l'interprète pour lui permettre de devenir un hyper interprète, c'est-à-dire de jouer plus vite, plus haut, plus grave, tout ce que l'interprète ne peut pas faire puisqu'il est limité, pauvre interprète qu'il est même si c'est le meilleur du monde.
	Q-591	Il va se marier avec. Il y a un véritable travail de symbiose sonore où l'un n'existe pas sans l'autre. Ce n'est pas la limitation de l'instrumentiste qui justifie l'utilisation de l'électronique, c'est un mélange des deux. Là on est dans une mixité réelle, presque hybride.
	Q-603	On peut avoir une bonne écoute chez soi. C'est quand même de l'électroacoustique. C'est une partie, nous [instrumentistes], qui est à prendre en compte d'une manière (.) essentielle. L'électroacoustique, ça ne peut sonner que si la diffusion est à la hauteur, c'est-à-dire on prend en connaissance réellement de la dimension sonore de la partie électroacoustique que réellement en situation.
	Q-662	Il faut savoir que chacun a son rôle, que cette angoisse là [problèmes avec l'électronique], elle n'est pas pour soi mais elle est pour la personne qui est derrière la console. Nous sur scène, on est sur scène. The show must go on. Mais c'est très compliqué.
I-07	Q-735	Et donc pour moi c'était vraiment tout ce qui concerne la musique de chambre, le travail sur j'allais dire « trouver un espace sonore », et qui exactement le même quand on doit faire travailler un trio avec piano et voilà.
	Q-738	Déjà ce qui me semble intéressant, c'est quand on travaille une œuvre instrumentale, on a donc toutes les données techniques à aborder. Je vais peut-être parler d'une œuvre instrumentale avec d'autres instruments puisque pour moi, ce n'est pas vraiment le répertoire solo pur car quand on travaille une pièce de musique mixte, on ne travaille pas une pièce solo, on travaille vraiment dans un cadre plus de musique de chambre.
	Q-748	En fait, c'est les aider [les étudiants] à pouvoir moduler justement tout ce travail, j'allais dire. Enfin, c'est la même chose pour moi quand je dis cela car ça m'a permis de prendre un peu de recul en fait mais c'est le même travail que je fais avec moi: quand on module notre façon de jouer à nous, voir en quoi ça module la partie de l'autre beaucoup plus fortement, je trouve, que dans une partie écrite de musique de chambre. [...] Ce que je trouve intéressant justement c'est doser le travail sur les nuances, l'articulation et le tempo.
	Q-751	[...] on va voir ce que ça donne si on définit, si on affine les nuances, entre autres dans tout ce qui est pianissimo ; voir, si on les renforce, ce que ça peut donner.
	Q-753	Ce que je trouve vraiment très intéressant et que j'essaye de faire passer aux étudiants, c'est que habituellement quand on joue, on a une acoustique avec quatre murs, un plafond, un sol et on a le son qui se diffuse de façon cohérente par rapport à cela. Et là, le fait qu'on ait un travail avec les haut-parleurs, une transformation du son en temps réel, tout d'un coup, cette notion d'acoustique cubique – je ne suis pas spécialiste –... la salle disparaît et tout se transforme.
	Q-761	Par contre, il faut qu'il y ait quelqu'un dans la salle qui est souvent le compositeur ou le RIM ou voilà, des gens qui nous donnent le retour.
	Q-762	Mais dès qu'il y a de la musique mixte, on n'est pas tout seul. Et ils sont globalement dans la salle les gens qui jouent avec nous si je puis dire.
	Q-780	Ce qui va jouer c'est la résonance de la salle et c'est surtout la sensation de retour du musicien. Quand on est dans la salle, il n'y pas forcément une énorme différence pour l'auditeur mais il y a une grosse différence de sensation sur scène. Et puis les repères ne sont pas les mêmes.
	Q-784	Après je suis complètement incompétente pour utiliser le matériel. Et je ne vois pas forcément comment l'organiser et tout. C'est en cela que je dis que je fais confiance aux autres.
	Q-825	Ca implique comme personnes, j'allais dire quelqu'un qui soit ingénieur du son pour tout ce qui est besoin de micro, pédales, diffusion avec les haut-parleurs et puis quelqu'un qui suit la musique – ça peut être la même personne – mais celui qui suit la musique peut être un RIM, le compositeur.
	Q-826	En fait j'ai l'impression qu'il faut au minimum deux personnes même si ce n'est pas tout le temps deux personnes, il faut une personne qui a les doubles compétences en plus de l'interprète.

