Composing Lines

Juan Pablo Vergara Valdés

A portfolio of compositions and commentary submitted to the University of Huddersfield in partial fulfilment of the requirements for the degree of Doctor of Philosophy

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Abstract

My work as a composer over the course of my PhD studies has focused on developing novel approaches to the notion of 'line' in music. This portfolio of compositions, composed between 2013 and 2017, is accompanied by a commentary that presents the conceptual ideas underlying my work with lines, from both a technical and aesthetic perspective. In this approach, the most novel element resides in the fact that lines function here often not as metaphor but as literal objects.

Throughout the text a range of different conceptions of lines are presented, providing a contextual and explanatory panorama for the compositional work. A line is understood in this context as a sustained sound that changes at a slow but perceptible rate, its 'line-ness' defined principally by its continual and smooth character. The approach undertaken consists of first conceiving lines as single entities, thoroughly exploring aspects such as their materiality, physicality, plasticity and fragmentability, in which their objective quality is gradually revealed and exploited further compositionally.

The commentary is divided roughly in half, initially proposing a series of types or families of lines, and then moving on to discuss the behaviour of those lines and the ways in which lines can be organized compositionally. First, various line-models are addressed, including the geological-line, the polychromatic-line, the thread-line, and the drawing-line, each typified in relation to a particular piece from the portfolio. I then present the idea of the 'pixelation' of lines from both vertical and horizontal perspectives, unveiling the extended resonant potential of fragmented lines. Later, certain combinatorial possibilities are pursued, giving rise to emergent behaviours of blurriness or in fluid-like textures characterized by permeability and motion. Throughout, I contextualize these musical approaches with references to other disciplines—especially the visual arts—helping to illustrate the ideas and concepts presented.

Acknowledgments

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During these years I have been very lucky to work with top-level performers including Distractfold ensemble, Two New Duo, Trace ensemble, ensamble CEPROMUSIC, Mdi ensemble and Line Upon Line Percussion ensemble; I would like to thank them all. I am especially grateful to Alevi Peña, Diego Castro and Linda Jankowska for sharing their exceptional talent, and trusting my music by encouraging me to compose.

Many thanks to Cristian Morales for his help with the recording of my pieces.

Finally, I would like to remark the importance that my family had through the process, but especially the love and support of my wife, Xaviera, to whom this work is dedicated.

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Portfolio

1. **Ohne** (2013-14)

For violin, viola, piano and percussion. Ca. 8 min.
Premiered on 10.03.2014 by Distractfold ensemble at St. Paul's Hall, University of Huddersfield, UK.
Format: score, audio, video.

2. **d'uno** (2014)

For trombone and violoncello. Ca. 10 min.
Premiered on 05.02.2015 by Two New Duo at St. Paul's Hall, University of Huddersfield, UK.
Format: score, audio, video.

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Premiered on 23.05.2017 by Diego Castro in Santiago, Chile.
Format: score, audio, video.

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Format: score, audio, video.

Introduction

Over the course of the years I have developed an approach to sound dealing primarily with environments formed by lines. Within that approach, notions such as singularity, continuation, connectedness, repetition and horizontality play an important role, allowing an immersion into the listening experience. *Lines* in this context make reference to sustained sounds that change at a slow but perceptible rate such as a glissando or a wide and slow vibrato: by moving smoothly across the frequency range, they stress its continuous nature. The idea of considering continuous sounds as lines comes from their graphical representation in time as drawn on the horizontal axis. Lines can hence be understood as straight or curved contours that move sinuously through time. They do not have a need for closure, nor a directional drive: what defines their line-ness is their continual character, to be sustained in time; but also involving change in frequency so that they are perceived as moving entities. Their line-ness is such in relation to their behaviour, and not as presupposing any teleology.

Lines have been a central preoccupation for a number of composers, among them Iannis Xenakis, Giacinto Scelsi, Alvin Lucier, Peter Ablinger and Chiyoko Szlavnics. The different perspectives found in either the music or aesthetic conceptions of these composers have influenced my work in several ways, as in the pursuit of a visual compositional approach; putting a special attention to small frequency collisions; considering lines as potentially physical objects; and in understanding musical discourse as formed by the interaction of lines.

Although the work of each of these composers is considerable,[1] I would like to comment briefly on their different uses of lines.

While the music of Giacinto Scelsi implies more directly the idea of sound than that of lines, the pieces from his late period can be interpreted as consisting of the construction of large continuous sound objects by the placing in time of multiple horizontal lines that 'touch' or excite similar frequency areas, producing the emergence of sound-complexes through their interaction. In that sense the music of Scelsi can be understood as using lines because of the smooth and sinuous movement inside constant fluxes of sound, fluxes formed by the superposition of changing and often vibrating line-objects. The most illustrating examples are his string duos, trios and quartets, in which he normally presents a focal pitch, that is, a single note over which he creates a variety of simultaneous small fluctuations by means of glissandi, vibrato, tremolo and trills, which produce emergent qualities of sound such as differential tones and a wide range of harmonics by the co-vibration and constant collision of frequencies. The horizontality and flatness of his sound complexes are emphasized by the insistence of lines acting on reduced pitch areas, producing slowly moving line-objects as result.

Concerning the work of Alvin Lucier, his approach to lines deals specifically with the creation of sound situations where beatings are sought to emerge. He has referred to continuous sounds as 'lines' especially on the title of some pieces, as in *Broken line* (2006) and *Shadow lines* (2013). In these and other works such as *Panorama* (1993), *In memoriam Jon Higgins* (1984) and *Two circles* (2012) to mention just a few, he normally confronts two or more sustained sounds in unison or octaves where one sound is to remain static while the other changes very slowly and gradually in order to obtain beating, which arises from their difference and fluctuates accordingly. Such acoustic phenomena is presented sometimes in isolation as in the case of *In memoriam Jon Higgins*, in which a clarinet plays sustained tones against a slowly ascending tone produced by a pure wave oscillator; and in other occasions there are more complex harmonies

[1] Involving specialized studies in the case of Scelsi and Xenakis.

involved including several pitches moving microtonally against still lines, as in the case of *Two circles* (also using wave oscillator combined with acoustic instruments). In other pieces as *Panorama* and *Broken line* static frequencies are assigned to the piano and vibraphone, while changing lines are assigned to the trombone and flute respectively. I find fascinating the way in which Lucier constantly exploits the oblique movement of lines either as the spreading from a unison or by moving towards it, always producing interesting acoustic outcomes as a result of these operations. Both Scelsi and Lucier are interested in the use of multiple lines that collide inside small frequency areas, Lucier being more focused on the beating phenomena taking place, and Scelsi being more interested in the emergence of sound as a whole. The work of both composers has influenced my search for acoustic situations arising from the oblique movement of lines on one hand, and by the use of very slow and gradually changing lines on the other.

Another composer that has made extensive use of the idea of lines in music is Iannis Xenakis. This is not surprising given his initial metier as engineer and architect, areas of knowledge in which lines play a crucial role both conceptually and practically. This knowledge is in fact at the core of Xenakis compositional practice, in which he often develops the evolution of sound in graphical ways by setting first a group of steps in a formalized procedure, carrying out the calculations by hand on millimeter paper, and finally producing a spatial/visual plane of coordinates as result. His lines then are usually the literal mapping of those calculations into the score rendered as glissandi (played mostly by string instruments), although he also uses lines made from fixed-pitched trajectories in seemingly scale-like passages. Xenakis conceptualises lines in a variety of ways, for instance as representing the probabilistic trajectory of particles in space,[2] or as describing the velocity of an entity by the slope of its glissandi, in which the faster the movement of the entity the faster the rate of change of the glissando.[3] These ideas unveil a deep preoccupation with objects moving in space and a dynamic approach to sound imagination and construction. Another aspect of Xenakis' use of lines (and points) is the idea of masses or groups of similar

[2] Xenakis, 1992, p.15.
[3] Ibid, p.13.

entities (clouds[4]), mass configurations playing a huge role in his musical thinking. In fact, Xenakis was the first composer to use masses of glissandi in his piece *Metastasis* (1953-54), in which he emphasises the continuous aspect of frequency space by creating changing surfaces formed by line aggregation: "If glissandi are long and sufficiently interlaced, we obtain sonic spaces of continuous evolution. It is possible to produce ruled surfaces by drawing the glissandi as straight lines".[5] Other Xenakis line environments consist of arborescences (as in *Evryali,* from 1973), small and repetitive fluctuations of glissando (as in *Phlaegra,* from 1975) and heterogeneous textures that include points and lines (as in *St/4-1,080262,* from 1956-62) among many others. Xenakis' graphic approach, the blurred quality of his line masses, and the idea of sound as movement in space have all influenced my work in manifold ways.

Two other composers that I consider important to mention involving the use of lines are Peter Ablinger and Chiyoko Szlavnics. Both composers have approached lines from a conception close to the visual arts, although they are certainly concerned with sound. Ablinger constantly invokes in his work a synesthetic attitude towards music in relation to visual and conceptual art, making questions pertinent of one to the other and vice versa. Through that exercise he has developed a proclivity for abstraction, as in his *verticalizations*[6] (also called *condensations*), a notion concerning lines in a vertical sense, consisting of the superposition of pitches "as a palette, in which the line is presented in maximal contrast to its resultant surface, its densification".[7] Instead of involving horizontality, verticalizations consist of hugely thick vertical lines in which "by condensation, successive events are transformed into the simultaneity of a spectrum. A succession of sounds as an input turns into a color of sound as an output".[8] Other uses of lines by Ablinger involve working with diagonals, as in *Weiss/weisslich* Nº1 (1980), a piano piece using exclusively white keys played from high to low; and also the use of simultaneous glissandi, as in *Augmented*

[4] Xenakis, 1992, p.12-21.
[5] Ibid, p.10.
[6] This idea is the "basic operation" for his IEAOV pieces: "Instruments and Electro-Acoustic Site-specific Verticalization", consisting of "pieces for instruments and a form of live-electronics by which a succession of sounds as input become timbre as output", as explained in http://ablinger.mur.at/ieaov.html.
[7] *Metaphors*, unpublished English version of *Metaphern* (2004), used with permission.
[8] From http://ablinger.mur.at/ieaov.html.

study for 7 violins (2012), a "Proportion canon from a slow glissando over one octave",[9] involving the superposition of seven ascending lines. This work aims at blurring the perception of the listener through the "redundancy of maximally simple material,"[10] in this case multiple deferred glissando lines in very slow ascending motion.

Contrasting Ablinger but also within a spectrum extending to the visual arts, the work of Chiyoco Szlavnics is concerned with the production of graphic images comprising mainly horizontal straight and curved lines drawn by hand that are later transformed into sound by submitting the image to a process of translation. For her, the primordial images are considered and should be read as works of art in themselves: "I create works of art to produce unique forms which almost literally represent frequency and duration. (…) The drawings' first identity as visual art (…) seems crucial to the consistent production of a variety of fascinating musical results". [11] In her drawings, lines are thought to be continuous glissandos, intended to "shape and control very slow figures over an extended period of time".[12] In a second stage of the process, she scans the images into the computer and adjusts them to fit into grids that will define the register and just intonation ratios. Later she orchestrates the lines, producing finally a conventional score for its performance. Similarly to Lucier, her work with slowly changing simultaneous lines is related to a search for the emergence of beating, but also of differential tones as arising from the collisions of close frequencies. Szlavnics' dual thinking represents an interesting step forward into the unification of lines and sound, while Ablinger's work displays some fruitful possibilities of an approximation between sound and abstraction.

Similarly to the working methods of Xenakis, Ablinger and Szlavnics, my personal compositional process often involves the drawing of lines for then to analyse them on paper, relying on what Xenakis has said about this relation:

[9] From http://ablinger.mur.at/txt_augst_augmented.html.
[10] Ibid.
[11] Szlavnics, 2006, p.3.
[12] Ibid.

> The drawing and thinking of the sound-image go hand-in-hand, the two can't be separated. It would be silly to leave out of account, when drawing, what will sound in reality. We have also to be able to find on paper the visual equivalent of the musical idea. Any changes and modifications can then be carried out on the drawing itself (…).[13]

Such a connection between the hand, the visual realm and imagination is also important in my work, especially at the first stages of the composition process in which the primary goal is to visualize the type of lines that I am going to use in terms of shape, behaviour and interaction. Drawing helps at this point to make images of sound situations that could potentially be developed later at different time-scales of the music (fig.1).

