

Cool Control, Occam, and Océan: The Radigue and Bozzini Game

Emanuelle Majeau-Bettez

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Article abstract

This article analyzes the dynamics of the new and current collaboration between the Montreal-based Bozzini String Quartet and female electronic music pioneer Éliane Radigue. Starting in the late 1960s, Radigue's electronic music career has been characterized by seemingly unchanging hour-long pieces in which organic micro oscillations between pitches replace traditional rhythm. Since 2001, Radigue has turned to working with instrumentalists, using an "intuitive-instinctive compositional process" akin to "oral transmission of ancient traditional music" (Sonami 2017). While the few academics that have shown interest in Radigue's instrumental music have focussed their attention on the oral aspects of her compositions, this paper seeks to move beyond non-written formal parameters of her music, and explore the ways in which the actual sound of a Radigue piece generates radically new understandings of performance and composition. Drawing on field notes and recordings of the Bozzini rehearsals at Radigue's apartment on July 2017, as well as on the author's correspondence with Radigue and the quartet, this paper highlights moments of strong emotional response to, or caused by, Radigue's sound. Affective reactions on both Radigue's and the quartet's side reveal points of tension between different assumptions regarding collective creation, and completely reorient what it means to own, to transmit, to perform and to compose music. Spectrograms and recordings of the Bozzini's attempts to create a Radigue sound will be used to further analyze these points of tension, and will reveal that in order to successfully play a Radigue instrumental piece, the Bozzinis need to reproduce every element of Radigue's previous electronic music—the string quartet needs to "become" Radigue's electronic instrument.

Cool Control, Occam, and Océan: The Radigue and Bozzini Game

Emanuelle Majeau-Bettez
(McGill University)

To study technologies in any meaningful way requires a rich sense of their connection with human practice, habitat, and habit. It requires attention to the fields of combined cultural, social, and physical activity—what other authors have called *networks* or *assemblages*—from which technologies emerge and of which they are a part. (Sterne 2003)

In the afternoon of July 11, 2017, the members of the Bozzini Quartet—a Montreal-based string quartet specializing in experimental music—are in Paris.¹ Travelling from rural Finland, they arrived in town the previous evening, and this special Parisian visit finalizes their European tour. In a few moments, they will meet for the first time with composer and experimental music pioneer Éliane Radigue to collaborate with her on her current instrumental project, *Occam Océan*.²

Starting in the late 1960s, Radigue’s electronic music career has been characterized by seemingly unchanging hour-long pieces in which organic micro oscillations between pitches replace traditional rhythm. Since 2001, after nearly 40 years of composing for her ARP 2500 modular synthesizer, Radigue has now turned to collaborating solely with instrumentalists, using an “intuitive-instinctive compositional process” akin to “oral transmission of ancient traditional music” (Sonami 2017). In 2016, through mutual friends and colleagues, the Bozzinis got in touch with Radigue, letting her know about their interest in her music and her compositional approaches. After a few letters, telephone calls and emails, Radigue agreed to receive the quartet in her apartment, in Paris, for a three-day rehearsal/collaboration session. Radigue’s conditions are clear:

1. Meetings must be in the afternoon;
2. As the composition of the piece is undergone solely through oral transmission, the performers should know that recording the sessions is welcomed;

3. Although the goal of their collaboration is the creation of a new piece, there must never be a scheduled performance date before Radigue has decided that the piece is ready to be performed;
4. Although the goal of their collaboration is the creation of a new piece, this goal may not be fulfilled. If Radigue is not satisfied with the rendition of a piece, she will not “sign” the work. If a non-“signed” piece is to be performed, the instrumentalist may say that the piece is inspired by Radigue, but not that it is a Radigue composition.³

How will these meetings go? How will the encounter between the Montreal-based experimental music specialists and Radigue unfold? Will the Bozzinis and Radigue succeed in creating a new piece? What does it sound and look like when a former electronic music composer collaborates with instrumentalists? What does it sound like when an experimental music ensemble meets Éliane Radigue?

I do not wish to keep the reader in unnecessary suspense, and will admit that while I do not have an exact answer to each of these questions, I know the outcome of the sessions. I have in my possession the recordings of the three-day collaboration at Radigue’s apartment, and may affirm that all went more than well. In a letter written shortly after the sessions, Radigue says: “The encounter with the Bozzini Quartet was a magnificent moment of great musical sharing.”⁴ Violinist Clemens Merkel echoes this enthusiasm and, speaking for the quartet, describes their experience as “an extraordinary blast...”⁵ The story I am telling is a delightful one: the Bozzini Quartet and Radigue are pleased, and a new Radigue piece, *Occam Delta xv*, has been premiered in Montreal on June 9, 2018 at the Suoni per il Popolo Festival, as well as in Huddersfield on November 22, 2018 at hcmf// [Huddersfield Contemporary Music Festival], and will be

¹ The author would like to give special thanks Éliane Radigue and to the members of the Bozzini Quartet for their incommensurable generosity during this research project.

² The members of the Bozzini Quartet are Stéphanie Bozzini (viola), Isabelle Bozzini (cello), Clemens Merkel (violin), and Alissa Cheung (violin).

³ Radigue’s conditions have been communicated to the author during an interview (August 2016).

⁴ In a letter to the author (August 2017).

⁵ In an email to the author (August 2017): « Il faut qu’on te raconte un peu notre expérience avec Éliane Radigue — un vrai blast, extraordinaire... »

performed in Bruges on February 23, 2019 at SLOW—Festival Concertgebouw Brugge #1.

Since I have spoiled the outcome of the Bozzini-Radigue encounter, it must by now be obvious to the reader that results and conclusions will not be the only focus of the current article. In this project it is not that important to trace exactly how or why the meeting between the Bozzinis and Radigue was successful, although some hypotheses should inevitably lead us toward such conclusions. This approach is inspired by sociologist Bruno Latour, who impresses on his readers the “uselessness,” when studying the success or failure of a technology, of “get[ting] bogged down concentrating on the final phase” (Latour 1996, 10). Where Latour has used the metaphor of the detective novel to develop his methodology, in this article I employ sport analogies to describe the Bozzini-Radigue encounter. Meetings between composer and instrumentalists become a sport-like “game” where different “players” take action. Somewhat echoing Latour’s dismissal of the “final phase,” I deliberately take my cue from countless high-school gym-class teachers: *L’important c’est pas de gagner, c’est de participer*!⁶ Although such gym-class rhetoric obviously has a whole other range of strategic function than that which will be explored in my project (I am not interested in taming down teenage competitive impulses), it still is enough for me to know that the players *participated* in the game. Taking as a premise the fact that the result of the encounter in itself could never be as revealing as the process of the game at hand, focus and importance will be given to the latter. To paraphrase Sterne (cited in the epigraph), I wish to ponder the cultural, social, and physical conditions opted for by Radigue or the Bozzinis during the particular setting of their Parisian sessions. Focussing on moments where the string players share—in sound or in words—how they react to the new or somewhat foreign setup proposed by Radigue’s approach, I will try to trace how one trajectory is built, out of all the other possibilities at hand.⁷ My project is an attempt to describe “what the various actors [in the given setting] are doing to one another,” and how they participate in influencing the ways in which sound is produced (Akrich and Latour 1991, 259). During the studied sessions, sound is produced through trials, and these trials are undertaken and shaped by diverse latourian actors, which will henceforth be called (latourian) players.⁸ The players of this game are akin to sociologist Bruno Latour’s actors in that they are much wider than one individual human. Indeed, despite what it may seem, the players include but do not limit themselves to

the Bozzini instrumentalists. Given the scope of this essay, I have recruited a total of four players:

Player #1: The string quartet as a social structure composed of four individuals;

Player #2: The string quartet as one big instrument;

Player #3: (The traces of) Radigue’s ARP 2500 synthesizer;

Player #4: The string quartet as more than four instruments.

During the sessions, each of these players is part of and forms a resolutely heterogeneous ensemble which includes, but is not constrained to, discourses, institutions, technological transformations, philosophical and aesthetic propositions. Still following Latour, my goal is to study the links that bind all the heterogeneous and ever-changing parts of the setting in which the players take action. For example, how will the instrumentalists’ virtuosity—which has been trained and developed in different institutions, in previous encounters with other instrumentalists, through the Bozzinis’ various stages and performance experiences, in intimate relationship with their instruments—play in the moulding of a Radigue sound, one that has evolved over almost half a century in the domestic space of her apartment, hand in hand with a modular synthesizer? Between all these elements, a certain adaptation is forced through encounter, a certain “game” of modification. It is this game that I will investigate in the following pages.

The reader is invited to follow the game in roughly two different ways. The core of this essay is marked by “game highlights” that occurred at Radigue’s apartment between July 11 and 13. These involve transcriptions of, and comments on, certain key moments that occurred during the encounter between the Bozzinis and Radigue. Mimicking current sports channels, a second voice chimes in to supplement the aforementioned game highlights with descriptions of “players’ background”. In these, attention is paid to physical, social and cultural aspects with which the players are entering the game, and take written or pictorial forms. In order to keep these two discursive modes separate—that of the “game highlights” and of “players’ background”—a sans-serif typeface is used to mark the latter. Footnotes will also often take the role of clarifying “players’ background”. By exposing some of the ways in which players make repetitive and strategic adjustments of various scales in order to adapt to the game at hand, comments during the highlights will pay particular attention to the ways in which this “background” translates during the game itself.