I-08	Q-900	Ca peut se comparer, je trouve, à toute la musique de chambre. Surtout avec le temps réel, parce que le temps réel réagit... c'est de la musique de chambre avec... à la fois avec la partie électronique, à la fois avec la personne avec qui on travaille.
	Q-902	Au début, quand j'ai commencé mon doctorat, j'avais un peu l'idée de développer mes compétences informatiques, ces choses là, puis je me suis vite rendue compte que ça m'intéressait pas tant que ça finalement. J'allais pas faire croire que genre j'allais être indépendante sur scène avec mon propre ordinateur pour déclencher mes affaires. Ça a pas pris de temps que j'ai laissé ça aux autres. Puis je trouve ça assez satisfaisant comme ça, quand j'ai des super belles collaborations avec des gens au CIRMMT. On est super choyé quand on joue là.
	Q-911	Mais qu'il y ait les équipements puis les ressources humaines disponibles facilement. Autant que d'avoir un pianiste. Ça, ça veut dire que, moi je pense que l'idéal, c'est qu'il y ait des classes d'ingénieur du son. Je pense qu'il y a cela à McGill, je me trompe pas. Ici on a pas ça. Donc ce sont des étudiants techniciens qui sont engagés, ça devient peut être un petit peu plus compliqué parce qu'ils sont pas nécessairement formés pour ça, certains oui certains non, ils sont plutôt... leur mandat principal d'habitude c'est plutôt d'enregistrer les concerts. C'est pas du tout pareil.
I-09	Q-925	Une certaine manière c'est comme travailler avec un autre instrument sauf qu'on a beaucoup plus de références quand on travaille avec un pianiste par exemple, que quand on travaille avec de l'électro parce qu'en général on commence à faire ça plus tard, donc il y a beaucoup de choses à ré-apprendre pour se familiariser, [pour] avoir le même niveau de familiarité avec des effets électro qu'on aurait avec un pianiste ou un flutiste ou n'importe quoi.
	Q-934	Ici au CIRMMT, on a de la chance, ou au DCS, c'est un autre studio, ici à McGill, dans l'autre bâtiment, mais je sais pas s'ils sont reliés ou pas, Digital computer... quelque chose comme ça [Digital Composition Studios]. On peut recréer les conditions live mais en beaucoup plus petit, c'est comme travailler dans un bocal. Donc je peux avoir une idée de comment ça va être en live. Parce qu'il va y avoir le même système de diffusion par exemple en 7.1 ou 5.1.
	Q-936	C'est un répertoire qui demande vraiment de la préparation en salle. Rien que pour les placements de micros ou tester les haut parleurs, tout ça c'est super important.
	Q-955	Pour moi c'est aussi important d'avoir autant de connivence avec un haut parleur, ou une boîte de n'importe quel type que ce soit, qu'avec un pianiste.
I-10	Q-991	[...] alors je veux bien... chaque fois que j'ai un concert qui est un peu dans, soit dans un espace différent, qu'il y a moyen d'avoir les hauts parleurs, l'équipement, j'essaie d'ajouter une pièce et même a coté de la musique classique, à coté de la musique du XX ^e siècle ou quelque chose.
	Q-1005	[...] de vraiment jouer avec l'électronique, c'est quelque chose... c'est vraiment une expérience nouvelle, de musique de chambre, de jouer avec toi-même, nous, de jouer avec nous-même, les interprètes, ou les haut-parleurs [...] et de comprendre, parce qu'on est sur scène et on [ne] va pas comprendre.
I-11	Q-1075	Quelque part, nous sommes les passeurs de cette marque de fabrique si on peut dire.
	Q-1097	[...] souvent, dans une pièce sans électronique, on arrive à la fin de l'écriture de la pièce. C'est-à-dire que le compositeur a déjà écrit tout. Et puis, après, il nous amène le produit fini [i.e. la partition], alors que quand on travaille avec électronique, c'est étape par étape [...]
	Q-1106	Il y a deux façons de faire. La méthodologie qu'on peut avoir, c'est se dire: j'ai une partition, déjà il faut que je comprenne le langage de cette partition en tant que musique acoustique. Et puis si on a la chance de travailler directement avec l'électronique, c'est mieux. Parce qu'il y a une corrélation entre les deux. Il y a, comment dire, c'est sans arrêt des aller-retour entre ce que je propose, ce que l'électronique me propose, etc.
	Q-1121	Donc c'est comme deux personnes qui ne se connaissent pas: ils vont apprendre à se connaître. Mais c'est au moment où on se connaît bien que la pièce peut être diffusée au public. C'est exactement la même relation qu'avec un autre instrumentiste. Pour moi ça devrait être cela.
	Q-1122	Pour moi c'est de la musique de chambre. C'est dans l'écoute. Ce n'est pas un instrumentiste et puis on rajoute un deuxième lego par dessus et ça fait une musique mixte. C'est sans arrêt, on passe de l'un à l'autre.
	Q-1123	Au fur et à mesure du travail on annote sur notre propre partition des éléments d'électronique parce qu'ils n'y sont pas.
	Q-1131	Donc oui il y a des instrumentistes qui veulent absolument. Encore aujourd'hui de jouer, que ce soit à l'Ircam ou ailleurs, mais être instrumentiste et jouer des pièces avec l'Ircam, c'est un privilège et ce n'est pas donné à tout le monde alors que beaucoup de clarinettes même étudiant, aimerait pouvoir avoir accès à cela mais n'ont pas cet accès. Pourquoi. Parce qu'il y a un coût très important [...]
	Q-1134	Oui, pour moi c'est un quatuor. Même si c'est seulement moi qui suis sur scène. Tout seul sur scène. Mais je ne fais que 25 % du travail.
	Q-1137	Hier soir j'ai créé une pièce pour clarinette seule. Ce n'est pas du tout la même relation. C'est un dialogue. Alors que quand on met de l'électronique ce n'est plus un dialogue, c'est un quadrilogue.
	Q-1155	C'était mon idée. Je me suis fait un studio à la maison. Mais par manque de moyens...
Q-1156	Non non. J'ai préparé cela minutieusement car je voulais avoir un petit Ircam à la maison mais c'est complexe. Parce que ça veut dire avoir au moins une table de mixage, au moins un ordinateur, voire deux dédiés à cela car les fichiers c'est très long, très lourd. Il faut avoir au moins deux ou quatre enceintes. Tout cela se chiffre. Donc c'est possible. Imaginons mon studio c'est la table, j'ai mis quatre prises électriques au centre, j'ai mis huit points pour accueillir les enceintes mais pour l'instant je n'ai pas eu l'argent pour les acheter. L'idée, elle est présente chez moi.	
Q-1168	[...] Si j'ai les moyens de faire un récital avec des pièces avec électronique, si j'ai les possibilités d'avoir un ingénieur du son, un assistant musical ou tout le matériel qui va avec pour faire les choses bien, je vais le faire mais ce ne sera pas nécessairement exclusivement des pièces mixtes et tant que possible je vais voir la possibilité d'intégrer des pièces mixtes tant qu'on a la possibilité de le faire techniquement.	