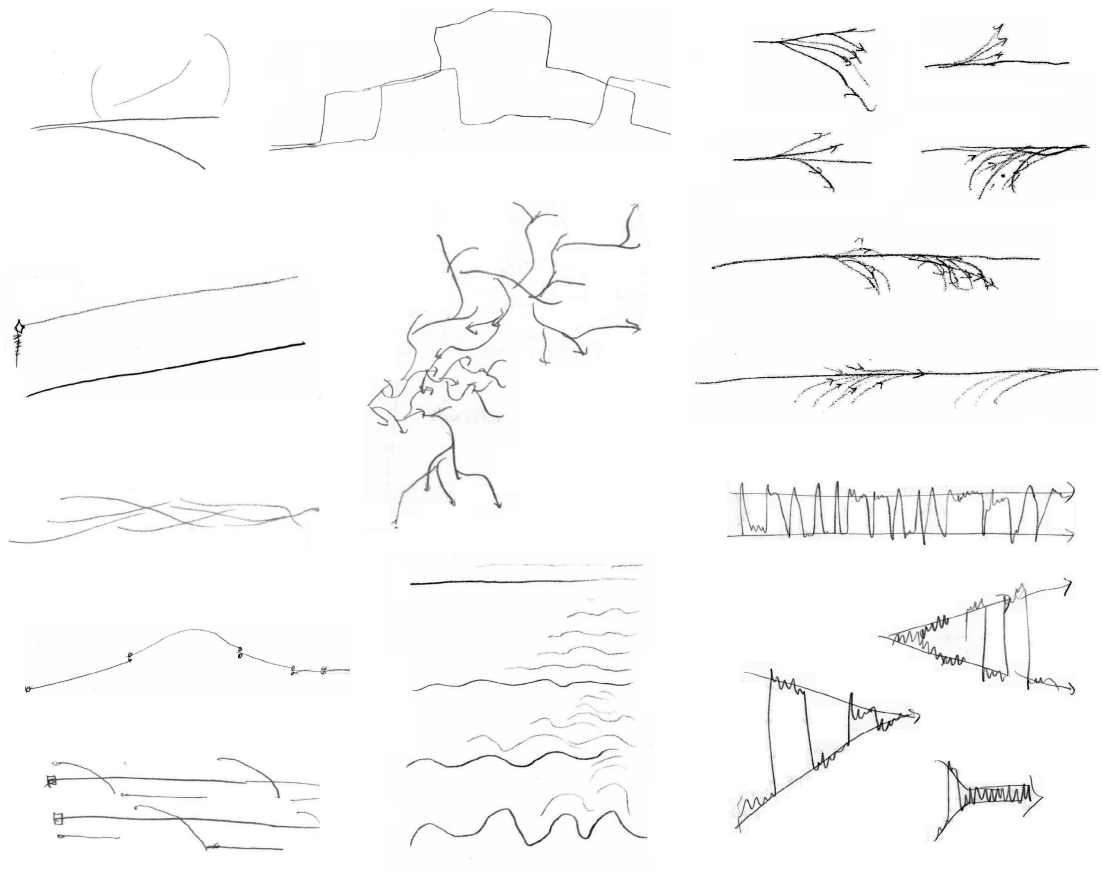


Fig.1: Sketches of isolated situations at first stages of the creative process.

[13] Xenakis & Varga, 1996, p.90.

Figure 1 shows some of the sketches done at initial stages of the pieces from the portfolio. As it can be observed, all of the small sketches involve the use of lines, with time being represented horizontally in most of them. Unlike Szlavnics, I do not literally transcribe my traces into sound: the drawing helps rather to imagine sound qualities and situations as an extended process of 'visual listening' or sound imagination, as if thinking sound out loud. Later in the process, when the situations and sound world of pieces are further defined, drawing helps to delineate the action to a finer degree in a way similar to writing a conventional score, although with more degrees of freedom so to speak. This can be appreciated in figure 2, showing sketches from two different stages of the composition process, corresponding to a fragment from the piece *Lines for Linda* (2017) for solo violin.

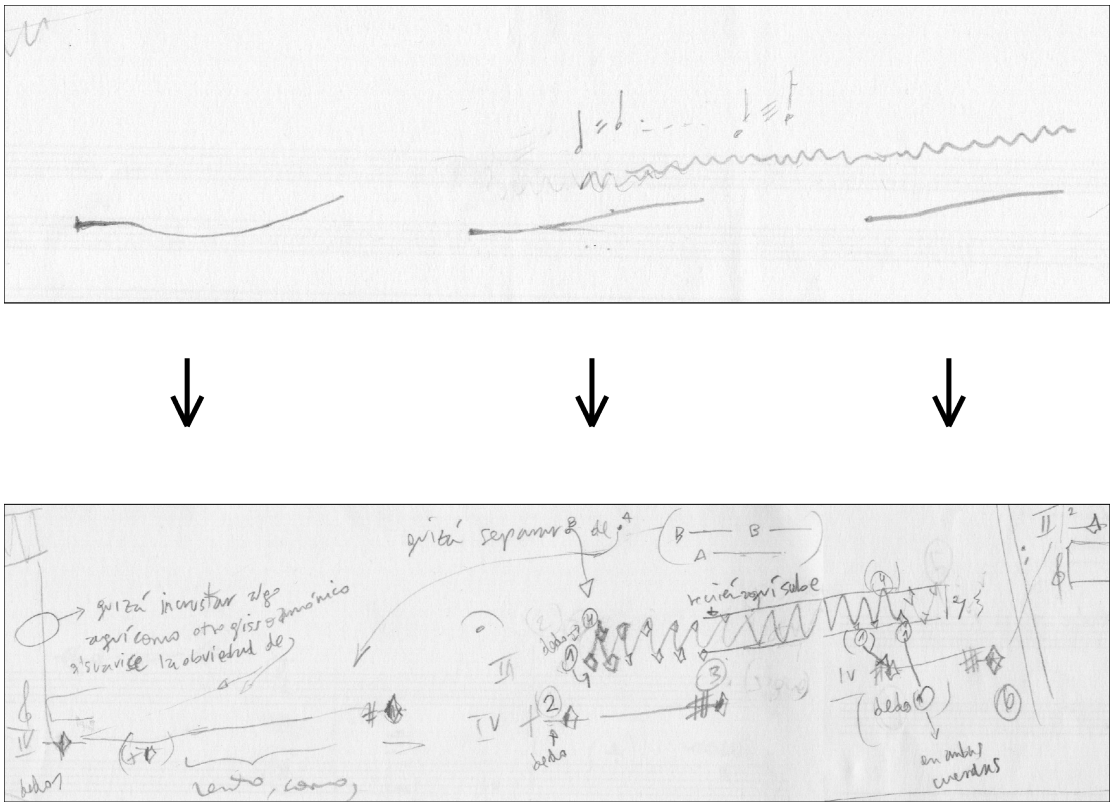


Fig.2: Sketches from Lines for Linda *(2017) for solo violin.*

As can be observed, lines—and the drawing in general—gradually get closer to traditional notation as local decisions take place. Usually my compositional process also involves touching, playing and improvising with the instruments for

which I am composing, so that drawing helps also in shaping each improvisation, to prepare visually the sound-search to be made with instruments themselves and to plan long term trajectories of the music. In the percussion piece *Engraving on Bronze* (2016-17) the relation to drawing was pushed further, as performers are asked to literally draw lines onto the cymbals with the tip of the drumstick. Drawing then becomes the sound production mechanism of the piece, in what could be considered an inversion of the process since drawing becomes its last stage.

In what follows I would like to address some of the general implications of embracing a line approach in composition, as for instance how the fact of using slowly moving sound entities affects conceptions of musical time; some ideas about lines' objectness; and the way in which lines are to be presented. These questions have arisen from adopting such a perspective, being thought through in the compositional process of the pieces presented in the portfolio.

In *Point and Line to Plane* Kandinsky states, "In general, the element of time can be recognized to a far greater extent in the case of line than in the case of point—extension being a temporal concept".[14] In sound, such an extension becomes continuity as lines consist of sounds sustained in time. This implies an understanding of temporality as being of a continuous nature, suggesting fluid spaces in which continuity is given by the prolongation of lines. Change, also important and necessary for this conception, is determinant for lines' inherent duration and hence to the overall time perception: the faster the rate of change of lines, the more dynamic the perception of time will be. We could say then that different types of lines will have different inherent durations according to their rate of change, depending usually on their particular slope.

Given that line environments will normally imply a lessening in the amount of perceptible pulses or attacking sounds, it can be broadly stated that the time produced by them is close to the idea of un-pulsed or uncut time proposed by

[14] Kandinsky in *Point and Line to Plane* (1926), as cited in Butler, de Zegher & Museum of Modern Art, 2011.

Boulez.[15] The time produced by lines can also be thought in relation to the smooth space[16] created by their gradual movement across the frequency continuum: it can be further speculated that smoothness in frequency space will produce a smooth quality in time. In that sense I find attractive from the point of view of perception the ambiguity between perceptible and imperceptible change that line environments produce, especially when lines' horizontality and flatness are stressed by means of slow smooth-motion. We could say that the slow rate of change of lines produces a particular temporality, imbued with an ambiguous character. This mindset would imply changing the perspective from an understanding of lines as unfolding *in* time to one in which lines *produce (a particular) time* through their unfolding. Being continuous by definition, lines produce—and are made of—time.

Another aspect to consider when dealing with the use of lines is their objectness. This means approaching lines as if they were physical objects with features and qualities beyond their immediate shape, and their subsequent transference into sound. Such a perspective enabled the development of ideas relating to the thickening of sound in the piece *d'uno* (2014), and also to approach ways for manipulating sound-lines in general as if they were made of a malleable material. As the notion of objectness allows inquiry into lines' physicality, it enables also a focus on their haptic attributes and the creation of musical discourses based on such physical interactions and constraints, as in the case of the piece *Ludium et* (2014 rev.2016) for solo guitar, in which the force applied to the string (the physical-line *par excellence*) and its resistance shaped the musical events. Early examples of line's physicality include the *Phillips Pavilion* (1958), where Xenakis applied the ideas from *Metastasis* to the design and construction of a large-scale structure,[17] and Lucier's *Music for a Long Thin Wire* (1977), in which a huge tensed metal wire is disposed along several meters, both ends connected to an amplifier and made to vibrate by a horseshoe magnet.[18] Although these examples display line's physicality outside conventional musical praxis, such an approach

[15] Boulez, 1987.
[16] Ibid.
[17] Xenakis,199 p.10-11.
[18] Lucier, 2005, p.360.

can be applied to musical traditional apparatus and to musical instruments themselves, as we shall observe.

Concerning the ways in which line-objects are to be presented from a syntactical point of view, my general tendency has been to create lines that are close to the phrase level, having hence an average duration shorter as compared to those commonly employed by composers such as Lucier and Szlavnics. In that sense, I have developed an interest in lines within the scale of the human gesture, incorporating certain elements of phrasing as for instance the necessity of breathing. Another device that I have employed frequently when displaying lines is the use of repetition, which in the case of singular line-objects allows exploring them in isolation through their constant re-enactment. Such musical contexts were created for example in the solo pieces for guitar and violin,[19] in which a time-space was devoted to single phenomena to unfold enhancing an immersion by both performer and listener.

Lastly, line interaction represents a fertile area worth exploring. From the endless possible ways for lines to interact, three main types of situation have been approached on this commentary: one involving connectedness as a way of creating greater line objects, another focusing in the production of blurred sound figures, and line interactions that produce fluid-like environments. Concerning the creation of larger line-objects, a notion of connectedness is useful and implies connecting the inner frequency constitution of simultaneous lines by working carefully with the ways in which these entities touch each other at the level of their frequency spectrums, which translates as a constant orchestration attitude. This implies a plastic conception of sound as being constructible by layers, relating also to the idea of line's objectness. Through their orchestration and duplication lines are enriched by the amplification of some of their partial content, acquiring object-like qualities and becoming denser by increasing the thickness of the brushstroke so to speak. Regarding other interactions and combinations, I have approached *blurring* as a phenomenon arising from small line displacements, a perspective suitable to multiple-line constructions since it

[19] *Ludium et* for solo guitar (2014 rev.2016), and *Lines for Linda* for solo violin (2017).

allows a variety of interesting acoustic situations to emerge. And finally an idea of line interaction as producing behaviours of a fluid quality has been explored by considering each line inside a collective display as a streamline originating streamness and fluidity on a wider scale, a type of interaction enhanced by the perpetual entrance and exit of lines. All of these ideas are to be addressed and expanded upon in the following text, which consists of an aesthetic exploration of lines through the analysis and commentary of different aspects of the music conforming the portfolio.