⁶ “What’s important is not to win, but to participate!”

⁷ “How one privileged trajectory is built, out of an indefinite number of possibilities”. See Akrich and Latour 1991, 259.

⁸ I have decided to use the term player (instead of actor) in order to illustrate the game aspect of the setting. Moreover, I felt player had more of a resonance with music.

Player #1: The string quartet as a social structure composed of four members, “no more no less” (Merkel 2013, 29).⁹

Many instrumental formations are characterized by an invariable number of instrumentalists and an immutable instrumentation. But then, writes Bozzini violinist Clemens Merkel, the string quartet distinguishes itself from these other small ensembles by its being the only ensemble composed of a pair number of instruments from the same family. Speaking of decision-making within the “microsociety” of the string quartet, Merkel writes:

There are but three possibilities in decision-making: 4:0, 3:1 or 2:2. The first combination, the unanimous decision, is ideal: for or against something like the choice of phrasing, of a piece, of the tempo of a movement, of the character of a section, etc. A 3:1 decision is not optimal, but it often happens. One of the individuals has to compromise or bend him/herself to the decision of the three others. Most of the time, he/she will try to impose herself during later decisions, using the previous compromise as an argument. There could also be a 1:3 constellation, which would mean that one person confronts the three others. This can happen in isolated instances, and in these instances the majority of the group is obliged to accept a decision that is imposed [by one person]. No group will accept this on the long run. When sides are equally divided, there is no decision to make. There cannot even be a compromise. Negotiation in this combination would only provoke indifference from both sides, and would render the whole group incapable of making any kind of choice. Compromise is possible only if at least one individual crosses to the other camp. This leads us back to the 3:1 combination in which one person adjusts temporarily to the majority (Merkel 2013, 29-31).¹⁰

Merkel further investigates the sociological effects of the specific numbers of individuals on the musical formation. Decision-making in a string quartet-as-a-social-structure does not exist in a vacuum: “it must also ponder its different positions within a given society” (Merkel 2013, 31). This society within which the string quartet exists at a given moment is heterogeneous, a melting pot of “a country, a city or a region, a specific audience, composers and other musicians” (Merkel 2013, 31). As a string quartet whose orientation

is radically contemporary, the Bozzinis have positioned themselves in tandem with other societal formations that share a similar aesthetic drive.¹¹ For example, they perform regularly in certain venues which host a specific type of audience, they are asked to organize and perform in a number of experimental music festivals, they collaborate with a number of composers, and further promote their music by distributing it on certain labels. The quartet’s positioning within a given network of societal formations is decided upon according to the ratios exposed in the previous quote (usually either 3:1, or 4:0) and has oftentimes a decisive impact on the artistic work of the musical ensemble. Of course, this last observation could also be said about larger musical ensembles. However and as Merkel argues, what is particular about a small ensemble like the string quartet is that impact of its societal positioning is felt more directly and in a more uniform way by all four members. Drawing on German sociologist Georg Simmel, Merkel underlines how, as a small group, string quartet instrumentalists are held equally responsible for the success of a concert, and are thus rewarded in equal shares. For example, financial or artistic success of a performance is distributed equally amongst all four members of the ensemble. In reverse fashion, if a concert receives bad press or if the gig did not pay enough, all four members assume the consequences. Moreover, Merkel continues, string quartet members must deploy amounts of energy that go beyond rehearsal time and performance; each instrumentalist is normally responsible for a certain amount of administrative work that she or he would not have to take care of in a larger and more departmentalized organization. Given the number of instrumentalists, each member of the string quartet-as-a-societal-formation is equally, directly, and concretely responsible for the strategic positioning of the ensemble within the wider network of societal formations (Merkel 2013, 31).

Game highlight: Water and Ockham’s Razor, or the rules of the game

In her apartment on July 11, while the string players are unpacking their instruments and testing the gear with which they want to record the rehearsals, Radigue does not waste one minute:

⁹ Translated from French by the author.

¹⁰ Translated from French by the author.

¹¹ Sociologist Georg Simmel (whom Merkel is drawing on) has elaborated in other works on this matter. Despite being over 100 years old, some quotes have strong resonances with what Michel Foucault calls the dominant strategic function of the *dispositif*: “[The manifold forms of social life] grow with one another, for one another, in one another, against one another, and through one another, in state and communities, in church and economic union, in families and associations [...] From innumerable ‘things’ there are human impulses and interests that move us and force us towards others in the forms of unification [...] I therefore designate sociability as the *playform of creating society (Spielform der Vergesellschaftung)*” (Simmel 2006, 47-48).

I will start with the very beginning, *voilà!* The title, *Occam*, comes from a fourteenth century English theologian, William Ockham, who wrote very interesting things on intuition [...] and who is still known today for what is called Ockham's Razor; in a situation where there are multiple options, and that *bon*, we are not sure which one to explore... the *simplest [is] always the best!*¹² This, you must try to remember while working. Always ask: what is the simplest solution?

As for the work, *Occam Océan*, it is a series of pieces that are all based on solos. There are now 22, 23 of them [...] I have to slow down the production of solos, because, see, there are enough of them! I can show you, here, you see there are already about fifty pieces made [through the combination of solos].¹³

So there are the solos, called *Occam I, II, III* or *IV*; the duos, *Occam River*; the trios and quartets *Occam Delta*—so you guys are an *Occam Delta*. Then there are *Occam Hexa*, etc. There is also an *Occam Océan*, a piece for orchestral formation. *Bon*. That's it for the structure. For the story, ah! There is *toute une histoire* (laughter). Here is the story of *Occam Océan*: ...¹⁴

Sometime in the 1970s, Radigue reminisces, she had travelled to Los Angeles for a friend's concert. During her free time there, she would enjoy visiting art or science museums. In one of the rooms of the California Museum of Science and Industry (now called the California Science Center) she was stunned. A strip of material was pasted along a wall, and on it one could trace all the wavelengths known to humans: from the largest known one—from earth to the sun—down until the “micro-mini-mini” ones, from which the human ear can only perceive a parcel. Radigue had written all of this down, “*comme ça !*” to try to make sense of the vertigo entailed by the feeling that “our universe lives like this, floating in diverse wavelengths, many of which are not even known, many more, we can imagine...” The closest thing that gave Radigue a more immediate feeling of this myriad of swaying wavelengths was the ocean, with its great tides and its little “*clapotis*” by the beach. Some 35 years after this epiphany, Radigue tells the Bozzinis that this is the fundamental spirit of the piece they are about to discover, and that it is common to all that they will undertake.

Indeed, water is literally a *fundamental* element of Radigue's *Occam Océan* project, meaning that it is part of the *foundation* of a given piece. Since each of the instrumental

pieces are made *sur mesure*—tailored by and for each instrumentalist during their encounter with Radigue—a different and personal water image is chosen for each piece.¹⁵ Radigue and the instrumentalists chose the image together, and use it somewhat like as a scaffolding to create and remember the structure of a given piece. It is highly important that the instrumentalists have a special connection to the chosen body of water: it is usually something they have seen, it flows near where they live, where they come from, etc. Once the piece is well known by the instrumentalists, this mental water image can be “left behind in the drawer, like a score when one knows a piece by heart.”¹⁶ If ever there is a problem with the piece, the instrumentalists are invited to come back to this fundament, to take the image out of its drawer and have a quick “look” at it.

It is also important to know both the relevance of the mental water image, and its limits in the sound material of the piece. Of course, if an instrumentalist and Radigue decide together that a piece starts with the image of a great waterfall, it will sound different from one that starts with a small creek up high in the mountain. But then again, Radigue's music is no sound illustration: “It's more about all the feelings that come with it.”

Éliane Radigue: Now the sound material—and you must already know it if you know my work—is essentially a work on partials, on overtones, on micro beatings, on pulses, on harmonics, on subharmonics [...] To obtain these, there is no need to [use fermatas] or to suspend the beat, because there is no beat! Of course, everything is in *piano* dynamics, from *ppp* to sometimes a *mezzo forte* (more *mezzo* than *forte*!) because when it's too loud, that's when the fundamentals resurface. That's that for the technical work. For the tuning—and this is more valid for the solos—we couldn't care less about the tuning fork. 440 or 435 *on s'en fiche!* And even when playing in quartet, there can be very, very slight variations [in tuning], and that's actually what creates—between the instruments—all these little intangible, elusive marvels. Sub-harmonics are rare, *rarissimes!* Do you guys ever produce some? They are low pulses, completely immaterial... but wow! When we hear it, wow.

Isabelle Bozzini: I never produced one when playing alone. When we play together sometimes...

Éliane Radigue: This is the material with which we are working. There are never brutal attacks [...] there must be continuity.

¹² Said in English by Radigue.

¹³ See up-to-date list *Occam Océan* premieres in Annex A.