	Q-1195	Je me rappelle, je l'ai travaillé avec une perforatrice au sol quand je travaillais chez moi seulement pour avoir la sensation d'appuyer sur quelque chose avec le pied au bon moment.
	Q-1204	Pour moi il n'y a pas de réelle différence entre la préparation d'une pièce acoustique et d'une pièce avec électronique. Je me repose beaucoup sur l'assistant musical ou le musicien ou les gens qui sont derrière la console.
	Q-1211	Dans ce cas, ça revient à, comme si c'est un travail de musique de chambre avec un autre musicien. [...] Il y a des décalages, on travaille exactement comme si on était avec d'autres instrumentistes. C'est un travail de musique de chambre avec l'électronique.
	Q-1218	Dans certaines pièces, il faut mieux jouer presque en autiste sans s'occuper de l'électronique et faire confiance aux gens derrière la console et tracer, faire son boulot comme, je dirais presque dans certaines pièces d'orchestre quand on joue sa partie, on suit le chef, on fait confiance au chef et on ne se pose pas la question si savoir le pupitre de cors n'est pas un peu fort de l'autre côté de l'orchestre. Là on est obligé de faire confiance au chef et on ne peut pas soi-même gérer cela.
	Q-1222	Et ça me paraît (.) exactement de la même manière que dans un quatuor à cordes, on ne va pas jouer deux fois de la même façon et on va interagir les uns avec les autres sur le moment comme en répétition.
	Q-1233	Et puis effectivement sur la partition parfois, mais pas toujours, il y a une ligne qui est censée représenter l'électronique. En général ce n'est pas très représentatif.
	Q-1256	Moi, je ne sais absolument pas comment ça marche un patch MAX. Je sais sur les grandes lignes comment ça marche mais je suis absolument incompétent pour faire fonctionner cela.
	Q-1269	Il reste quand même en haut de la pyramide le compositeur – ou à la base ça dépend comment on voit les choses – et si le compositeur n'a pas une pensée musicale forte, ça ne peut pas marcher. Après l'extension de cela, c'est d'avoir des assistants, que ce soit le violoncelliste d'un côté, et l'assistant musical et l'ingénieur du son de l'autre qui ont leurs compétences poussées et qu'il puisse se reposer sur eux.
I-12	Q-1271	La création faite, si tout le monde a très bien fait son boulot et que tout fonctionne, que la partition écrite est réalisable, qu'on peut la rejouer sans la présence du compositeur, [que] le patch est sain et fonctionne. Voilà. Après c'est pour cela qu'il faut particulièrement les compétences de l'assistant musical et de l'ingénieur du son qui peuvent parfois être la même personne.
	Q-1274	C'est pour cela que la compétence d'ingénieur du son de cette personne me paraît plus importante que la compétence d'assistant musical passé le stade la création si la pièce est saine, si le patch est sain et fonctionne. Evidemment c'est essentiel d'avoir quelqu'un qui ait vraiment des oreilles, qui puissent aller dans la salle et faire un son, créer un son dans la salle.
	Q-1275	C'est très agréable de jouer avec un type comme cela car je joue en duo avec lui exactement comme je jouerais en duo avec un pianiste. Il gère les deux très bien. On a fait les pièces de Saariaho avec lui et d'ailleurs Saariaho, en général, lui laisse carte blanche car elle a confiance en son écoute, ses compétences et sa sensibilité de musicien. Qu'elle soit là ou pas, elle le laisse faire parce que ça se passe très bien. Il sait. Il a vraiment une attitude de musicien qui écoute.
	Q-1284	On est seul sur scène mais dans une pièce avec électronique on n'est quand même pas seul. Il y a ce travail au moins en duo que je trouve très agréable et qui pour moi est comparable au travail de musique de chambre.
	Q-1285	De même que l'assistant musical ou le compositeur ne vient pas au dessus de mon épaule quand je fais les gammes, de même je ne viens pas derrière son ordinateur quand il ouvre des fichiers qui n'ont pas été ouverts depuis quatre ans... voir comme ça marche... si ça marche toujours.
	Q-1290	[en parlant de deux de ces partenaires] C'est des gens que je pratique depuis des années que ce soit en solo ou en ensemble. Je les connais, ils me connaissent, ils savent comment je travaille. Il y a vraiment le même type de partenariat de confiance qu'il y a avec un musicien instrumentiste.