Overview of the commentary

The structure of the chapters follows a pattern designed to give clarity to the subject. Chapters 1 and 2 deal with the nature of lines, in a movement from the abstract and metaphorical towards the concrete and physical. These chapters develop intrinsic qualities of lines. Chapter 3, 4 and 5 instead, present the transformation of lines as given by externalities, such as their fragmentation, combination, construction and orchestration, moving from singularity to multiplicity.

Chapter 1 examines the notion of materiality of lines, from a perspective of sound, and as a metaphor to some geological processes mirrored by the music. The line models addressed are the geological line, exemplified by the piece *d'uno* for trombone and cello; and the polychromatic line in relation to the piece *Lines for Linda* for solo violin.

In Chapter 2 lines are approached in their physicality as either physical objects or as physical gestures. The string serves as model for the thread type of line, as worked through the piece *Ludium et* for solo guitar. Then, the act of drawing is approached in relation to a line of friction, which gave rise to the piece *Engraving on Bronze* for percussion trio.

Chapter 3 explores the notions of vertical and horizontal pixelation of the line. Vertical pixelation is examined in relation to the frequency continuum, using the last section of *Ludium et* (for guitar) to illustrate that aspect, in constant dialogue with Paul Klee's work. Horizontal pixelation is later approached regarding the soprano part of the piece *Into Open Noir* (for soprano, flute and electric guitar).

Chapter 4 proposes criteria for the combination and interaction of lines. First, blurring serves as an analogy to the sonic effect produced by either heterophony or the thickening of a central pitch. Then, a model of streamness is proposed for a certain type of line interaction.

Chapter 5 takes a different approach to the subject, being the only place of the text that offers a methodology of construction and orchestration of a line-object. This is demonstrated using the piece *Ohne* (for small ensemble) as an example of constructing a line made of points, which functions as a *cantus firmus* for subsequent operations. Although the premises of this chapter differ slightly from the rest of the chapters, it makes an interesting contrast while including notions already introduced such as line thickening, duplication and orchestration.

1. Materiality of lines

My incursion into the world of lines goes hand in hand with the search for ways to explore and work the materiality of the line-object in terms of sound and musical conception. Materiality has been a creative source constantly present in my music both as a metaphorical image and as a concrete approach to sound. For instance in the piece *Al otro lado* from 2009 I created musical situations based on the different ways in which rock deforms, namely elastic, plastic and brittle. Those earlier experiments were the seed to later insights that led me to consider the idea of materiality from other perspectives. My interest in geologic materiality comes from experiences that I had in Chile, a country full of mountains, volcanoes, the high plateau and big deserted area in the north, and the pampas and glaciers in the south. I believe that these experiences left an imprint on my approach to composition.

The term *materiality* is used here in two senses: first, it refers to the sum of qualities displayed by a collection of entities, which in the case of lines emerges from an accumulation of surfaces, hence pointing to the uniqueness of macro scenarios as understood from their horizontality. This consideration of material deals with its unfolding through time. Secondly, *materiality* is used to denote the rough aspect of sound, its concreteness. In that sense we are not dealing with the traditional term *material* as it is often used in musical analysis when referring to a closed unity subjected to transformations, but instead to the inherent qualities of the acoustic phenomenon, the "concrete aspects of sound".[20]

The idea of a materiality of lines opposes to simply conceiving lines as material: the former involves considering further aspects of lines' inherent nature, as their

[20] Denis Smalley, in Emmerson, 1986.

temporality and spatiality, the question not being what to do with them but how and what they are. In that sense the time of the line is an embedded part of that materiality, and the environment that these objects form are an extension of their materiality.

In sculpture and the visual arts, materiality was pursued by artists such as Annie Albers, Barbara Hepworth, Eva Hesse and the Gutai group among others, who stressed the necessity of returning to the nature of the material itself, as Jiro Yoshihara energetically states in the Gutai manifesto:

> Gutai (concrete) art does not change the material but brings it to life…(it) does not falsify the material... The material is not absorbed by the spirit. The spirit does not force the material into submission. If one leaves the material as it is, presenting it just as material, then it starts to tell us something and speaks with a mighty voice.[21]

These artists demanded a fair treatment and dignity of materiality, somehow denouncing the subjugation to form that material had received historically. When discussing materiality in music however, a certain degree of abstraction and metaphor are unavoidable given that sound is made of air vibrations and hence it is rather untouchable. In this regard, the idea of line as a musical object is helpful, as it allows its materialization, observation and further treatment. A materiality of sound has been approached by some composers in the last and present centuries, most notably Helmut Lachenmann and Pierluigi Billone. In the works of the latter it is possible to appreciate a conception of material as a living entity. In a text about his piece *1+1=1* for two bass clarinets (2006), he explains that "the variations that become part of instrumental technique through each individual discovery (…)" become "active sonic layers, living matter with an intelligence of its own".[22]

Assuming a partially or entirely materialistic approach raises the question about the implications that it carries concerning creative decisions. As sculptor Barbara

[21] Danchev, 2011.
[22] From www.pierluigibillone.com.

Hepworth emphasizes: "the material has vitality—it resists and makes demands,"[23] or Albers when she writes, "What I am trying to get across is that material is a means of communication. That listening to it, not dominating it makes us truly active, that is: to be active, be passive."[24] Both artists suggest that it is necessary to give space to material to unfold, to let it 'talk', which in music can be interpreted as the necessity to give time to the materiality of sound, or to "let the sounds be themselves."[25]

Next, we shall observe materiality as applied to musical line-objects in the context of two compositions: *d'uno* (2014) for trombone and violoncello, and *Lines for Linda* (2016-17) for solo violin.

1.1 *d'uno*: a geological line

Fig.3: Quebrada de Humahuaca in Province of Jujuy, Argentina.[26]

The piece *d'uno* from 2014 (tbn-vcl) develops an approach to lines influenced by geology, specifically by the lines present on Earth's own surface materiality,

[23] Hepworth in an extract from 'Approach to Sculpture' on the web https://barbarahepworth.org.uk/texts.
[24] Albers & Danilowitz, 2000, p.75.
[25] Cage conversation with Bill Womack (1979), in Kostelanetz 1988, p.42.
[26] Photo by Paula Colantonio: https://www.flickr.com/photos/argentravel/4626113063/.

namely geological strata formed by sedimentary rock. These characteristic formations consist in the accumulation of different rock layers on top of each other producing usually horizontal line-structures, formed underwater and having had long processes of emergence to the surface, followed by deformation and erosion. What struck me about these multilayer strata are their strong materiality and the beauty that they exhibit, expressed as undulation, parallelism, colour and texture. Although the influence was mainly visual, I could not avoid reflecting on the temporal nature of those line layers, each one formed for periods involving thousands or even millions of years, a temporal scale completely out of the human reach, a geological time. My intention for *d'uno* was then to create line objects that had at their base some of the elements present in geological strata, as contour undulation reflecting their smooth and sinuous movement, porosity of sound emulating their rocky-sandy materiality, parallelism between the conforming lines, and an intrinsic longness expressed by a rather dilated pacing.

1.1.1 Line sinuosity

Fig.4: Strata undulation.[27]

Most geological strata present some degree of internal undulation in the contour of their layers (fig.4). Such curvatures or folds form usually by the effect of compressive, tensional and shearing forces, involving different fold mechanisms that include buckling, bending and passive folding among others.[28] Undulation gives a ductile appearance to the resulting deformed strata revealing the

[27] Photo by George Clerk.
[28] Bell, Harris, and Rothery, 2008.

plasticity of rock and suggesting the idea of fluidity: at a macro time-scale rock behaves indeed as fluid.

In *d'uno*, the undulation present in strata layers is mirrored by the use of lines that change their pitch contour gradually and slowly, stressing their horizontality by small pitch distances travelled on rather long notes, done by means of glissandi on both the cello and trombone. I imagined a type of line that when perceived gives the impression of simultaneously being and not being in motion, an ambiguity of movement occurring in a space between perceptible and imperceptible change. This ambiguity is one of the reasons why I use slowly changing lines, as I am fond of situations where slow deformation occurs.

Lines in the piece have different undulation degrees, always inside a small ambitus, a gradation relating to how often they change direction. Such lines intercalate during the first half of the piece, gradually acquiring more and smaller internal movement, although there is no directional process involved in this sense.

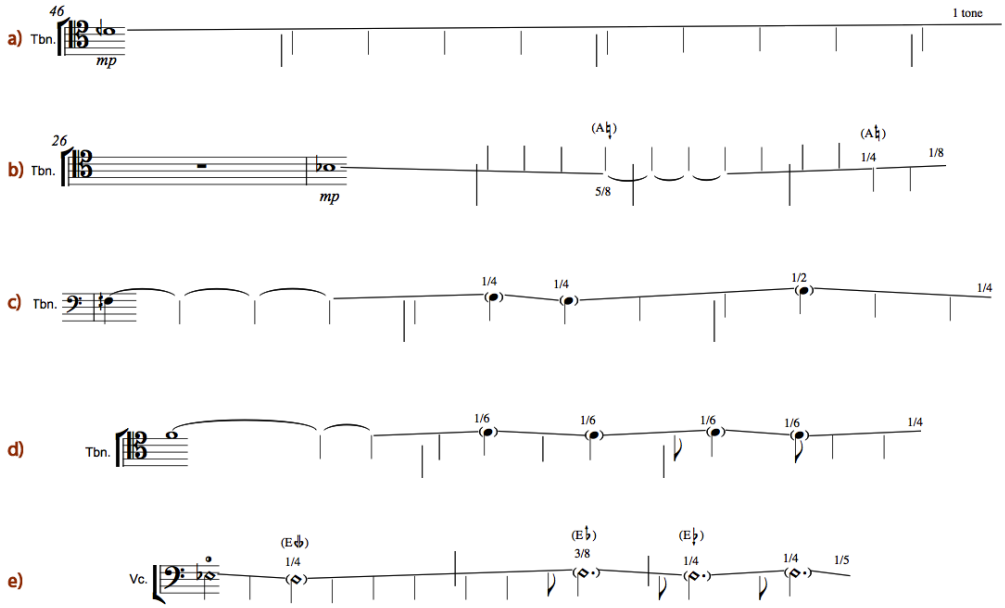


Fig.5: Different degrees in the undulation of lines.

Figure 5 shows different degrees of undulation in *d'uno*'s lines: 5a) consists of a type of line with a single direction and hence no undulation; 5b) represents a stretched *porrectus*[29] by its descending and ascending movement (showing also stasis in the middle); 5c) and 5d) exhibit a combination between stasis and several ascending and descending turns; and 5e) is made only of undulation without stasis, and can be considered as a widely stretched vibrato.

In composing *d'uno*'s lines, especially the long and unidirectional ones, I was influenced by Alvin Lucier's work *Panorama* (1993) for trombone and piano. *Panorama* consists of long and continuous lines made by the trombone, which are the result of the literal mapping of mountain peaks from a picture of the Alps into the time/pitch plane.[30] Another work that influenced the subtle curvy approach and phrasing in general is Aaron Cassidy's *songs only as sad as their listener* (2006)[31] for solo trombone, where repeated long lines oscillate very smoothly across a small range, in the construction of a delicate and quiet environment rarely seen in a solo trombone piece, accomplished by the constant use of a *whisper* mute.

1.1.2 Sound materiality

The material composition of geological strata, consisting of diverse types of rock and sediment, suggested an approach to sound imbued with porous and granular qualities, of a vibrating or even trembling nature. In order to render these I opted for the use of various instrumental techniques such as airy sounds, multiphonics, *flatterzunge* (frullati) and different naturally produced beating phenomena. These modes of emission were aimed at imprinting a sense of erosion and desert-like materiality.

The diverse multiphonics from the violoncello part are a good example of the different degrees of complexity that sound materiality can have. The simpler

[29] Porrectus: "In Western chant notations a neume signifying three notes, the second lower than the others." Entry from *Grove Music Online*. *Oxford Music Online,* accessed September 25, 2017.
[30] Lucier, 2005, p.274.
[31] Cassidy, 2006, self published.

multiphonics involve only two sounds, consisting of the fundamental plus the octave or twelfth. This is accomplished by positioning the bow on certain areas and bowing at a certain speed allowing that specific partial to vibrate stronger and hence louder. In contrast, the more complex type of multiphonics played by the cello (developed by cellist Ellen Fallowfield, who premiered the work[32]), contain an increasing number of harmonics and hence a greater amount of internal friction, resulting in noisier tones full of richness.