¹⁴ Unless otherwise indicated, all other quoted discussion between the Bozzini Quartet and Radigue are taken from the recordings of the sessions that took place at Radigue's apartment on July 11, 12 and 13, 2017. Conversations were in French, and are translated here by the author. For original French transcriptions, see Annex B.

¹⁵ Since this image should not be transmitted to the public due to the fear that they will try to “follow” where the instrumentalists are in the “score,” I will refrain from sharing the exact image in this paper.

¹⁶ Radigue in a conversation with the author (August 2016).

Throughout the hours of recorded sessions, Radigue rarely goes beyond the technical specificity stated in the previous quote.¹⁷ For example, she will never indicate specific bowing techniques, propose to use double or single strings, or even say when or at what frequency each musician should play. The string quartet has to figure out how to produce such sounds. They are the experts of their instruments, says Radigue, and she undergoes what she calls her “sound shopping”: “yes, this I like. No, this I don’t buy.”¹⁸ As we will see in further game highlights sections, once her “sound shopping” is done, Radigue’s advice focuses on reminding the quartet to choose the simplest path... all the while letting them figure out what that path is!

The quartet’s ability to produce a piece according to the standards proposed by Radigue’s music thus relies on their ability to draw from their earlier experiences, to adapt their trained technical abilities, and to apply their previously collected knowledge of Radigue’s music. While physical adaptation and technical remanipulation will be further investigated in subsequent sections of the current article, what is important to remember here is that the Bozzini’s chances for success heavily relies on their positioning within a certain type of societal agglomeration. Knowledge of Radigue’s music through mutual friends and experience of the quartet with musical works that are somewhat similar to Radigue’s is paramount to the relevance of the encounter. The Bozzinis’ social and artistic positioning is an important advantage, even before the game has even really started.¹⁹

While Radigue exposes the physical dispositions and technical requirements of her music to the quartet-as-a-social-structure made of experimental music specialists (no direct attacks, production of a continuous sound, attention to partials), she is simultaneously addressing her comments to the quartet as a family of instruments. Radigue’s music is marked by a large number of micro-beatings, a particularity which

cannot necessarily be done with conventional tuning.²⁰ When playing in solo, string instruments will often have two strings (or more) tuned to slightly different frequencies. For example, during the premiere of *Occam River XVI*, harpist Rhodri Davis tuned some of his G flat strings down to E flat, and made a few of these E flat strings a fraction sharper than the others.²¹ This slight discrepancy (between each of the E flat strings) created a perceived periodic variation, or beating.

When speaking about the string quartet, Radigue actually applies the same “detuning process” that is normally applied to one solo instrument, that being a slight disparity between two similar pitches. Each of the stringed instruments (as a whole) of the quartet function like one section of a big four-part solo instrument; each of the instruments—like the strings of a solo string instrument in a Radigue piece—are tuned to slightly different frequencies. One of the violins and the cello could, for instance, be tuned to A 440, while the two other instruments of the quartet would be tuned circa 10 cents higher.²² Thus, Radigue is treating the string quartet exactly like she would treat a solo instrument. The quartet functions like one big instrument.²³

Player #2: The string quartet as one big instrument. Spectrogram 1/trial 1

Éliane Radigue: In this type of work, instrument and instrumentalist are one. All four of you are the one instrumentalist! You are four in one, and one in four!²⁴

The spectrogram (Figure 1) acts as a visual tool to help us describe in words the sound produced by the string instruments on their first take of the Radigue piece. Brighter lines indicate where sounds are heard most vividly. What we can already analyze from this simple feature of the spectrogram is that the most audible sounds that the Bozzinis are making are heard below 600 Herz. The other yellow lines that become dimmer as we go up the

¹⁷ Radigue does at one point in the session comment about bowing technique: “From what I have seen, between the bridge and the tailpiece, it is often very interesting. This is just from what I have seen, because I am no violinist!”

¹⁸ Radigue in a conversation with the author (August 2016).

¹⁹ It would perhaps be important to remind the reader that the ensemble pieces of Occam are made up of previously composed solo pieces, meaning that Radigue has collaborated in private with each member of the given ensemble before the ensemble is formed. This is not the case with the Bozzini Quartet: “But since you already know my music... And what’s more, it’s the first time that there is a string quartet... *Eh oui*, you are the first ones on many levels!” In this way, not only did their knowledge of Radigue’s music give them an advantage—it enabled them to meet with Radigue, period.

²⁰ Radigue also often exploits pre-inscribed particularities of an instrument, like a wolf tone in a cello. Conversation with the author (August 2016).

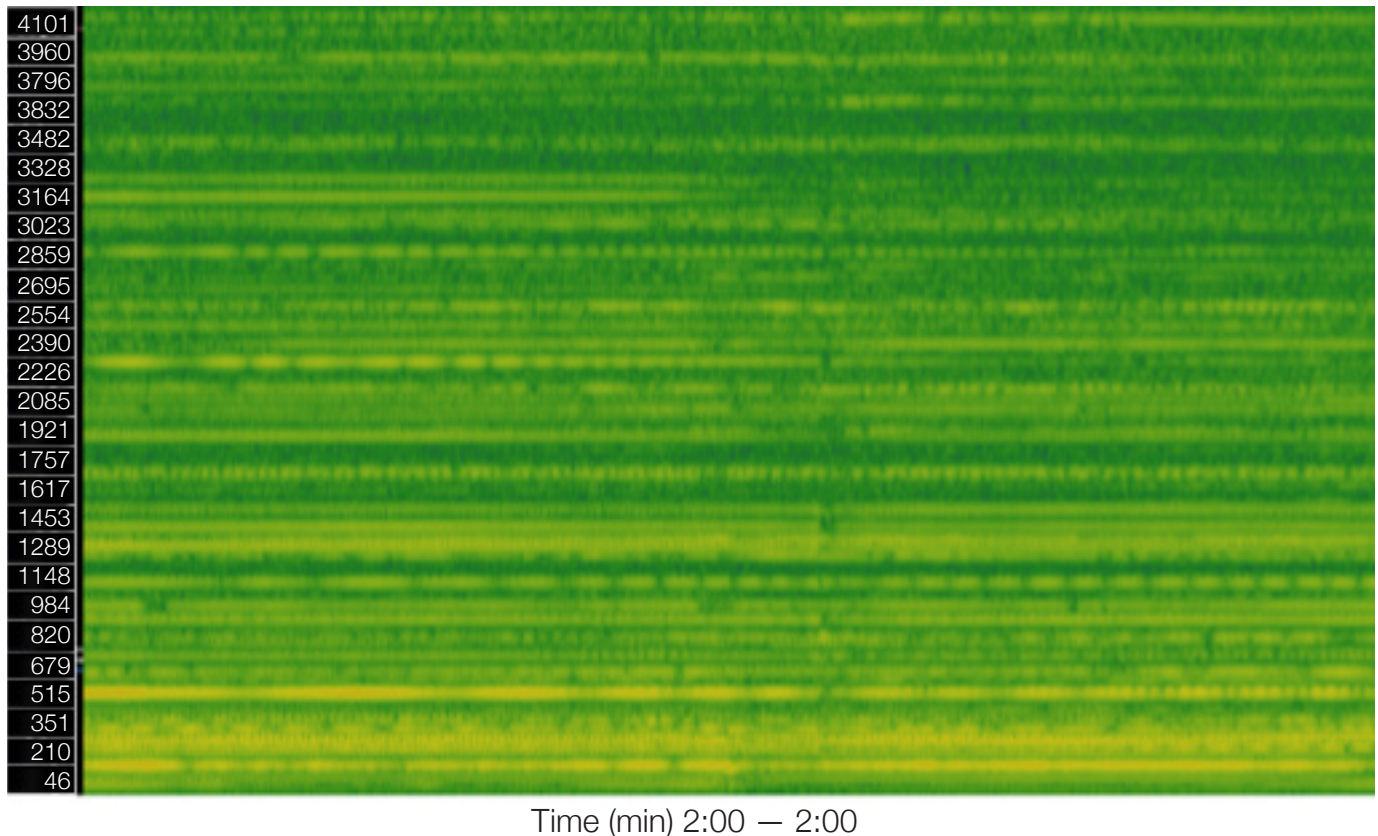
²¹ In an email to the author. *Occam River XVI* was premiered by Rhodri Davis and Carol Robinson on October 20, 2017 at Issue Project Room in Brooklyn. The concert was sold out.

²² As stressed by Clemens Merkel, it is important to note that this “detuning” process is no strict rule per se. Radigue gives it more as a proposition, and the instrumentalists should then adapt their technique in accordance with the acoustics of the surrounding space. Conversation with the author (July 2018). See also Luke Nickel 2015, 22–35.

²³ Of course, one could say this about string quartets in general. Nevertheless, I would argue that there is something novel in the way that Radigue wants the string quartet to sound like one instrument—not only like a choir of the same family of instrument. Her usage of the string quartet as one instrument goes far beyond orchestral color. We will observe this in further detail in subsequent sections of the article.