Chapter 5

¹ In this paper, we use the term 'live electronics' to describe any type of action in terms of electronics that occur during the performance (sound processing or synthesis, cues management, etc.).

² All quotes, identified as Q-xxx and provided in the annex, are translated into English. Unless otherwise indicated, all French quotes have been translated into English by the authors.

³ The notion of a 'musical instrument' became very controversial with the development of new musical technologies. In this paper, the term 'instrumentalists' refers to traditional 'classical' musicians and includes both singers and musical instrument players. Instrumentalists read music and play an instrument that is generally taught in music schools. The instrument can be acoustic (e.g violin, piano, saxophone...) or electronic (e.g. ondes Martenot, electronic keyboards...). We do not consider here a composer or improviser playing his own patch or a kind of home-made analogue and/or digital devices as an instrumentalist but as a live electronic musician. The participants we interviewed were what we call instrumentalists.

⁴ We distinguish live electronic musicians from computer music designers, who do not necessarily participate in the live performance after the premiere.

⁵ We may observe that today this is not always the case. Famous string quartets, for example, are often invited to play in large concert halls.

⁶ A graduate degree entitled ‘Master arts parcours Réalisateur en informatique musicale’ was created in 2011 at the Université Jean Monnet, Saint-Étienne.

⁷ We would like to express our gratitude to all the instrumentalists who participated in this research. We also would like to thank Karen Brunel-Lafargue and the editors for their attentive proofreading.