1.1.3 Parallelism: the creation of a compounded line

Another point of encounter in rendering geological strata in sound was to mirror their characteristic parallelism, one of their most interesting features. In geological terms "horizontal parallel stratification consists of thin, even strata. Each stratum is parallel with the others and the entire set is approximately horizontal".[33] While it is true that "the concept of the parallel would respect both the perfect correspondence and the non confusion"[34], geological strata have also the peculiarity of being at the same time a single unitary object and a collection of independent components or layers, where former thin lines participate in the co-creation of a wider kind of line, a meta-line. I tried to approach this duality in *d'uno* by the creation of a compounded line-object exhibiting parallelism between its constituent parts.

The proceeding of such parallelism consists of superimposing lines executed by both instruments keeping always parallel motion while change takes place. The basic principle is to thicken a single pitch line by reinforcing one of its internal partials, most commonly the first arising and stronger ones such as octaves and twelfths (fig.6). When there is a multiphonic sound at the base, the usual aggregate sound is a tenth. Such line duplication brings an unexpected acquisition of volume in the sounding result, producing an emergent three-dimensionality.

[32] Information about Elen Fallowfield's development of multiphonics can be found at her website: www.cellomap.com.
[33] Picard & High 1973, p.144.
[34] From Derrida's essay "Form and Meaning", 1967 (in Derrida, 1996).

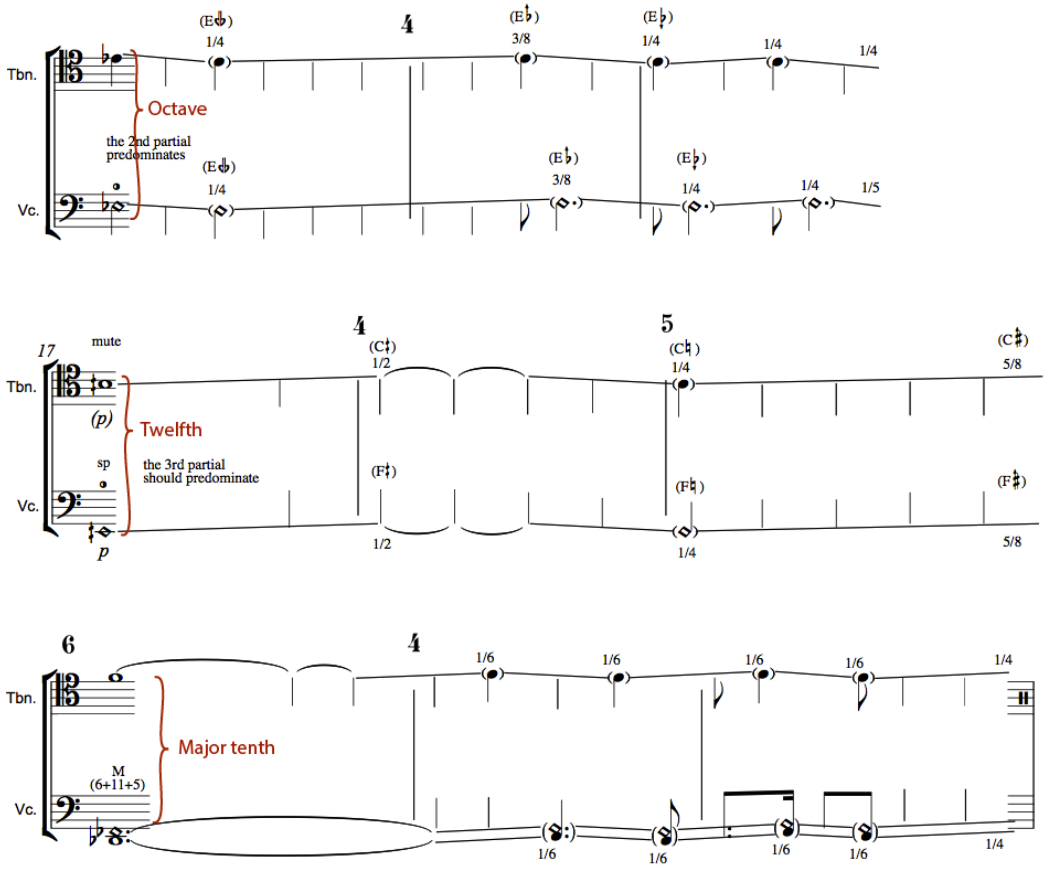


Fig.6: Three constructed parallel line-objects from d'uno.

This way of proceeding can be understood as a simplified version of the technique called *instrumental synthesis* frequently used by Spectral composers[35], where each individual pitch played by an instrument is considered to be part of a constructed harmonic spectrum or timbre (hence instrumental synthesis) as opposed to being an element inside a given harmony or chord. However, this 'hyper-line' approach differs from instrumental synthesis in that the emphasis is put on the line behaviour, not on the harmonic spectrum per se: by having less partial content the object maintains a clearer line-ness (contrary to the hypothetical orchestration of an entire sound spectrum gliding). As we see, parallelism works here in the collective construction of a specific materiality emerging out of the conjunct forces (sounds) of both instruments. By their coordinated action, each line component works finally as a layer of sound in the production of a hyper-line.

[35] Daubresse, Assayag, and Fineberg. 2000.

1.1.4 Broken Lines

Fig.7: Faulted interbedded metagraywacke-slate.[36]

One of the ways in which strata parallelism can be discontinued is by the action of faults. Faults are discontinuities between rock masses showing lateral displacement, in which "the amount of displacement may vary from only a few tens of millimetres to several hundred kilometres".[37] I imagined then geological faulty scenarios and how their broken lines would sound when interacting. As a result, in the middle of *d'uno*, both instruments become independent, playing lines of different durations and register, in a polyphonic interaction where each voice consists of big interval leaps, as if mapping faulty broken lines (fig.8).

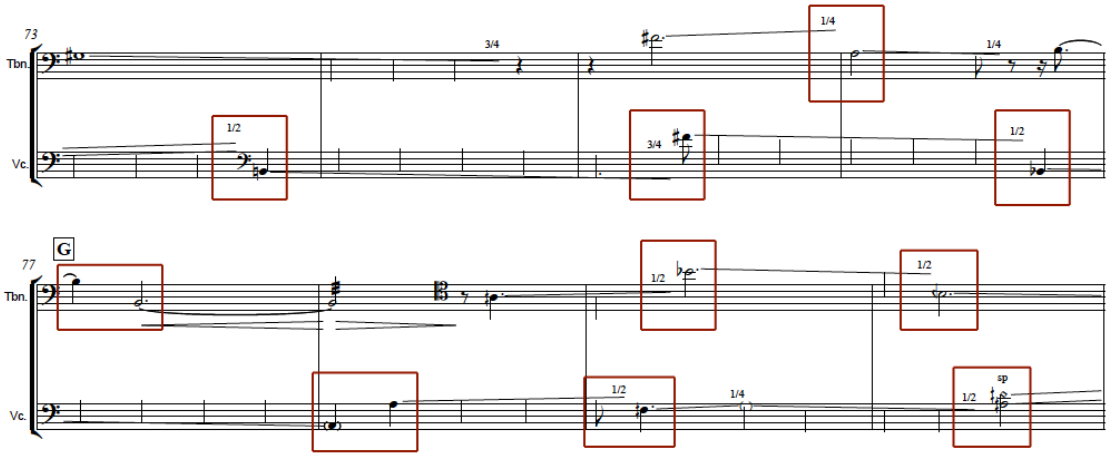


Fig.8: Broken lines interacting polyphonically.

[36] Photo by James St.John: https://www.flickr.com/photos/jsjgeology.
[37] Bell, 1983.

The accumulation of tension, pressure and/or stress forcing lines to break is generated in the immediately previous zone of the music by the insistence of a gesture consisting of lines that open (glide) in both directions from an initial unison (A3) into wider—but still small—registers. Such behaviour provokes the line to break and give way to line independence afterwards.

1.1.5 Time of a geological space

As mentioned earlier, the temporal aspect of geological lines is important in relation to materiality, forming part of it. I conceive their temporality as belonging to an elongated time-nature associated with desert landscapes, in which big extensions of open land suggest a dilated temporality. Slowly moving lines then are intended as a depiction of these geographically desolated spaces where change occurs gradually and smoothly, although not without a sense of erosion and dryness. In relation to this idea, I also experimented with the composition of silences in between phrases or actions, and between sections as well. I approached silences as having compositional meaning and intention, beyond simply articulating spaces of action (although they function also in that way). Such meaning points to experiences that I had in this type of environment, in which the everyday experience of constant activity is lost, and one easily becomes disoriented by such confrontation with oneself. The rendering in *d'uno* of that type of situation operates nonetheless in rather symbolic ways, through the inclusion of silence as a structural element in the temporal construction of phrases, concerning especially the first and last sections of the piece.

For instance, in the last section of *d'uno* there is a process of time expansion in which the music consists of groups formed by the alternation of still lines and silence (fig.9). On each group, a still line is followed by a longer silence; followed in turn by a repetition of the initial sustained line (yet longer in duration); followed by an even longer silence. Instead of using long pauses (as the one articulating the previous section in bar 106) I opted for precise silent durations that the performers have to count internally as if counting sonic events. The reason for doing so was to allow the perception of silence as a prolongation of

the gesture initiated by the line, consisting of the exponential growing of each group. In this context we could say that silence is as important as sound.

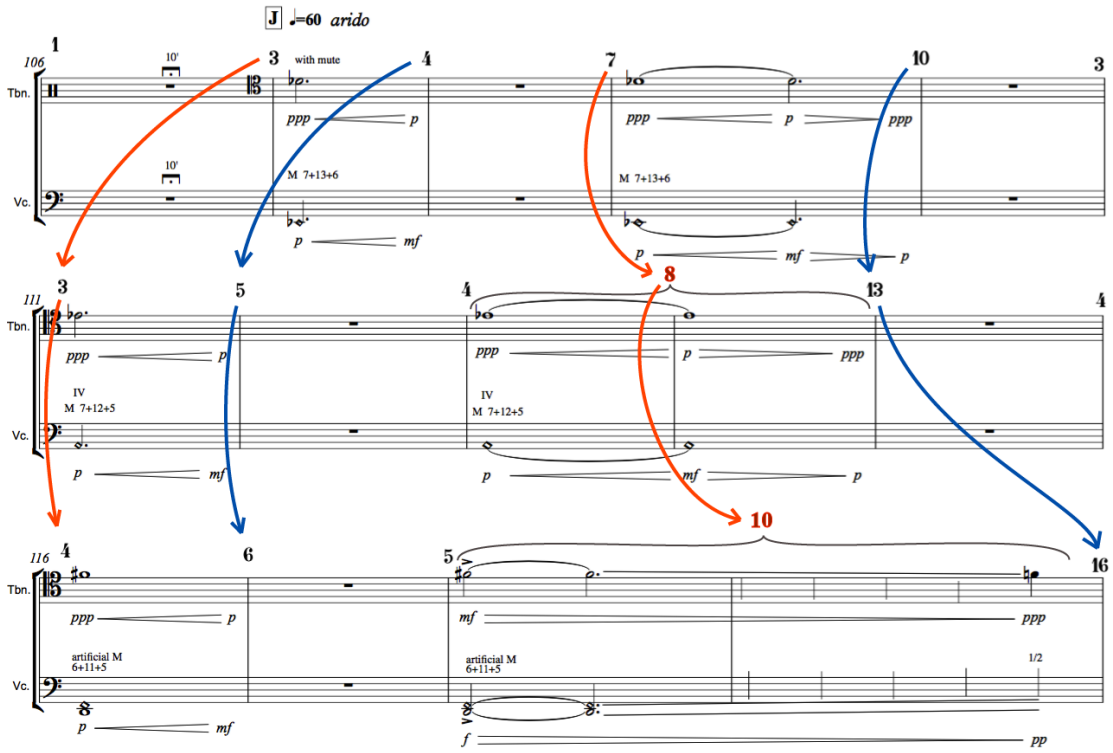


Fig.9: Composed silences in the final section of d'uno.

In the example, each system contains a different group undergoing an internal expansion of durations (i.e. 3, 4, 7 and 10 seconds the first group), and each subsequent group presents slightly longer durations while maintaining similar internal proportions (3, 5, 8, 13 the second group, and 4, 6, 10, 16 the third). Expansion operates both at the level of the group and at the level of the section as it can be observed.

Another place where the composition of silences was relevant is the first section of the piece, in which—similarly to the previous example—silence exhibits a fixed relation to the duration of lines. But instead of being longer than lines, here silences complete the gesture by having a duration equivalent to half the extension of the line event (fig.10). This means that if the line involves for example fourteen quarter notes, the silence following it will have seven quarter notes, and so on as shown in figure 10. Although this device was not used on

every long line of the first section, it is constantly present and emerged as a consequence to the question of the embedment of silence inside *d'uno*'s musical discourse.