²⁴ This quote is both similar and different from what Giacinto Scelsi, did in his later violin pieces. In *L’âme ailée/ L’âme ouverte* (1973) for example, Scelsi notates each string of the instrument as a separate part, thereby making one violin a quartet in itself. Each “part”, i.e., string, plays the same note but at a slightly different frequency (a few cents apart from one another). When tuning (or purposefully playing) each string of the violin to the same frequency but only a couple cents apart, an interference pattern (beating) arises during performance of the piece. As we will see in the next section of the game, Radigue’s instrumental music could be described in similar terms.

Figure 1: Spectrogram of the Bozzini's first take.



vertical axis are harmonic series resulting from each note produced.²⁵ In a string quartet piece where instruments have marked entries, the spectrogram translates these entries by showing lines that swell.²⁶ In the Bozzini example, each of the yellow lines is straight. This proves that the Bozzinis, as per Radigue's indications, are very careful not to produce marked attacks. This also visually shows how, while playing the Radigue piece, the Bozzinis sound like one instrument, like one seemingly unchanging block of sound. In a way, by describing the spectrogram, we end up repeating what Radigue has told the instrumentalists directly before their first take: they are four in one, and one in four!

Game highlight: Time out 1/Strategic adjustment 1 (Taking place directly after the first trial as seen in the spectrogram)

Éliane Radigue: The four parts are there, but they are too quick. You have to take your time. Did you feel the four parts?²⁷

Isabelle Bozzini: To be honest, I only heard three...

Stéphanie Bozzini: Me too.

Alissa Cheung: I was still stuck in the first part!

Isabelle Bozzini, to Éliane Radigue: I started with a fundamental, is that alright?

Éliane Radigue: Yes, that was great. But you have to keep a little more body throughout. One has to be patient!

Clemens Merkel: I believe something that we have to figure out is how to know when we are all ready to transit to the next section, from one phase to the other... It's not a cut; it can take several minutes [...] How can everyone be conscious of the same thing at the same time?

Éliane Radigue: Yes, absolutely. As a matter of fact, when I say something, then I let you guys figure it out amongst yourselves. I made my comment, and now you have to figure out how to do it...

Isabelle Bozzini: I wonder, shall we decide that one person starts the transition, or should we leave this open, with a large time window...

Clemens Merkel: I don't know yet...

Isabelle Bozzini: OK, I won't be shy with the fundamental.

Clemens Merkel: I would like to propose something, to make it simpler. How about if we start by playing only one section, just to figure out how to make that transition, how to find a good way to get in the second space.

Alissa Cheung: OK, so we go from point 1 to point 2. I like that, I have a destination!

²⁵ In this paper, harmonics automatically refer to the higher harmonics. When speaking of the first harmonic, the author calls it the fundamental.

²⁶ See Annex C for an example of marked entries.

²⁷ The image on which the Bozzini quartet and Radigue have agreed upon has 4 different sections/areas.

Éliane Radigue: You know, at the end there were really extraordinary things, micro-beatings, immaterial songs! Sometimes instrumentalists try to cheat, and give me half way through the first, second or third harmonic, and I say: “This is not [a good] harmonic, this is [just like] a new fundamental!” [Laughter] Sometimes people make a mistake about the material! [...] Yes, at the end there, it was very beautiful, very lyrical.

Isabelle Bozzini: Yes, it’s the bow signing.

The Bozzini Quartet is capable of very high-level virtuosity. As Radigue mentions, they do not “cheat” and merely go for the first, second or third harmonic. Rather, they are able to improvise with only the most “interesting” harmonics. Moreover, it proves that the quartet is well aware of Radigue’s aesthetic, and had previous experience with such musical material. In a word, on their first trial, the Bozzinis really understood and mastered the type of material that forms a Radigue piece.

But then, the problem lies in the structure of the piece. Even if all the instrumentalists have the same four-part image in mind, how to know when to transit to the next section? How to decide who will give the transition cue, and how? Even if one member decides to take the lead—say Stéphanie—how can she make sure that the other members are ready to transition to the next section? What if she is ready to move to the third section, and one member is still “stuck in the first one?”

These may seem basic questions, and it is therefore important to remind the reader of the material that is being produced within a Radigue piece. While playing, the instrumentalists avoid producing a “flat” sound where the fundamental is heard too prominently, and rather focus on exploiting what could be called a tone’s inner activity: its partials, overtones, micro beatings, pulses, and harmonics. In order for these “little intangible marvels” to emerge, one has to resist changing to another note too quickly. For example, while the slight detuning of the instruments will naturally give rise to beatings, the Bozzinis are not supposed to purposely control them. Although instrumentalists will sometimes bend their harmonics just a fraction sharper than other audible ones (to create a beating), such a technique should not be used to emphasize the beatings as the main colour of the piece.²⁸ Normally when beatings do occur they

should not be disturbed, and the instrumentalists should just “appreciate the ‘glistening’ music.”²⁹ “Waiting” and listening both to a tone’s inner activity, and to the ways in which it contributes to the overall group-sound, the Bozzinis have to find the patience to “just stay on one note” for a long time.³⁰ The quartet thus bows in an extremely constant and slow fashion, this giving the ensemble the appearance of quasi-immobility. While they are seemingly not budging, all four instrumentalists are actively and equally participating in the texturing of a seemingly unchanging block of sound, one that “may appear stagnant on the surface, but full of activity of you listen closely.”³¹

This type of improvisation—on higher harmonics especially—is no doubt virtuosic, but it is a virtuosity that translates itself in extremely minute gestures. In this way, visual cues are not necessarily the best transition option. How does one get an audible or visual cue when there are no cuts, no drastic changes, no audible attacks? How to get an audible or visual cue when all four instruments are practically immobile, and are meant to sound like one big instrument producing an ostensibly unchanging block of sound? How does string quartet decision-making arise when the quartet is treated like a single instrument?

For the time being, the Bozzinis do not have an answer to these questions. The temporary solution is to try to stop the process right at the transition, and to concentrate on making the first part a bit louder, and a bit longer. Before letting the quartet leave her apartment to go to rest and practise on their own, Radigue advises: “And just keep going until there is a problem... you have the score!”³²

Player #3: (Traces) of Radigue’s ARP 2500 modular synthesizer

As briefly mentioned at the beginning of the current article, Radigue composed with the ARP 2500 modular synthesizer for over 40 years, becoming a virtuoso of the instrument.³³ In light of the sections of the Bozzini-Radigue game that have been discussed up to now, it would be illuminating to scrutinize the link between her long-time practice with the ARP, and her collaboration with instrumentalists.

²⁸ Radigue commented on the matter during the spring 2018 sessions with the Bozzini Quartet: “Little artifices should always be used to serve the whole!”

²⁹ Alissa Cheung in an email to the author (June 2018).

³⁰ Isabelle Bozzini in a conversation with the author (April 2018).

³¹ Alissa Cheung in an email to the author (June 2018).

³² This comment by Radigue is in line with the Occam Razor notion: If things are going fine, the simplest solution is to keep it going. Throughout the sessions, Radigue will one way or another keep hinting at the Razor.

³³ The traces of Radigue’s long practice with the ARP have been rightfully linked to her collaboration with instrumentalists in terms of oral transmission; due to her background in electronic music, non-traditionally notated music is the medium she had always worked with. See for example Nickel 2015, 22–35.

At the level of the material of the music, the link between Radigue's electronic and instrumental pieces is more than obvious. All her electronic music is essentially a work on "mistuned" partials that form a seamless yet highly textured mass of sound. This similarity in texture and material even lead people to say that Radigue composes for instrumentalists as if they were a synthesizer.³⁴ Radigue voluntarily acknowledges this, exclaiming herself that if one were to put all her pieces next to one another, it would make one immense piece: "I have composed the same music all my life!"³⁵ Where she brings an interesting nuance to this discourse is when she explains how, fifty years ago, no instrumentalists would have been willing to play the kind of music that she wanted to make. She even adds with humour that they would clearly have run out of her apartment (*pris leurs jambes à leur cou*), or if they came "they would come once, never twice." In this sense, then, if Radigue now composes "synthesizer" music for instrumentalists, for thirty some years she somewhat reversely composed electronic music because no instrumentalist would have wanted to play the sounds she wanted to hear.³⁶ Now that things have changed a lot, as she told the Bozzinis, "how would you want me to go back [to the synthesizer]... this joy of sharing!"

Bearing in mind the minute gestures undergone by the Bozzini Quartet during their rehearsal time with Radigue, an addition to the writing-for-instrumentalists-as-if-they-were-a-synthesizer quote can be made. It is important for this matter to know that Radigue's ARP synthesizer did not have a keyboard. Radigue fell in love with "him" (the ARP synthesizer), but with him minus the black and white keys.³⁷ She had voluntarily left the keyboard interface in the United States, where she had purchased the instrument, and came back with the remainder of her ARP to Paris. She feared that if she were to have kept

the keyboard, she would have risked coming back to old pianistic habits.³⁸ Consequently, she would have missed out on the sounds that she wanted to make so badly—sounds that were made "*du bout des doigts*," and that she had started to love and discover while making feedback music with her Tolana tape cassette machines.³⁹ Over the years spent sitting at her synthesizer, Radigue actually developed physical abilities—a certain technique—to produce her music; potentiometers were moved "*d'un fil*" through precise, controlled and minute tactile movements. Through these microphysical movements, Radigue was able to create slight discrepancies between pitches, thereby producing the "beating" which has been discussed in the previous sections of this study. Moreover, because the ARP synthesizer was the very first technology that could keep stable pitch for more than half an hour, Radigue was able to use it to play around with micro beatings, to develop games between slightly different pitches.⁴⁰ In this light, it would be fairer to say that if Radigue is composing as if instrumentalists were synthesizers, this particular synthesizer is her instrument—her keyboard-less ARP 2500.

Game highlight: Time out 2/Strategic adjustment 2

Coming back to Radigue's apartment the next day, Isabelle, speaking for the quartet, shares how happy they are up to now with the whole process. Nevertheless, they are still 'stuck' in the first and second half of the piece—they still cannot figure out how to transit to the third and fourth sections. Clemens adds that after a few minutes in the piece, he cannot hear who is playing what.

Clemens Merkel: With the mix [of sounds] I can't know anymore.

Isabelle Bozzini: It's like an accordion!

Clemens Merkel: At one point there was a beating between Isabelle and I, so I tried to play with my pitch a little.

³⁴ Radigue in a conversation with the author (August 2016).

³⁵ Conversation with the author (August 2016).

³⁶ In light of the extremely similar features between Scelsi's music and Radigue's, and without wanting to diminish Radigue's take on her own experience, I would add that gender bias here had quite the role in Radigue's previous relationship with instrumentalists. Although it would not be fair to say that Scelsi was performed widely, leading performers like the Arditti String Quartet or pianist Marianne Schroeder promoted his music worldwide. See Sciannameo and Pellegrini 2013. One could also add Alvin Lucier and Phill Niblock—two other contemporaries of Radigue who worked with microtonal oscillations—to the list of composers who did not have trouble finding performers.

³⁷ "I really fell in love with the ARP synthesizer. Immediately. Immediately! That was *him*! [Laughs]." Excerpts from an interview by Tara Rodgers (2010, 56).

³⁸ "Of course I didn't use the keyboard, I left it in New York when I moved the synthesizer to France. I didn't want to take the keyboard, because I was sure if at one point I got discouraged, I would have the temptation of going back to it!" (Rodgers 2010, 57). Interestingly, Radigue's discourse about keyboard interfaces on the ARP synthesizer echoes Don Buchla's take on the matter: "A keyboard is dictatorial. When you've got a black and white keyboard there it's hard to play anything but keyboard music" (Dolan 2012, 8).

³⁹ The "Big Tolana" tape machines were taken to Radigue's apartment in the early seventies, so that she would not have to commute to Henry's studio every day, and could work at her ease on Pierre Henry's tape pieces. After one year of volunteer work, Pierre Henry gave her the Tolana machines to thank her for her good service. It is in these years that Radigue started making her own music by experimenting with feedback. See Girard 2013.

⁴⁰ "It was an age when gigantic modular systems dominated the synthesizer world. However, the tuning of these instruments was usually unstable and each manufacturer struggled with this problem. ARP decided that the development of a highly stable oscillator was important so they dedicated research and product development towards achieving this goal. The model they first developed was the ARP 2500, a large modular synthesizer." (ARP Instruments).

But then it wasn't me at all! That's what's most difficult—knowing which note to play! I don't know who is playing what, so then I don't know how to react... [laughs]

Éliane Radigue: You will have to let go, stop worrying about this, because this is mostly how it goes [with this music]. You have to do with it (*Il faudra faire avec*)! It's normal to think of these questions now—it's the preparatory phase. You know, the most sublime of scores is only a series of dots on lines [...] no matter who the conductor is, you are the ones playing! With some musicians, it's sometimes difficult... But with you, I'm not worried!

Isabelle Bozzini: I think we just have to let go. We have to be patient.

Éliane Radigue: Yes, one thing that is important: never force anything. You have to work, but you have to work cool.

In order to understand what is at stake here, it is important to keep in mind that the quartet's instruments are tuned a few cents apart. When playing two notes that have microtonal differences, an interference pattern appears between the two, and is perceived as beating (Meyer 1957). When sound signals interfere in this way, the beat signal can sometimes even be heard as a separate note.⁴¹ These third-party interferences accumulate in Radigue's music into what clarinetist Carol Robinson evocatively called “a big balloon of sound, floating above your head when you're playing.”⁴²

This means that while the Bozzini instrumentalists have to demonstrate an extremely high level of control in order to bend harmonics and produce frequencies that are only slightly different, the result of this high control is the production of almost uncontrollable sounds. As the piece evolves, these freelance frequencies inevitably accumulate, and it becomes extremely hard to differentiate between which notes are *played* on an instrument—let alone who is playing them—and which notes are the result of the sum of two similar *played* notes. In a way, Radigue's music—while demanding high control over the instruments—comes back on itself to deny that very control to the instrumentalist, to challenge it. In other words, one should say that Radigue's music does not deny all types of control, but rather requires the instrumentalists to embrace a different type of sound mastery.

As we have seen earlier, from one perspective the string quartet is used within Radigue's music as one solo instrument to create a seemingly unchanging block of sound—*four is one and one is four*. And yet when listening

differently, each instrument of the string quartet sounds as if multiplied; as if each string instrument was four instruments on its own. While the string quartet as a social structure clearly is composed of four members, “no more no less,” the quartet as instruments and as instrumentalists in Radigue's piece eludes this description. It is simultaneously larger and smaller, controlled and uncontrolled.

While decision-making in the string quartet as a social structure can be described in 4:0, 3:1 or 2:2 ratios, these decision ratios either mysteriously shrink or expand in the string quartet as an instrumental/instrumentalist ensemble. Given that perception is somewhat distorted by the nature of Radigue's music, decision-making during performance—which relies mainly on auditory perception—is interesting, to say the least. For example, if Alissa feels and hears that it is time to transit to the next section of the piece, this decision is probably caused by either of the two following situations: 1) she feels she cannot keep the beating or vibration going on in a certain way much longer; or 2) she hears that other players are transitioning to a new section. In both cases, it is hard to understand what the decision ratio is. If we take only the first example, since the block of sound produced by the four instrumentalists sounds like one big instrument, Alissa may feel like she is transitioning away from one entity, and the decision ratio equals 1:1. On the other hand, Alissa and her instrument are most probably making more sounds than that which is produced by the friction between Alissa's bow and the body of the instrument. When Alissa starts to transition to a next section, it may sound as if more than one player were changing gear, as if three players were detaching themselves from the unified block of sound. The decision ratio is then 3:1; three being Alissa and ‘her players,’ and one being the rest of the string quartet.

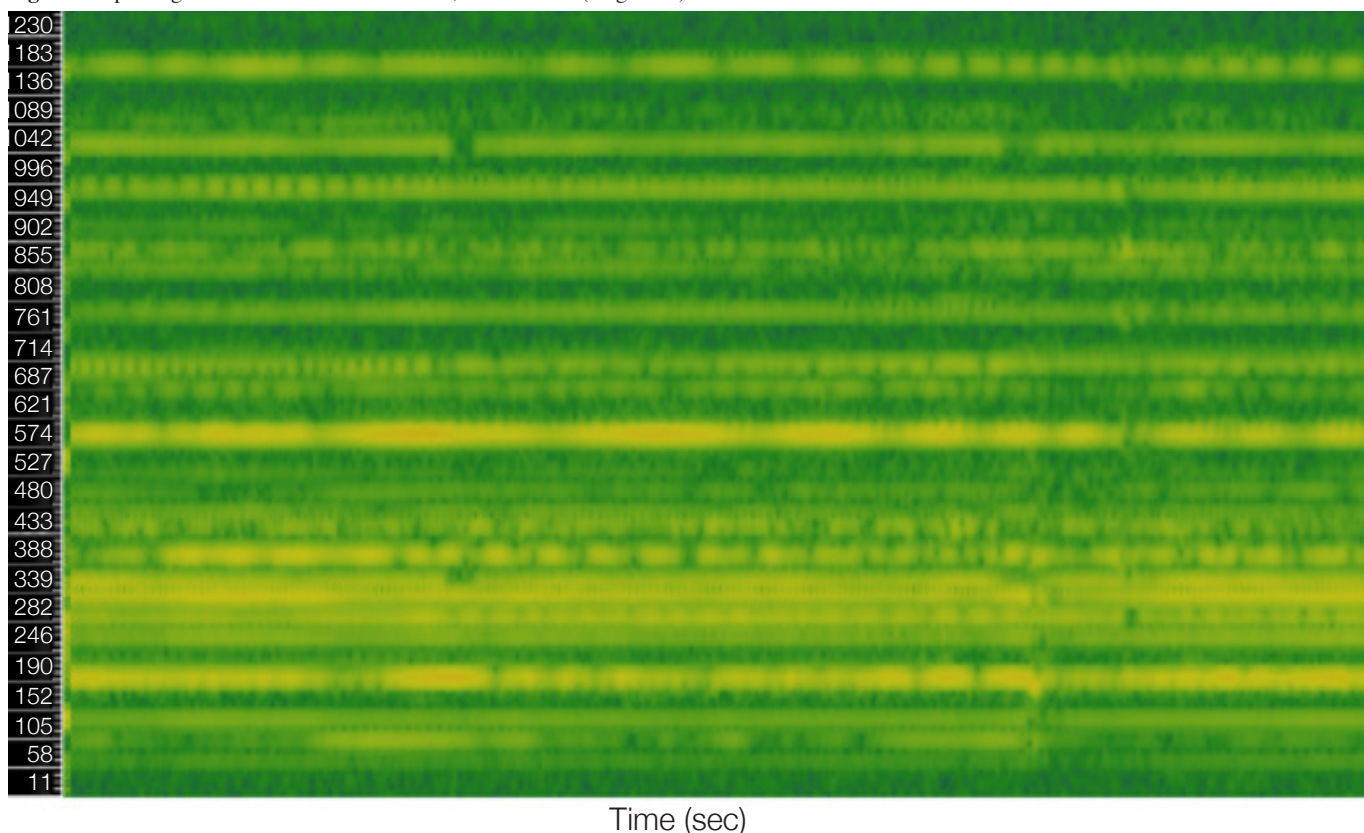
This all comes down to one main aspect of Radigue's music; as per Clemens's comment, performance of such music is extremely confusing. In order to keep producing the sounds demanded by Radigue's music, each instrumentalist has to operate, make decisions, and listen as if simultaneously part of one big instrument and 1000 instruments at the same time. To paraphrase Radigue, instrumentalists are confounded with instruments in her music. Instrumentalists have to adapt to the sounds produced by their instruments—sounds that seem to be produced outside of the scope their control. Instrumentalists control instruments, and instruments control instrumentalists.⁴³