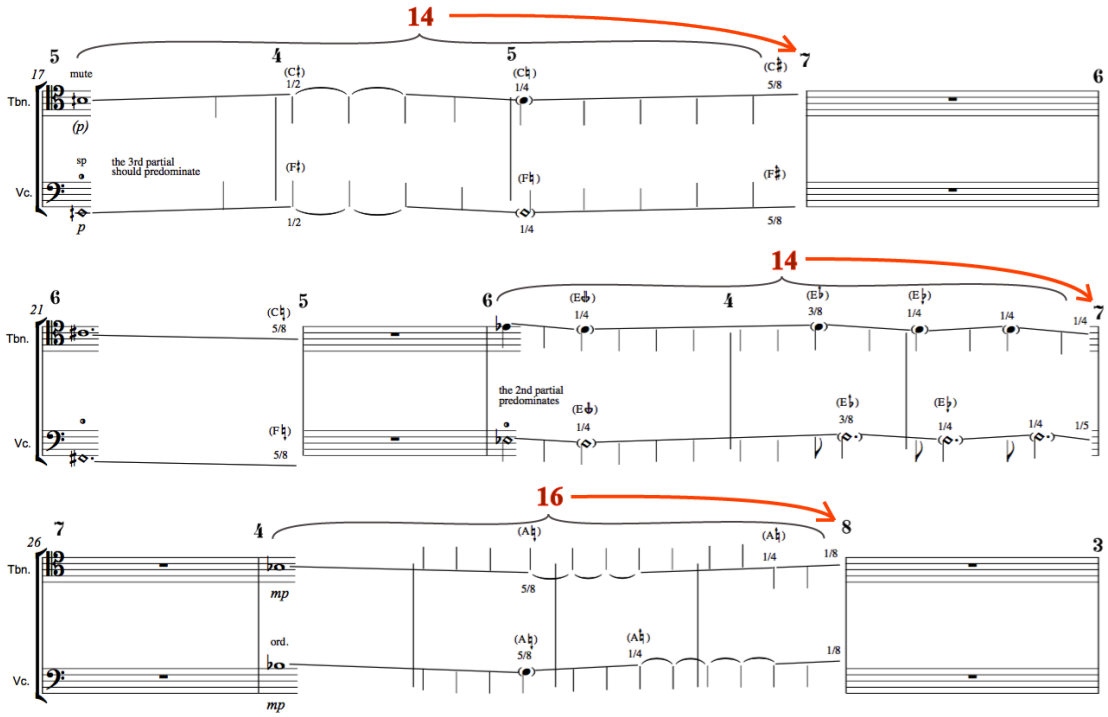


Fig.10: Composed silences in the first section of d'uno.

Composed silences are spread through the piece, although they have a major presence in the first and final sections (from a total of 5), producing a symmetrical formal scheme since the action in both sections is similar due precisely to their constant use of silence. In the centre of the piece on the other hand, line activity becomes denser and silences are used mainly in between sections.

1.2 *Lines for Linda*: a polychromatic line

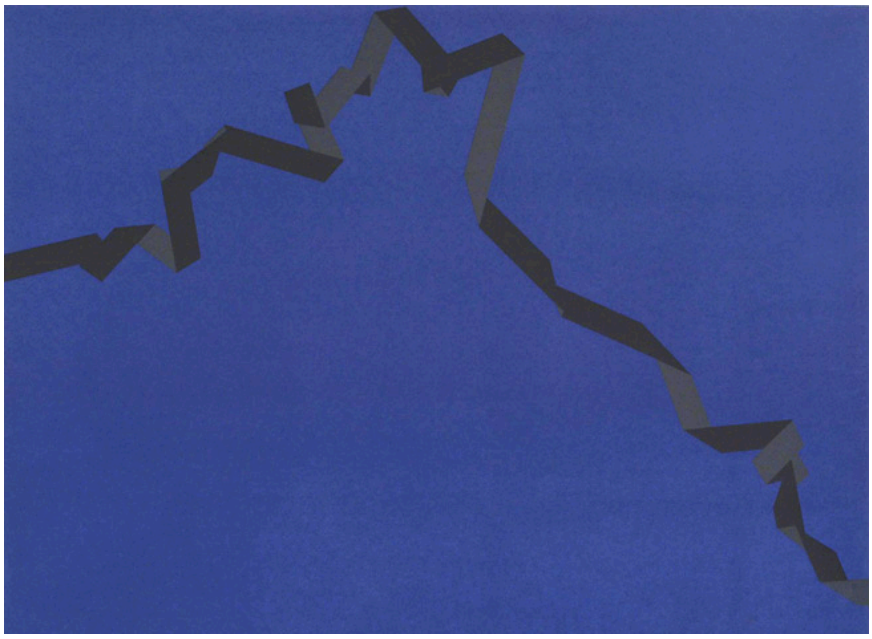


Fig.11: Sainte-Victoire Blues II *nº1 (1998) by Vera Molnar.*[38]

The line language of the piece *Lines for Linda* (*L.L.*) for solo violin (2017)[39] is similar in some extent to the one used in *d'uno*, with the difference that in this work the focus lies in a more active approach to changes in line materiality, and hence in more dynamic situations in general. Besides, a solo piece imposes different challenges to musical action, having to sustain the entire musical discourse with reduced instrumental means.

L.L. consists of the implementation of a set of sequential moving lines that change in colour as they slide through the pitch plane. I took this idea from Vera Molnar's *Sainte-Victoire Blues II nº1* (fig.11), made after the contour of Sainte-Victoire Mountain (she has countless series and individual works based on such a 'motif', similarly to Cèzanne, who was obsessed with this mount and also painted it repeatedly[40]). What caught my attention on this serigraphy is how the two flat surfaces of the line reflected light in a different manner, one side in shadow and the other more illuminated. This thought led me to consider the

[38] From: www.veramolnar.com.
[39] The piece was worked in collaboration with the violinist Linda Jankowska, for whom it is dedicated.
[40] Nonhoff, 2005.

composition in sound of such a line, by using timbral variations on the violin as if reflecting light and shadow differently as the line moves. But in Molnar's work the line goes through a two-dimensional folding only, which I considered to be too restricted, so the idea in *L.L.* was to include more dimensions, adding transitions between different timbral states. The notion of a polychromatic line hence gradually took form: a line whose surface reflects light in extraneous ways as if having iridescent properties.

1.2.1 Materiality of sound in *Lines for Linda*

The sound materiality of the piece was approached by using exclusively natural harmonics and harmonic-derived sounds such as half harmonics. I conceive this sound world as close to the world of light for various reasons: for instance, when sliding the finger on a violin string with harmonic pressure (and bowing), the diverse harmonics that arise have a particular shimmering nature, enhanced by their counter-intuitive distribution along the space of the string: I associate this sensation to the reflection of light. Also, in the analogy between light and sound (which seems reasonable given their similar wave composition), harmonics—as played on string instruments—correspond to filtered frequencies from the total sound complex: the frequencies comprised in a sound played normally (its partials) are equivalent to the compounding frequencies of a beam of light. On the other hand, half harmonics, which are sounds produced by applying a half pressure in the finger touching the string (a pressure between harmonic and normal), produce a sound in which both realities are heard simultaneously: depending on which place of the string it is played, the sound renders both the 'fundamental' tone as in normal playing plus the natural harmonics corresponding to the nodes being touched, or the fundamental sound plus several harmonics which would not appear with normal left hand pressure. In that sense, a half-pressured sound combines several different 'lights'.

One of the main gestures used in *L.L.* consists in the descending passage from a harmonic node that produces a clear and univocal pitch to a multiphonic sonority. This was done in two places of the string exhibiting different

behaviours. First, going from the node that divides the string in two (the second partial) towards the fake node of a major seventh, which does not exist as an audible division of the fundamental. In that node, the multiphonic is produced because the second partial is very strong: it has a wide radius of effectiveness, so that when the finger (the fourth finger, as the node needs to be activated lightly and precisely) descends to the space corresponding to a major seventh, the two frequencies (octave and major seventh of the fundamental) collide producing a multiphonic sonority.

The same descending/distorting gesture was used starting from the third partial of the string (that produces a twelfth of the fundamental) and arriving to an area crowded with nodes corresponding to what would be a tritone if normal pressure were applied. The difference is that in such area of the string the multiphonic sonority arises fully and naturally because of the concentration of harmonic nodes, which can be embraced with the tip of the finger (in this case the second finger as a wider area needs to be lightly touched). Figure 12 shows the two zones of the string from where the descending gesture takes place, starting from partial 2 and from partial 3 (the diagram bellow was created by Ellen Fallowfield).

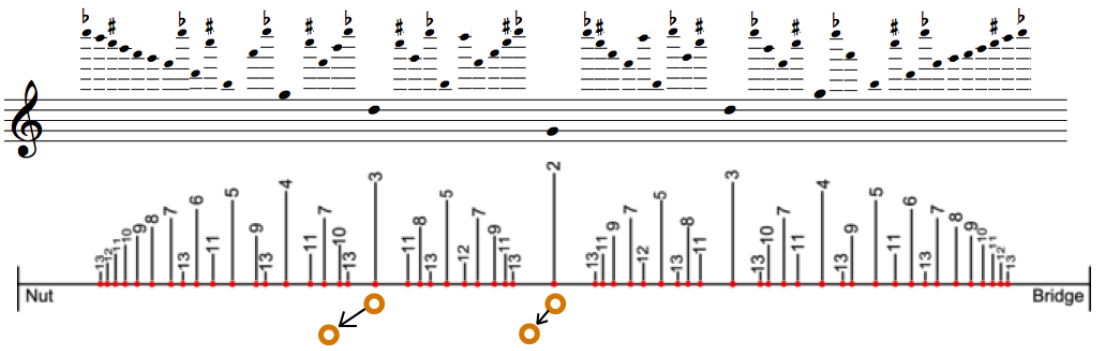


Fig.12: Diagram showing the places of the violin string in which the descending distorting/gesture occurs. Numbers in the diagram show the distribution of natural harmonics in a string (here a G string).[41]

In the score of *L.L.*, the symbol indicating the multiphonic sonority consists of an 'X' inside a square, and the real pitch is provided above in an *ossia* staff for the

[41] Diagram from Ellen Fallowfield (pentagram added) at: www.cellomap.com.

violinist to have a visual idea of the pitches expected to sound at that moment (fig.13).

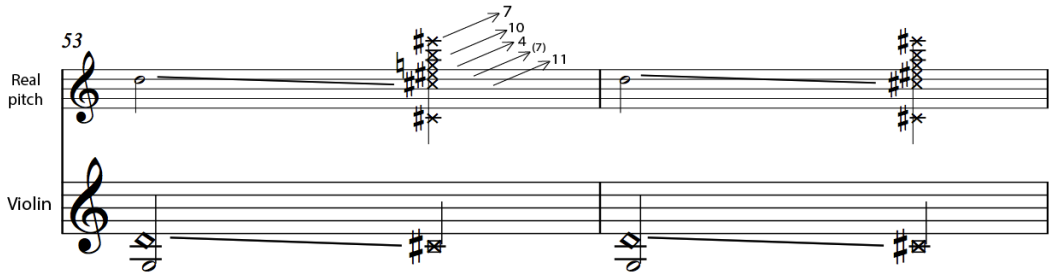


Fig.13: Notation of the descending/distorting gesture in Lines for Linda.

The real pitches notated were transcribed by ear and show that the sound resulting from the multiphonic includes the lightly touched 'node' corresponding to the tritone (low C#), and also partials number 7 (E#→F), 11 (C#) and 10 (B). Partials 10 and 11 are heard an octave lower from where they theoretically should be, and partial 4 sounds as well with no apparent reason: the distortion produces a slightly different result than expected.

Going back to the analogy between light and sound, I conceive the recently described gesture to be similar to the phenomenon produced when a light ray passes through a prism, in which light is divided into its constituent waves due to the bending caused by refraction[42] (fig.14). What in light is dispersion, in sound is heard as a scattering, a granulation produced by the strong collision of frequencies in the air. When touched with the finger, the zone of the string crowded with harmonic nodes works as the prism for light, as an opening door allowing frequencies to suddenly become independent, producing natural noise and distortion in so doing it. Such a door renders the individual frequencies listenable.

[42] Johnston, 2002.