⁴¹ These “extra” notes are called Tartini tones, or difference tones: “Tartini tones sound like a low-pitched buzzing note with a frequency equal to the difference between the frequencies of the two interfering tones” (University of New South Wales School of Physics).

⁴² Conversation with author (October 2017).

⁴³ Clarinetist Carol Robinson also mentions an interesting particularity of Radigue's music in regards to control. As we are starting to see with the Bozzinis, while learning and creating a Radigue piece the instrumentalists have a lot on their shoulders; they make technical decisions, they have to figure out many things by themselves. Moreover, and as Robinson underlines, the ‘real’ work starts after the meetings with Radigue. When the instrumentalists have gone back home, they have to incorporate all that they have learned. Mastering the piece enough for it to be performed can take many months, even years.

Figure 2: Spectrogram of the Bozzini's first take, 2:11"-2:20" (magnified).



Player #4: The string quarter as more than four instruments

Again we come back to the same spectrogram (Figure 2). This time, it is magnified in order for the reader to pay more attention to the harmonic series. Where the non-magnified version of the spectrogram presented traces of the quartet as one instrument, the magnified version gives us another perspective on the matter. First, we see that especially below 1000 Herz, the harmonic series overlap each other, making two harmonics extremely close to one another. Second, as we follow each harmonic along the horizontal axis, it sometimes appears brighter, sometimes darker.⁴⁴ Again, the reader should remember that this is a visual translation of what is perceived aurally; the difference in brightness of colour is a perceived difference in dynamics. Given the overlap of harmonics, this difference in dynamics is not surprising: proximity of the harmonics creates the interference pattern discussed in earlier sections of this paper. This interference pattern is perceived as a very quick variation in dynamic (beating). The spectrogram translates this beating in colour: bright yellow when sound is loud, green for soft or in-existent sound. The

spectrogram enables the reader to see the interference patterns that cause the mysterious multiplication of each instrumentalist, and that are so confusing during performance.

Comparing both spectrograms is a visual way to understand two simultaneous aural perspectives offered by Radigue's music. Listening to Radigue's music requires the ability to sway between different layers and levels of sound: from the great ocean to the little "clapotis" by the beach. The string quartet appears to both audience-listeners and to performer-listeners simultaneously like one giant mass of water, and like the little ripples on the coast.

Conclusion

Given these different layers of sound—controlled and uncontrolled, single yet multiplied—how *did* the Bozzinis figure out how to navigate from one section to the other? Since the success of the Radigue piece as a whole requires transitions to different sections, this means, logically, that the Bozzinis figured out how to transition. Indeed, the Bozzinis do transition.⁴⁵ But again, how did they do it? To address this question would require quite an expansion of

⁴⁴ For example, if we follow the yellow line at 1181 Hz (roughly a D6) we see that, especially towards the end of the horizontal axis, it appears in quick alternation of green and yellow. This note could be the first harmonic of the yellow line at 587 Hz (roughly a D5), or even the 5th harmonic of the G3 that appears around 191 Hz, the D5 then being the G3's second harmonic.

the description of the game at hand. For example, certain aspects of the social positioning of the quartet would need to be further situated within the discourses, institutions and technological transformations that continuously shaped the quartet's goals, artistic expectations and aesthetic propositions. We would need to ask questions such as; who are these other experimental composers with whom the quartet collaborates? How have these encounters shaped the quartet's social and artistic positioning as an experimental ensemble? What are these festivals in which they regularly perform? How have these specific experiences enabled the Bozzinis to transition from one section of Radigue's piece to another, without the traditional visual and aural cues usually granted by, for instance, scored music or music with a controlled pulse?

Exploration of only one question would require the description of the Bozzini/Radigue game to expand far beyond the scope of this essay: the sections of the game exposed in this study are only a slight parcel of the social and historical elements that are at play. In this game "parcel," we have encountered four players. We have paid attention to the ways in which the four of them adjusted and reacted to the cultural, social and physical activity—to the game—of which they are part. We have seen how the Bozzinis navigated in Radigue's extremely demanding sound: a sound that must be known by the instrumentalists even before they travel to Paris to really learn and produce it; a sound that requires a high level of virtuosity, of physical control and patience. Moreover, despite the very high level of control that instrumentalists deploy to produce it, once played for a few minutes, the sound takes an agency of its own, comes back on itself and expands beyond the instrumentalists' control. We have also observed and followed how, reacting to this sound, both Radigue and the quartet made decisions, adjusted their sound or advise. By observing "what the players are doing to one another," we have detected an interesting game of control, of tension and relaxation that somewhat binds all players. A game where the quartet as instruments and as instrumentalists is simultaneously larger and smaller, controlled and uncontrolled. A game of strange control where all players, perhaps surprisingly, have to learn to "let go [...] to work, but 'cool'."

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⁴⁵ Many more rehearsals have taken place since this paper was written, and the version of the piece that is currently played has now been reduced to three parts.

Annex A: List of *Occam Océan* projects⁴⁶

***Occam I* for harp**

Premiered by Rhodri Davies in London (Sound and Music Festival, June 14, 2011)

***Occam II* for violin**

Premiered by Silvia Tarozzi in Bologna (Angelica Festival, May 3, 2012)

***Occam III* for birbyné**

Premiered by Carol Robinson in Bologna (Angelica Festival, May 3, 2012)

***Occam IV* for viola**

Premiered by Julia Eckhardt in Bologna (Angelica Festival, May 3, 2012)

***Occam V* for cello**

Premiere by Charles Curtis in New York (Issue Project Room, September 20, 2013)

***Occam VI* for EMS synthesizer**

Premiere by Thomas Lehn in Berlin (faithful!/Berghain Festival, October 12, 2012)

***Occam VII* for voice and electronics**

Antye Greie-Ripatti

***Occam VIII* for cello**

Premiere by Deborah Walker in Metz (FRAC Lorraine, December 5, 2013)

***Occam IX* for “digital spring spyre”**

Premiere by Laetitia Sonami in San Francisco (Brava Theater SFEMF2013, September 13, 2013)

***Occam X* for trumpet**

Premiere by Nate Wooley in New York (Issue Project Room, October 24, 2014)

***Occam XI* for tuba**

Premiere by Robin Hayward in Brussels (Q-O2, December 5, 2014)

***Occam XII* for viola**

Catherine Lamb

***Occam XIII* for bassoon**

Premiere by Dafne Vicente-Sandoval in Glasgow (Techtonics Festival, May 2, 2015)

***Occam XIV* for harp**

Hélène Bréchand

***Occam XV* for clarinet**

Bruno Martinez

***Occam XVI* for bass clarinet**

Premiered by Carol Robinson in Dundalk (Oriel Centre, June 20, 2014)

***Occam XVII* for double base**

Dominic Lash

***Occam XVIII* for sub-base recorder**

Premiered by Pia Palme (Huddersfield, Beyond Pythagoras Symposium, March 21, 2014)

***Occam XIX* for five string double bass**

Premiered by Louis-Michel Marion in Clermont-Ferrand (Festival des Musiques Démesurées, November 15, 2011)

***Occam XX* for EMS synthesizer**

Premiered by Ryoko Akama in Huddersfield (November 22, 2014)

***Occam XXI* for violin**

Premiered by Angharad Davies in Mexico (Nieho #5, May 17, 2015)

***Occam XXII* for voice**

Yannick Guédon

***Occam XXIII* for alto saxophone**

Premiered by Bertrand Gauguet in Paris (Palais de Tokyo, December 14, 2018)

***Occam XXIV* for bass and alto flute**

Premiered by Cat Hope in Eveleigh New South Wales (Carriageworks, June 28, 2018)

***Occam XXV* for organ**

Premiered by Frédéric Blondy in London (Organ Reframed Festival, October 18, 2018)

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***Occam River I* for birbyné and viola**

Premiered by Carol Robinson, Julia Eckhardt in Bolzano (Muserole Festival May 5, 2012)

***Occam River II* for violin and cello**

Premiered by Silvia Tarozzi, Deborah Walker in Metz (FRAC Lorraine December 5, 2013)

***Occam River III* for birbyné and trumpet**

Premiered by Carol Robinson, Nate Wooley in New York (Issue Project Room, October 24, 2014)

***Occam River IV* for tuba and cello**

Premiered by Robin Hayward, Charles Curtis in Brussels (Q-O2, December 5, 2014)

⁴⁶ Kindly given to the author by Rhodri Davis and Carol Robinson.

Occam River v for viola and cello

Premiered by Catherine Lamb, Deborah Walker in Brussels (Festival Ars Musica, November 14, 2014)

Occam River vi for sub-bass recorder and harp

Premiered by Pia Palme, Rhodri Davies in Huddersfield (Beyond Pythagoras Symposium, March 21, 2014)

Occam River vii for bassoon and cello

Dafne Vicente-Sandoval, Deborah Walker

Occam River viii for bass clarinet and five string double base

Premiered by Carol Robinson, Louis-Michel Marion in Claremont-Ferrand (Festival des Musiques Démesurées, November 15, 2014)

Occam River ix for two violas

Premiered by Julia Eckhardt, Catherine Lamb in Brussels (Festival Ars Musica, November 14, 2014)

Occam River x for bassoon and tuba

Premiered by Dafne Vicente-Sandoval, Robin Hayward in Glasgow (Techtonics Festival, May 2, 2015)

Occam River xi for bassoon and cello

Premiered by Dafne Vicente-Sandova, Charles Curtis in Glasgow (Techtonics Festival, May 2, 2015)

Occam River xii for cello and harp

Premiered by Charles Curtis, Rhodri Davies in Glasgow (Techtonics Festival, May 2, 2015)

Occam River xiii for bassoon and harp

Premiered by Dafne Vincente Sandoval and Rhodri Davies in Oslo (Ultima oslo contemporary music festival, September 9, 2017)

Occam River xiv for harp and five string double bass

Hélène Breschand and Louis-Michel Marion

Occam River xv for violin and double bass

Premiered by Angharad Davies and Dominic Lash in Matlock Bath, Derbyshire (Great Masson Cavern, September 17, 2017)

Occam River xvi for birbyné and harp

Premiered by Carol Robinson and Rhodri Davies in Brooklyn (Moving Sounds Festival, October 20, 2017)

Occam River xvii for violin and harp

Angharad Davies and Rhodri Davies

Occam River xviii for double bass and harp

Dominic Lash and Rhodri Davies

Occam River xix for viola and baryton

Julia Eckhardt and Yannick Guédon

Occam River xx for harp duo

Helene Breschand and Rhodri Davies

Occam River xxi for tuba and harp

Robin Hayward and Rhodri Davies

Occam River xxii for bass clarinet and saxophone (co-signed with Carol Robinson)

Premiered by Carol Robinson and Bertrand Gauguet in Paris (Palais de Tokyo, December 14, 2018)

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Occam Delta i for birbyné, violin, viola and harp

Premiere by Carol Robinson, Silvia Tarozzi, Julia Eckhardt, Rhodri Davies in Bologna (Angelica Festival, May 3, 2012)

Occam Delta ii for bass clarinet, viola and harp

Premiered by Carol Robinson, Julia Eckhardt, Rhodri Davies in Huddersfield (Huddersfield Contemporary Music Festival, November 19, 2012)

Occam Delta iii for violin, viola and cello

premiere - Silvia Tarozzi, Julia Eckhardt, Deborah Walker in Metz (FRAC Lorraine, December 5, 2013)

Occam Delta iv for tuba, cello and harp

Premiered by Robin Hayward, Charles Curtis, Rhodri Davies in Paris (Festival d'Automne, November 22, 2013)

Occam Delta v for bass clarinet, tuba, cello and harp

Premiered by Carol Robinson, Robin Hayward, Charles Curtis, Rhodri Davies in Paris (Festival d'Automne, November 22, 2013)

Occam Delta vi pour bassoon, two violas and cello

Dafne Vicente-Sandoval, Julia Eckhardt, Catherine Lamb, Deborah Walker

Occam Delta vii for two violas and cello

Premiered by Julia Eckhardt, Catherine Lamb, Deborah Walker in Brussels (Festival Ars Musica, November 14, 2014)

Occam Delta viii for bassoon, tuba, cello and harp

Premiered by Charles Curtis, Rhodri Davies, Robin Hayward, Dafne Vicente-Sandoval in Glasgow (Techtonics Festival, May 5, 2015)

Occam Delta ix for violin, viola and bassoon

Premiered by Silvia Tarozzi, Julia Eckhardt, Dafne Vicente-Sandoval in Paris (Fondation Cartier pour l'art contemporain, July 4, 2016)

Occam Delta x for trombone, horn, tuba

Hillary Jeffrey, Elena Kanakaliagou, Robin Howard

Occam Delta xi for violin, viola and bassoon

Silvia Tarozzi, Julia Eckhardt, Dafne Vicente-Sandoval

Occam Delta xii for bass flute, bass clarinet and cello

Erik Drescher, Volker Hemken, Robert Engelbrecht

***Occam Delta XIII* for base clarinet, harp and double bass**

Carol Robinson, Hélène Breschand, Louis-Michel Marion

***Occam Delta XIV* for harp, violin and double bass**

Angharad Davies, Dominic Lash, Rhodri Davies

***Occam Delta XV* for string quartet**

Premiered by Isabelle Bozzini, Alissa Cheung, Stéphanie Bozzini, Clemens Merkel in Montreal (Fonderie Darling, Suoni per il Popolo Festival, June 9, 2018)

***Occam Delta XVI* for saxophone, viola, baritone, bass clarinet**

Premiered by Bertrand Gauguier, Julia Eckhardt, Yannick Guedon, Carol Robinson in Paris (Palais de Tokyo, December 14, 2018)

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***Occam Hexa I* for bass clarinet, tuba, viola, cello and harp**

Premiered by Carol Robinson, Robin Hayward, Julia Eckhardt, Charles Curtis, Rhodri Davies in Paris (Festival d'Automne, November 22, 2013)

***Occam Hexa II* for flute, clarinet, viola, cello and percussion**

(co-signed with Carol Robinson)

Premiered by Decibel (Cat Hope, Lindsay Vickery, Aaron Wyatt, Tristen Parr, Stuart James) in Perth (PICA, October 30, 2015)

***Occam Hexa III* for trumpet, bassoon, bass clarinet, violin, viola and double bass – Nate Wooley, Dafné Vicente-Sandoval, Carol Robinson, Silvia Tarozzi, Julia Eckhardt, Louis-Michel Marion**

***Occam Hexa IV* for 2 violins, viola, cello and double bass**

Silvia Tarozzi, Angharad Davies, Julia Eckhardt and Dominic Lash

*

***Occam Océan I* for large ensemble**

Premiere by ONCEIM, conductor Frédéric Blondy in Paris (Église Saint Merri, CRACK Festival, September 26, 2015)

Annex B: Éliane Radigue and Bozzini Quartet rehearsal, July 11 and 12, 2017

Éliane Radigue : Je commence par le commencement, voilà ! Le titre, *Occam*, vient d'un théologien anglais du 14^e siècle, William Ockham, qui a écrit des choses très intéressantes à propos de l'intuition [...] et qui est connu aujourd'hui pour ce qu'on appelle le rasoir d'Occam ; dans une situation où il y a plusieurs options et que, bon, on ne sait pas laquelle explorer, la plus simple est toujours la bonne... *simplest always best* ! Ça c'est une des règles, et c'est commun à tout ce qu'on fait. Toujours se demander quelle est la solution la plus simple.

Pour ce qui est d'*Occam Océan*, c'est une série de solos. Il y en a maintenant 22, 23 [...] Je ralentis les solos parce qu'il y en a assez. Je peux vous montrer, voyez il y a déjà une cinquantaine de pièces [créées par la combinaison de solos].

Donc, il y a les solos, qui sont les *Occam* un, deux, trois ou quatre; les duos, *Occam River*; les trios et quatuors *Occam Delta*—donc vous êtes un *Occam Delta*. Il y a des *Occam Hexa*, etc. Il y a un *Occam Océan*, qui est une pièce pour formation orchestrale. Bon. Ça c'est pour la forme. Et pour l'histoire, ah ! Il y a toute une histoire (rires). Voici l'histoire d'*Occam Océan*...