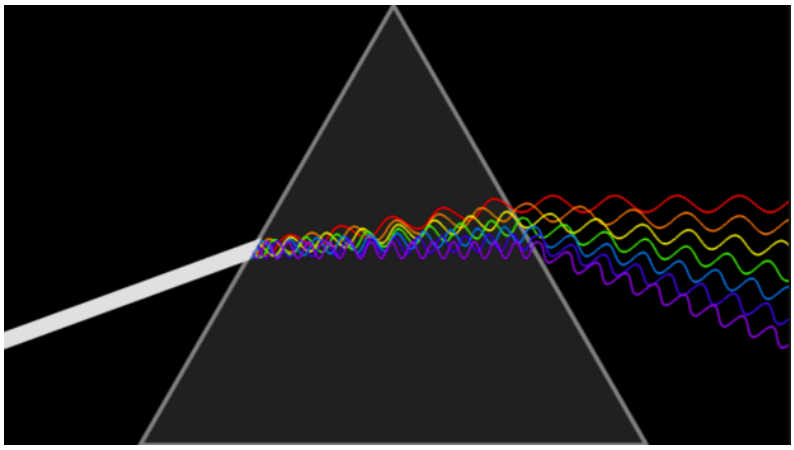


Fig.14: Refraction of light.[43]

1.2.2 Many descending lines

There is an aspect of *L.L.* which relates to the idea commented earlier on this chapter concerning the space that materialities need in order to unfold properly. This issue was approached in general terms by using a small repertoire of line gestures along the work, and in particular by composing a moment in the centre of the piece that operates via the constant repetition of the same gesture, which gradually acquires velocity as it progresses. This zone of the piece was inspired by another work from Vera Molnar that also depicts the contours of mount St.Victoire, named *Six millions sept cent soixante-cinq mille deux cent une Sainte-Victoire* (2012) (trans. "Six million seven hundred and sixty-five thousand two hundred one Sainte-Victoire"). The work, which belongs to the category of *livrimages* (book of images) from the artist, consists of a book of 112 pages, but each page is cut horizontally in four equal parts, and each part has a sliced segment of St. Victoire's contour, different from the next page, which gives a total of 6765201 possible combinations of contours as draw by Molnar (fig.15).

[43] By Lucas V. Barbosa.

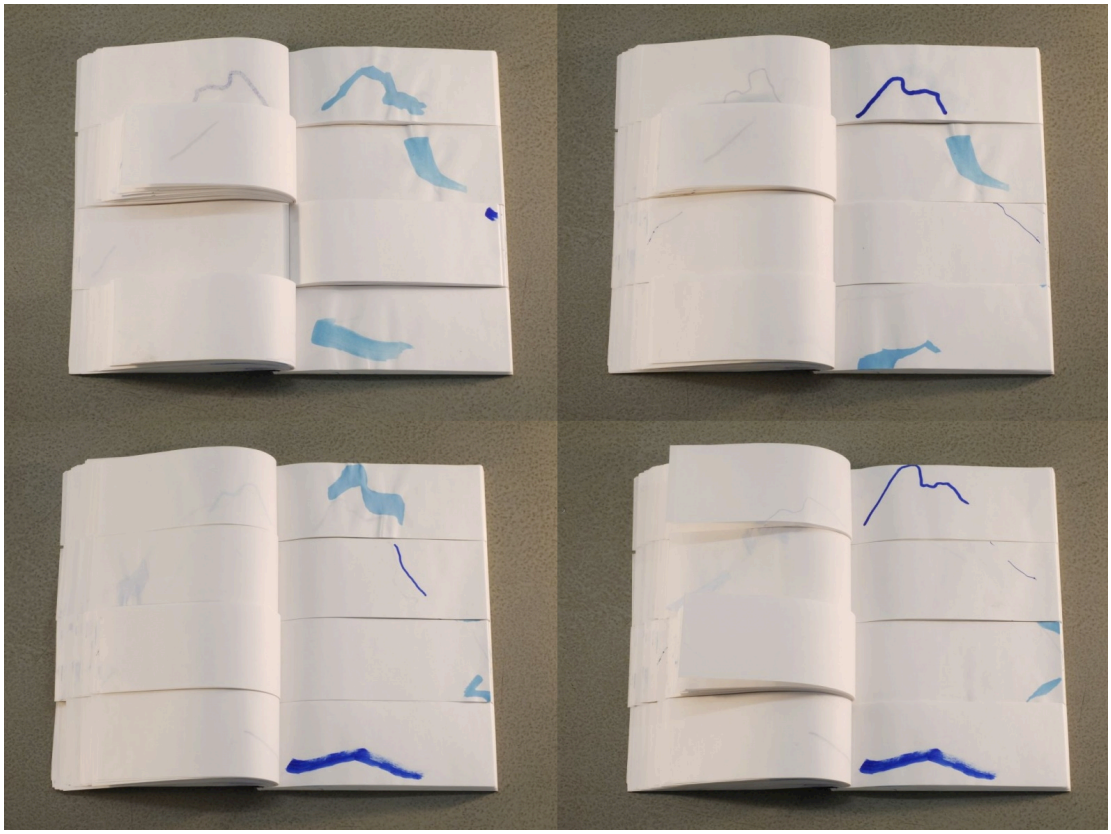


Fig.15: Six millions sept cent soixante-cinq mille deux cent une Sainte-Victoire *(2012).*[44]

This work encouraged the idea of repeating a descending gesture successively, with small changes between each 'fall'. Such changes increase progressively, gradually modifying the gesture as it gains momentum by accumulation and increment in velocity and volume. The falling gesture comprises three distinct elements, consisting of:

a) A sound descending from the second partial of the first string (tuned to D quartertone higher) to the artificial multiphonic described earlier in the space of the string corresponding to a major 7th.

b) A descending left-hand tremolo on the fourth string producing an artificial harmonic (4th partial), starting from a sound similar in frequency to the last note of the previous element.

c) A descending inexact unison played as *bisbigliando*—that is, a bowed tremolo alternating between strings—on the third and fourth strings on

[44] Vera Molnar, 2012.

the nodes corresponding to partials 3 and 4 accordingly (the third string is tuned to C quartertone higher) (fig.16).

Differences between subsequent falls are given by the inclusion/exclusion, distribution and duration of each of these elements.

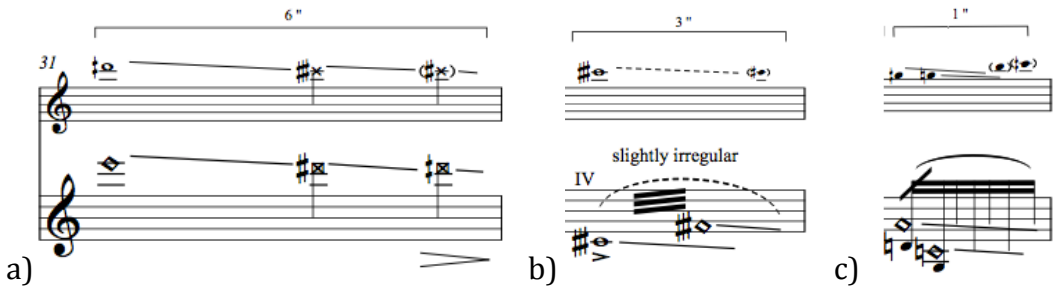


Fig.16: Different elements of descending gesture in L.L.

The descending moment starts with the repetition of the first element, until on the fourth fall the second element appears, not being present on every descending line but alternating its appearance. Then, on the tenth fall the third element occurs, very briefly at first, and gradually acquiring more presence until being the only element left from the repetitive falling gesture.

Summary of Chapter 1

Both works presented in this chapter exhibit a specific line language and gestural world, not only in relation to lines' sense of smooth and gradual contourness but also concerning their materiality in terms of sound and behaviour. In the case of *d'uno*, a materiality of lines was approached as a metaphor to geological processes and materials, in which sound-lines were conceived as reflecting the features of rock formations and strata, such as their undulation as produced by various geological forces; their parallelism through the coupling of lines in the formation of greater lines; their dislocation as mirroring geological faults; and a time-dilated quality enhanced by the use of silence. All of these features meant to recreate in sound and time the idea of desolated and desert-like landscapes.

Then, by considering the piece *Lines for Linda* it was observed that while sharing a similar line language with *d'uno*, the metaphor used for understanding the behaviour of lines was instead that of light reflection. There, a set of lines that change colour as they move was implemented, in which the 'light-quality' of lines was represented in sound by the use of natural harmonics, half-harmonics and naturally produced multiphonics. The latter as we saw are produced in two specific places on the string, arriving always in glissando from a natural harmonic above, and were considered to function as doors opening the pool of frequencies constituting the previously united sound 'ray'. Given its relation to the behaviour of the string and the quality of touch needed from the performer to obtain the requested sound world, this piece exhibits a more concrete materiality in comparison to *d'uno*. Finally, the organizing principle of repetition was explained in relation to the work *Six millions sept cent soixante-cinq mille deux cent une Sainte-Victoire* by Vera Molnar.

The movement from metaphor to concreteness started on this chapter will continue in Chapter 2, as we shall focus on the physicality of the line-object and its activation through different physical forces and actions.

2. Physical lines

In the second half of the twentieth century, line in the visual arts encountered new possibilities by abandoning the two-dimensional plane, as Catherine de Zegher explains:

> With line becoming a physical presence or absence, detached from the plane and independent of representation, drawing emerged (...) as a field coextensive with real space, no longer outlining an illusion marked off from the world. As art moved between two and three dimensions, drawing—and its basic mark, a newly dynamic line—subtly hybridized, becoming inextricably entangled with other mediums and materials (…) Its differences from painting, printing and sculpture blurred (…).[45]

This change of perspective toward line meant a big step for its transformation and evolution, as artists incorporated "notions of space, connectivity, progression, and a highly tactile sensibility for materials".[46]

Sounding lines can also be approached from a perspective involving space and physical action in a search for approximating tangibility, similarly to visual artists. Lines then could be considered as either physical entities themselves, or as being directly involved in physical action. In that sense, physical lines deal not only with three-dimensional form and materiality, but also with the forces related to their activation, as for example tension, friction, and resistance. The physical line models to be addressed in this chapter are going to be first the line as a string, and then the gesture of drawing: both are representative of the distinction that Tim Ingold makes about "two major classes of line", namely *threads* and *traces,*[47] although concerning trace the emphasis will be put on the

[45] Butler & de Zegher. 2011, p.68.
[46] Ibid, p.70.
[47] Ingold, 2007.

act of marking. By examining these two types we will be in a position to better understand the idea of physical lines in relation to sound. Each case will be addressed in relation to a particular piece of music: *Ludium et* (2014 rev. 2016, for solo guitar) when discussing the thread, and *Engraving on bronze* (2016-17 for percussion trio) when presenting the drawing model.

2.1 Thread: the line as a string

A thread is, according to Tim Ingold, "a filament of some kind, which may be entangled with other threads or suspended between points in three-dimensional space".[48] A string is a perfect example of thread: it has three dimensions, certain flexibility that enables it to undergo twists and torsions, to experience tension, resistance, and force, all of them without losing its thread identity. When a certain amount of tension is applied between both ends of a string, new qualities will arise as for example the capacity to vibrate at a certain frequency causing airwaves to move (eventually producing sound), or it can be subjected to external forces that change the string's original tension, producing a continuous increase or decay in its vibration frequency. Also, as commented earlier, vibrating strings can be filtered by lightly touching their vibration nodes, in the isolation of partials from its complex harmonic content.

Various sound artists and composers from the last decades have work exclusively with the sonic and physical properties of strings beyond the context of traditional musical instruments, as for instance Alvin Lucier and Jez Riley French, although we could go as far as to consider Pythagoras the great father of this tradition with its famous monochord. For instance, Lucier's piece *Music on a long thin wire* (1977) makes an excellent example of the potential sonic manifestations of a string by exploring the sound produced by the complex vibration of a long extended and tensed metal wire attached on each side to the tops of tables. Then, both ends of the wire are connected to the outputs of an amplifier forming a current loop, and a large magnet is put so that both poles

[48] Ingold, 2007, p.41.

surround the wire. Finally, a sine wave oscillator is connected to the amplifier causing the wire to vibrate "in ways determined by the frequencies and amplitudes of the driving signals and the length, size, weight, and tension of the wire".[49]

Not very far from Lucier's *M.L.T.W*. are Riley French's series of works entitled *Teleferica* (2012), which consist of the meticulous sound recording of huge metal cables found in some Italian villages originally intended for transporting wood down from the up hills. It is interesting that environmental factors play a role in the sounding quality of these strings, revealing their rich three-dimensional threadness, as Riley French explains saying that the captured sound is

> generated by the tension of the wires, the strength of the breeze, the humidity and heat in the air—and a constant shower of sonic events caused by insects, leaves and birds landing on the wires— small incidents that create monumental waves of sound.[50]

Such small incidents are amplified by the long extension of the string, in a natural magnification.

2.1.1 *Ludium et*: guitar string

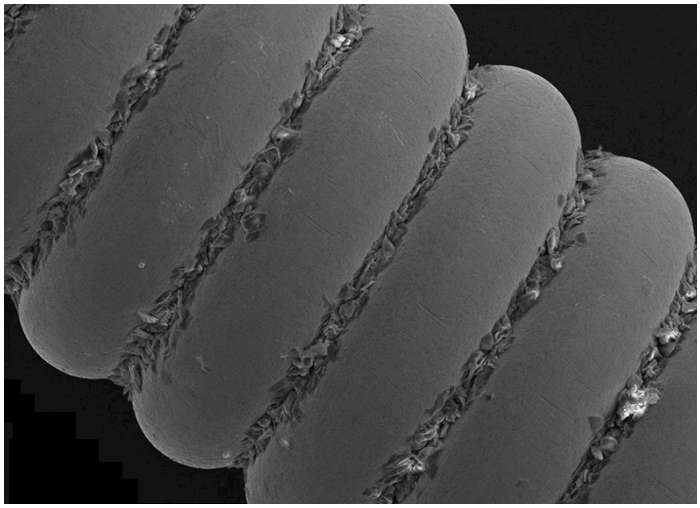


Fig.17: Guitar string under an electron microscope exhibiting dead skin and dirt.[51]

[49] Prose score of *Music on a Long Thin Wire,* in Lucier, 2005, p.360.
[50] Riley French, 2014, p.14.
[51] Photo by Benjamin Berson.

In the piece *Ludium et* for solo guitar I imagined the magnification of certain sounds produced by guitar strings, which belong to a specific musical instrument with its own repertoire of idiosyncrasies, not to mention its participation in a number of different musical traditions. (In fact, some of those idiosyncrasies were assumed and adopted as a starting point as we shall observe.) The guitar sounds that I was interested to magnify were some infrequent natural harmonics, artificial harmonics, the descending or ascending resonance product of moving the tuning pegs, and the beating produced by the collision of close frequencies.

The way to make accessible that repertory of sounds to the ear was first by suggesting the optional amplification of the guitar for the performance in concert, but more importantly the creation of musical contexts where those minute sounds could be heard in their own right. Such conditions imply the constant use of harmonics through the piece, so that the listener tunes the ear almost exclusively into that sound world, and consequently, when the occasional "normal" (pressed) sounds of the guitar appear, they are played *piano* or *pianissimo* in order not to compete with or standout from the overall texture, but rather combine and mix with it. Harmonics on the other hand are always accentuated as means to have a clearer definition and longer resonance (fig.18).

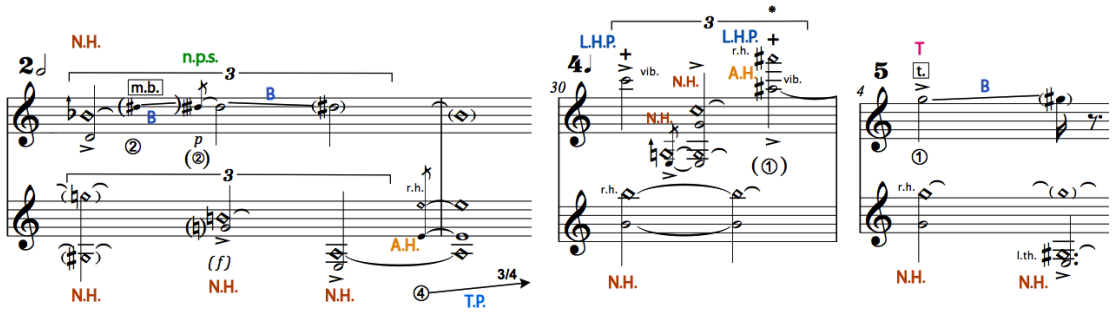


Fig.18: Use of natural and artificial harmonics, as well as other sounds in Ludium et.

As figure 18 shows, I used different types of sound in the piece, namely harmonic sounds, both natural (N.H.) and artificial (A.H.); sounds that change in frequency either by bending the string (B) or by detuning the string (T.P.); tapping sounds

(T); left-hand pizzicato sounds (L.H.P.); and normally played sounds (n.p.s.), on few occasions.

2.1.2 Changing the tension of the string

For my compositional purposes, the tensed string was a perfect model not only as a conceptual thread-line, but also as a tangible object capable of interacting with force. Thereby, I thematicized the changing tension of the string as part of the music in two different ways: first, by moving the tuning pegs while the strings are still vibrating; and second, by bending the strings with the fingers of the left hand.

The string's change of tension by means of rotating the tuning pegs is used thoroughly in the first section of the piece (which consists of three distinct sections). The idea there, was to include the routine-like and choreographic aspects of tuning in a self-referential motto, by adopting and developing such idiosyncratic elements of the guitar into the music. This behaviour was incorporated also for musical reasons, as I am very fond of the sound resulting from such an action: a slow glissando effect on the individual tone being altered, and a set of collisions of frequencies when other resonating sounds are involved, what as a whole creates an interesting microtonal texture in motion.

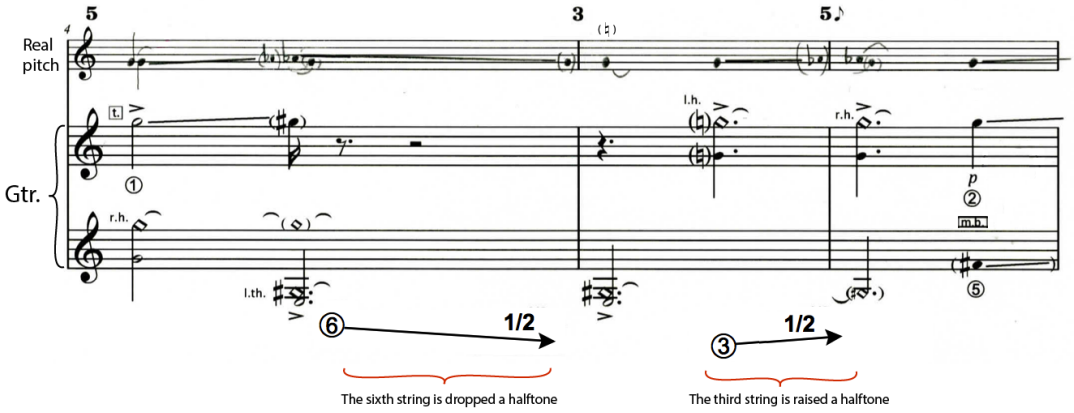


Fig.19: Change of tuning pegs in Ludium et.

This way of altering the frequency of a sound—in a continuous and slow fashion—produces lines directly related to the previously discussed conception

of lines: entities that change slowly and smoothly. In figure 19 this can be appreciated by the *ossia* staff situated above the 'action' staff, in which we observe that the resulting sounds are lines that bend in direct relation to the tension change of the string product of moving the tuning pegs. There is a moment in the middle of the first section where the performer literally tunes the guitar by comparing two or more sounds, listening to their common vibration, in a clear allusion to the tuning action. This is indicated in the score by the number of the string to be tuned (or equalled to be previous sound) followed by a dashed line arrow meant for the execution of that action (fig.20).

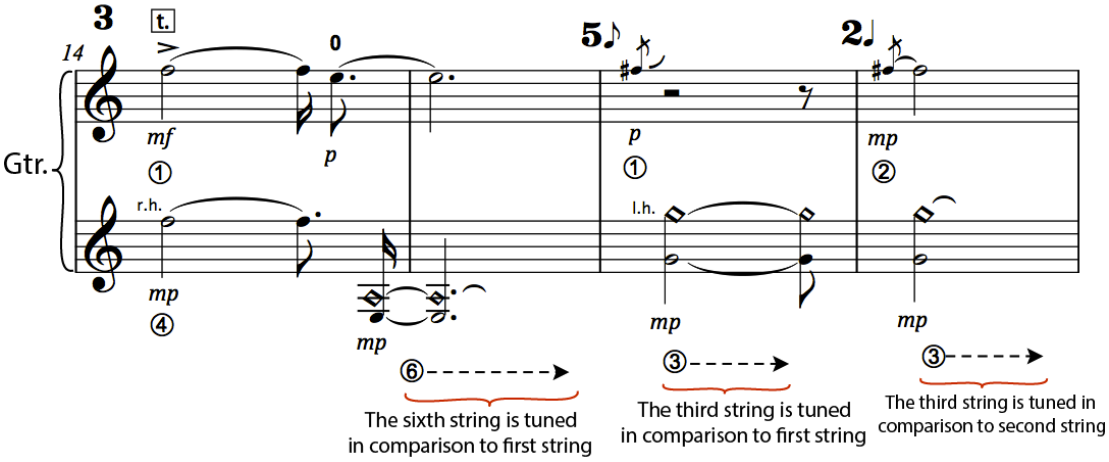


Fig.20: Tuning of the instrument from bars 14 to 17 by the performer in Ludium et.

2.1.3 Bends

Another way of changing the tension of the strings in *Ludium et* is through bends. These are directly related to the tactility of the instrument, as bending consists in applying a force to the string so that it is taken out from its axis, being literally de-centered. This produces a change in the frequency of sound analogous and proportional to the deformation of the string itself: for an instant, the sound-line and the physical-line mirror each other becoming one inseparable reality. The particularly elastic and flexible nature of guitar strings makes them ideal for this type of manipulation as compared to other string instruments such as the bowed family, where strings are usually pressed and surfed but almost never stretched or taken out of their centre, given their sound production mechanism and the

lack of frets. On the guitar tradition in contrast, especially from the electric guitar, bending is a regular device for expression. Such touchability has always represented one of its most special and characteristic richnesses.

Bends are also attractive given that in exerting them one experiences straightforwardly the resistance of the string, as described by Newton's third law of motion: "When one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body".[52] The opposite force exerted against the performer fingers induces the feeling of being somehow fighting the string and its resistance, a fight aiming at curving the line.

Bends are incorporated in the heterogenic texture of the first section of the piece, occurring with some frequency, although less often (roughly half of the times) than changes in the tuning pegs. In the second section instead, there are no changes in tuning, and the focus is put in resonance and its alteration precisely by bending duplicated frequencies of that resonance. Such section works by the repetition of a gesture that grows larger gradually until it reaches a climax for then to vanish. The functioning of this section is similar to the moment of the violin piece commented in Chapter 1, in the sense that a space is granted for a gesture to unfold in a sovereign way.

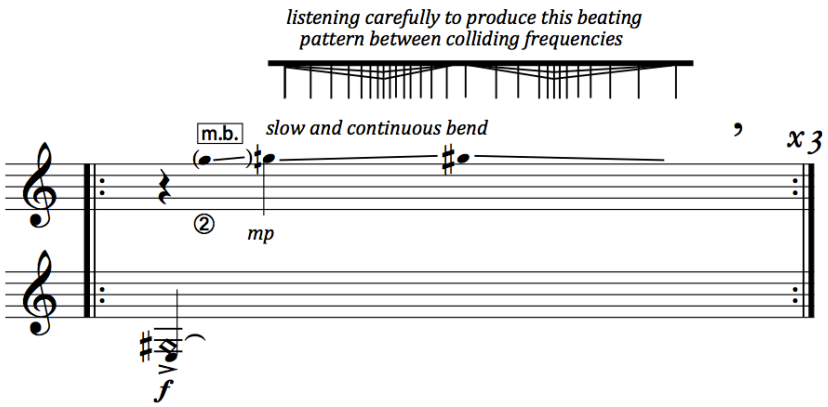


Fig.21: Gesture developed on the second section of Ludium et.

[52] Newton, 1687.

Figure 21 shows the compounded gesture repeated on the second section, consisting first in strongly plucking a natural harmonic (on subsequent repetitions two and three harmonic sounds are added to the resonating base), and then softly picking a frequency close to the resonating one in a different string, bending it. The oblique motion of lines produces a beating pattern characterized by an acceleration and deceleration of the beating as the second pitch approximates the first and resonating one. Then, as the string producing the second sound goes back to its original tension, a similar pattern is produced, although this time it is more difficult to hear, because of the fading of sound.

As observed above, the composition of *Ludium et* was an ideal laboratory to think and touch the string in its threadness, delineating the thread type of physical line. The third section of *Ludium et*, which consists exclusively of natural harmonics forming a line sequentially, will be commented on Chapter 3 in the context of vertical pixelation.