*

Éliane Radigue : Maintenant pour le matériau sonore — et vous devez déjà le connaître si vous connaissez mon travail — c'est essentiellement un travail sur les partielles, les *overtones*, les microbattements, les pulsations, les harmoniques, les subharmoniques [...] Pour les obtenir, pas besoin de suspendre la battue, car il n'y a pas de battue ! Bien sûr tout doit être dans les nuances plutôt *piano*, de *ppp* jusqu'à quelques fois un léger *mezzo forte* (plus *mezzo* que *forte*!) Parce que quand c'est trop fort, c'est là que les fondamentales ressurgissent. Ça, c'est pour le travail technique. Et pour l'accordage il y a un point très important — et ça c'est surtout valable pour les solos — on se fiche du diapason! 440 ou 435, on s'en fiche ! Et même à quatre, il peut y avoir de très très, très légères nuances [dans l'accordage] parce que c'est ça qui créer toutes ces petites merveilles... Les subharmoniques c'est rare, rarissime ! Est-ce que vous en produisez des fois ? Ces pulsations basses, complètement immatérielles... mais wow ! Quand on en entend, wow.

Isabelle Bozzini: Je n'en ai jamais produit seule. Quand on joue ensemble des fois...

Éliane Radigue: Ça c'est le matériel qu'on doit rechercher et avec lequel on travaille. Il ne doit jamais y avoir d'attaques brutales, c'est toujours en continuité.

*

Éliane Radigue: Les quatre parties sont là, mais elles sont trop rapides. Vous devez prendre votre temps. Est-ce que vous avez senti les quatre parties ?

Isabelle Bozzini : Pour être honnête, moi j'en ai entendu trois...

Stéphanie Bozzini : Moi aussi.

Alissa Cheung : Moi j'étais encore prise dans la première partie ! (rires)

Isabelle Bozzini, à Éliane Radigue : J'ai commencé avec une fondamentale, est-ce que c'est correct ?

Éliane Radigue : Oui, c'était très bien. Mais il faut que tu gardes un peu plus de corps tout au long. On doit être patient !

Clemens Merkel : Je crois qu'il y a quelque chose qu'il faut qu'on découvre. C'est comment savoir quand nous sommes tous prêts à faire la transition vers la prochaine section, d'une phase à l'autre... Ce n'est pas une coupure; ça peut prendre plusieurs minutes [...] Comment est-ce qu'on peut tous être conscients de la même chose au même moment...?

Éliane Radigue : Oui, absolument. En fait, quand je vous dis quelque chose, après je vous laisse voir entre vous. J'ai fait mon commentaire. Là, si vous avez des choses à voir sur la manière de faire...

Isabelle Bozzini : Moi je me demandais, est-ce qu'on veut décider que quelqu'un amorce la transition, ou est-ce que c'est quelque chose qu'on veut laisser ouvert, avec une idée de temps assez large...

Clemens Merkel : Je ne sais pas encore...

Isabelle Bozzini : OK, je ne vais pas me gêner avec ma fondamentale.

Clemens Merkel : Je voulais suggérer de juste jouer jusqu'à la première transition.

Alissa Cheung : OK, on va du point 1 au point 2. Moi j'aime ça, j'ai une destination !

Éliane Radigue : Vous savez, vers la fin il y avait vraiment des choses extraordinaires, des microbattements, des chants qui étaient de ces chants immatériels ! Quand il arrive qu'il y ait des musiciens qui essaient de tricher et qui me sortent à l'instrument une des premières, deuxièmes ou troisièmes harmoniques, je dis : « Non, ça, ce n'est pas une harmonique, c'est une nouvelle fondamentale ! » (rires) Il ne faut pas se tromper sur le matériau. Et là [à la fin], c'était très chantant, c'était très beau.

Isabelle Bozzini : Oui, c'est l'archet qui chante.

*

Clemens Merkel : Avec le mélange [de sons] je ne peux plus savoir.

Isabelle Bozzini : C'est comme un accordéon !

Clemens Merkel : À un moment il y avait comme un battement entre Isabelle et moi, alors je bouge un peu [ma fréquence]. Mais là je me rends compte que ce n'était pas moi ! C'est ce qu'il y a de plus dur — savoir quelle note jouer ! Je ne sais pas qui joue quoi, alors je ne sais pas comment réagir...

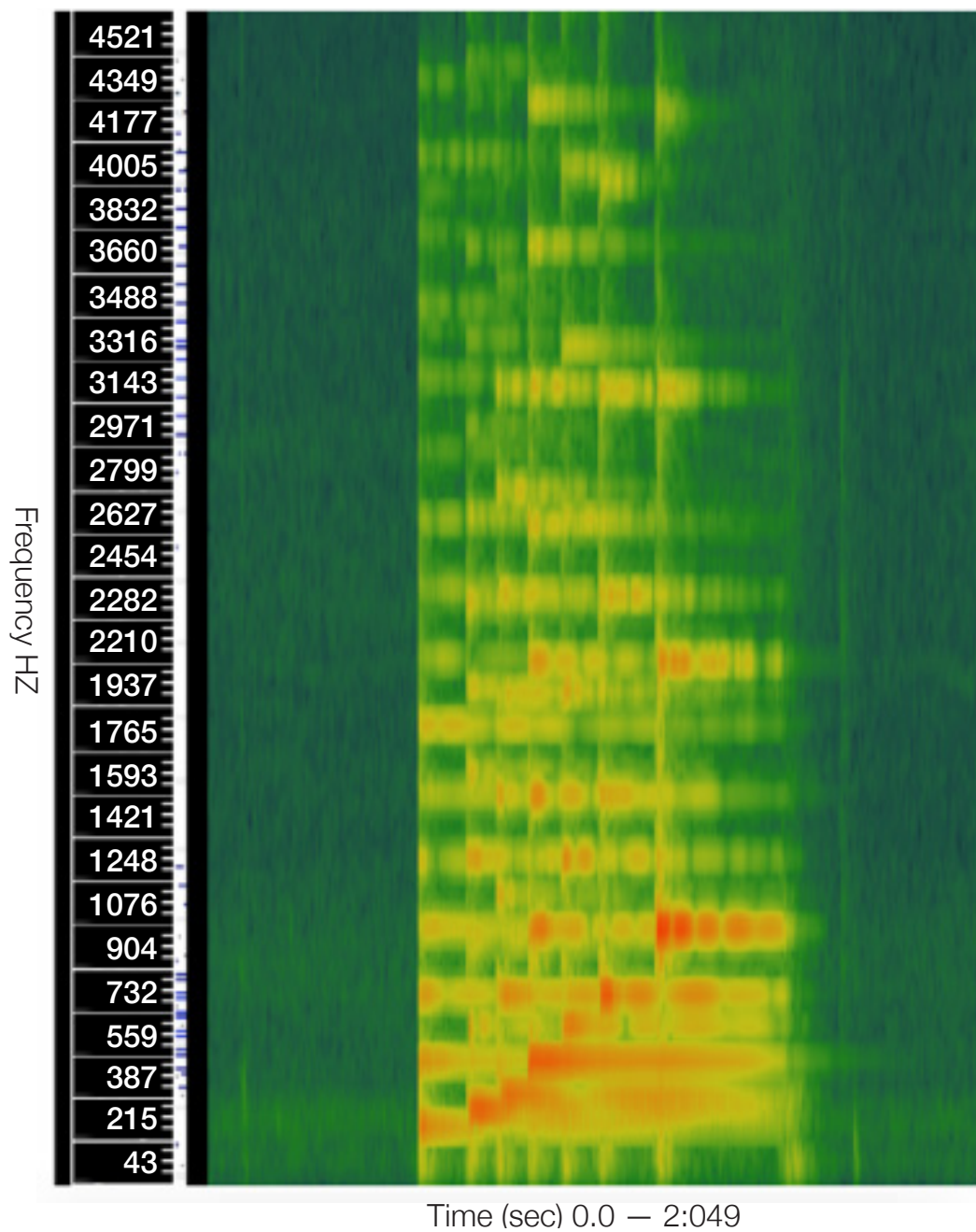
Éliane Radigue : Il faudra laisser aller, arrêter de s'en faire avec ça. Il faut faire avec ! C'est normal de penser à ces choses

maintenant, c'est la phase préparatoire. Vous savez, la plus sublime des partitions n'est qu'une série de points noirs sur une ligne [...] Peu importe qui est le chef d'orchestre, c'est vous qui jouez ! Avec certains musiciens, c'est parfois difficile... Mais avec vous, je ne suis pas inquiète !

Isabelle Bozzini : Je crois qu'il faut juste laisser aller. On doit être patient.

Éliane Radigue : Oui, c'est une règle dans ce travail et on est tous d'accord là-dessus : il ne faut jamais, jamais forcer. Il faut travailler, oui, mais *cool*.

Annex C : Author playing a C scale on the piano



***Regard sur la relève :
Nouvelles avenues en recherche***

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Adresse postale : Société québécoise de recherche en musique
 Département de musique de l'Université du Québec à Montréal
 Case postale 8888, succursale Centre-ville
 Montréal (Québec) H3C 3P8

Adresse physique : Département de musique de l'Université du Québec à Montréal
 1440, rue Saint-Denis, local F-4485
 Montréal (Québec) H2X 3J8
 Téléphone : 514-987-3000, poste 4075
info@sqrm.qc.ca

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