2.2 Drawing the line

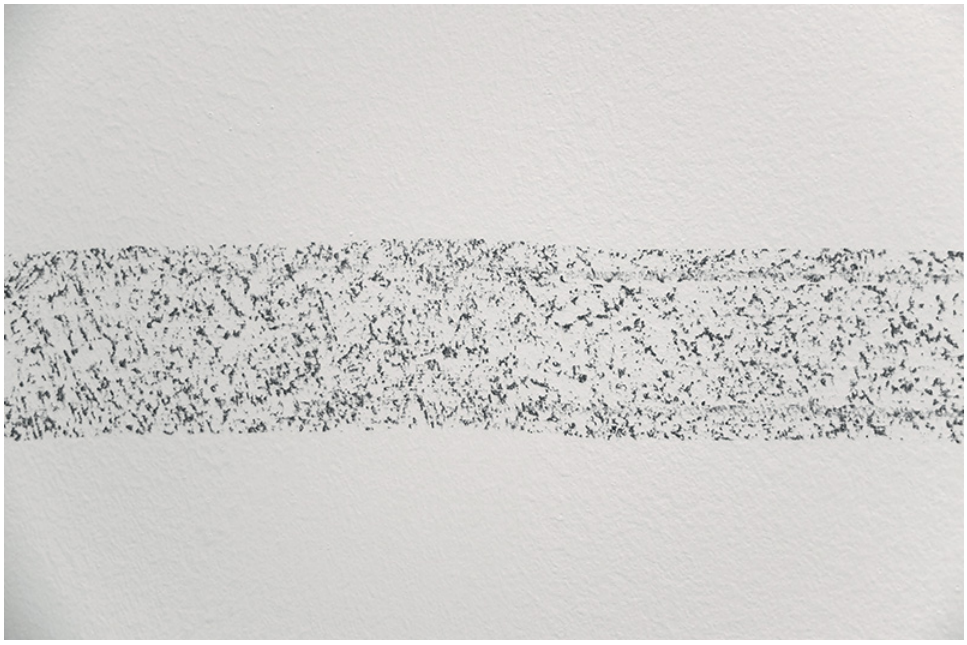


Fig.22: Francisco Ugarte Untitled (line of graphite and wall)*(2013).*[53]

[53] From www.franciscougarte.com/.

The idea of *drawing* contrasts with the *thread* in that instead of pointing to a three-dimensional object it describes the act of marking a surface. While threads normally deal with tension and torsion, marking deals rather with friction, as in writing, drawing, carving, painting: all involve some amount of friction between the marking agent and the surface being traced. Friction is produced by the resistance created between the moving drawing entity and the surface (which remains still). Such a contact between surface and marker constitutes the very essence of the trace left, it defines it (fig.22).

Tim Ingold makes a distinction between two types of traces: additive and reductive. Additive traces occur when "an extra layer [of material] is superimposed upon the substrate", as it would be the case of charcoal or chalk traces (fig.22). Reductive traces are instead "formed by removal of material from the surface itself", as for example in woodcarving or etching.[54] Under this scenario, the trace of sound—produced by rubbing or scratching the surface of a resonating body—is a problematic one, as it does not imply the addition or subtraction of any tangible material, belonging therefore to a different category of line. A provisional solution suggests that it is closer to an additive trace: when speaking about sand painting in Navajo artistic practice, Ingold states that "in this case, the line is clearly an additive trace, a crystallization of the precise movements and gestures involved in producing it".[55] If we assume that the sound resulting from a trace has imprinted on itself the gesture of the arm producing it, we shall accept the additive option. Nonetheless (as we shall observe), the friction line can also be conceived as one that reads and reveals the surface over which it is being drawn.

2.2.1 *Engraving on Bronze*: scraping lines of sound

Traces of sound product of marking or a similar action are commonly found on the extensive range of percussion gestures based on rubbing, as for example a superball mallet rubbed against a bass drum or Tam-Tam, or just the naked hand

[54] Ingold, 2007, p.43.
[55] Ingold, 2007, p.64.

interacting with a surface. Helmut Lachenmann has often taken this tactile approach in pieces such as his famous *Guero* (1969) for piano,[56] characterized by the gliding action of the hand which by its movement produces a percussive result as fingernails encounter the spaces between piano keys (hence transforming the keyboard surface into a guero). In the piece *Engraving on bronze* (*E.B.*) for percussion trio, I approached the idea of literally drawing lines of sound with the tip of the drumstick on the surface of cymbals, leaving an acoustic trace of sound (fig.23). That trace contains the imprint of the drawing action of the hand pressing the drumstick perpendicularly to the cymbal, but the drumstick also reads the tonal grooves as written by the engraver scratching the metal (bronze in this case as cymbals are made from it).

Fig.23: Picture from the concert performance of E.B*. by Line Upon Line Percussion.*[57]

Drawing on a surface in order to produce sound is close to what Xenakis did with the realisation of *Upic,* which consists of an electronic drawing interface where a sensitive surface like a tablet is operated by drawing with a pen-like artefact. The 'tablet' functions as a controller for triggering electronic sound processes mirroring the gestures of the pen.[58] The difference however between *Upic*'s and *E.B.*'s traces lies in that the latter ones are produced by the actual friction between drumstick and cymbal, we could say analogically, while on *Upic* the traced surface serves a controlling function independent of the surface materiality.

[56] For a performance by the composer himself, see: https://www.youtube.com/watch?v=sVHl-pqaIYM.
[57] Premiere of the piece by Line upon Line Percussion on March 2017 at the University of Huddersfield.
[58] Kanach, 2013, (Introduction).

2.2.2 *E.B.* lines

In the piece, I worked with three different types of lines arising out of the scratching action over the cymbal surface. These lines have suggestive names in the score such as *clean line*, *micro-scratch movement* and *saturated line.* The first type, the clean line, is defined as a sustained high pitch with 'almost' no distortions. 'Almost' because it is difficult to get a totally clean sound when scratching the cymbal. This sound is produced with a small amount of pressure while moving the stick slowly, following the circular shape of the cymbal (usually close to the bell but not onto it). It is interesting with this type of line that occasionally the sound leaps to another harmonic, an event that has a sound quality similar to the feedback produced on a loudspeaker. The notation of the clean line consists of an undulated line, imitating the oscillatory motion of the drawing (fig.24).

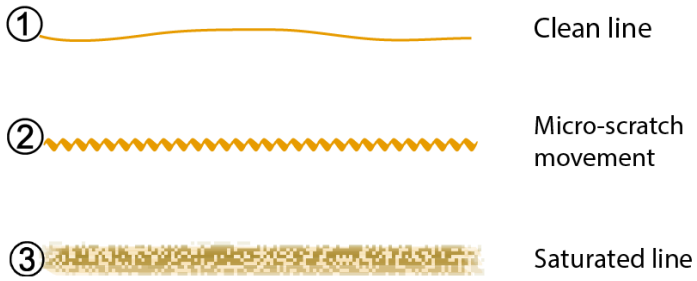


Fig.24: Notation of the three main line-types in E.B.

The second type of line, called 'micro-scratched movement', consists of the production of regular alternating sounds by zigzagging the tip of the stick over a small spot of the cymbal, exciting a specific small area. (Strictly speaking this is not a line in comparison to the line-objects discussed until now, but closer to the type of line to be discussed later in Chapter 3.) By increasing and decreasing the pressure, together with finding the right spot, it is possible to obtain three categories of continuous sounds: a) a sound without harmonics: only a barely audible metallic friction between the wood and the bronze, where tiny accidental scrape sounds occasionally occur; b) an intermittent sound where only one direction of the zigzag movement produces a harmonic sound; and c) a full

harmonic alternation in which both directions of the zigzagging produce harmonic sounds. The indication for which type of micro-scratched sound to be played by the performers consists of roman numerals from I to III, often involving transitions between a, b and c. For the rhythmic velocity of the zigzag a range is given: going from six to ten 'notes' per second. The notation of this line, as figure 24 shows consists of a saw line similar to the symbol used to indicate trills.

The third type is the saturated line, characterized by rendering a distorted sound of collapsing frequencies, produced in a way similar to the *clean* line, but applying more down-pressure with the stick. This is the sound most commonly associated to cymbal harmonic scraping, in which many frequencies sound together competing with each other. This line is notated by a mark exhibiting graininess, symbolizing the major amount of pressure needed for its emission, similar to a graphite trace. In the piece, each player has three cymbals, so in the notation the circled number before a line indicates on which of them the sound is to be made. Other lines of the piece include a tremolo made with a metallic brush (a type of line to be discussed in chapter 3) and lines that change of state as transition lines between the three main types (fig.25).

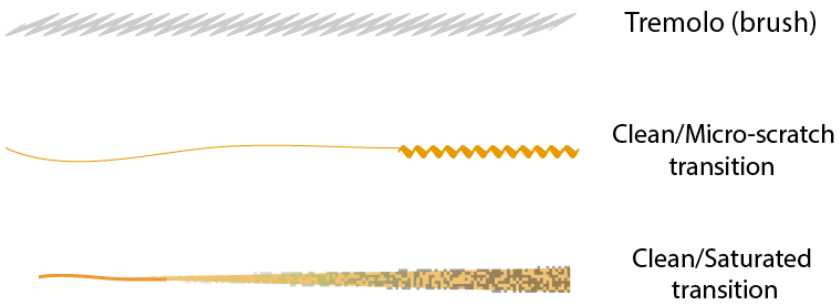


Fig:25: Notation of other lines of E.B.

It is important to mention that these lines are highly unstable because of their production mechanism, which has a good side though consisting in that each performance gives a different version of the work, especially if different cymbals are used.

2.2.3 The vinyl and the cymbal

When composing *E.B.*, the relation between its sound production mechanism and that of the phonograph constantly crossed my mind: both cymbals and vinyls are circular in form and contain numerous 'engraved' concentric circles at their interior, tonal grooves in the case of cymbals and just "grooves" for LP records. Due to their similarities, it is perfectly feasible to conceive a cymbal as an exotic kind of vinyl record. Indeed, various artists such as Ruth Levene, João Ferro Martins and sound performer Otomo Yoshihide have explored this relationship by experimenting with the conceptual, sounding, and visual implications of putting a cymbal on a turntable. In her work *Memory* (2007) Ruth Levene puts a cymbal onto a turntable to be read by a regular turntable device, amplifying the fabric tonal grooves imprinted on the cymbal.[59]

Fig.26: Vinyl player, Cymbal scratching *(2010)*[60] *and* Engraving on Bronze.

In *E.B*. a further step is taken, as the drumstick takes the place of the needle, becoming to the cymbal what the needle is to the vinyl, as shown in figure 26. Likewise, the drumstick reads the micro-geography found on the surface of the cymbal by the friction imposed by the player; we could even say that by this

[59] Ruth Levene's work *Memory:* https://vimeo.com/15437634.
[60] Installation by João Ferro Martins, (2010).

action the performer becomes a human version of a turntable, as it reads the metallic materiality imprinted on the cymbal with the drumstick.

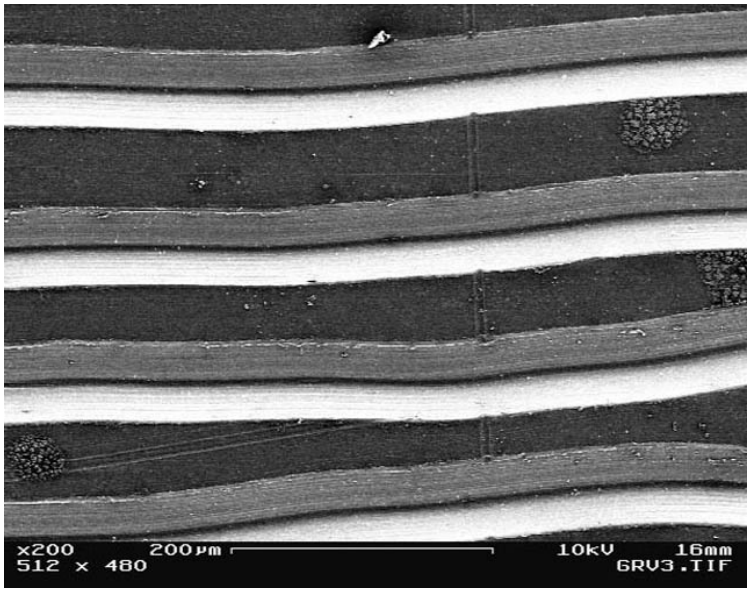


Fig.27: Photograph of vinyl grooves under an electron microscope.[61]

In the score of *E.B.*, the so-called 'clean' lines are conceived as if they were grooves contained in a vinyl disc (fig.27), which the performer reads from the surface of the cymbal. On the score however, the lines are presented in unravelled form, not in a circular fashion (fig.28).

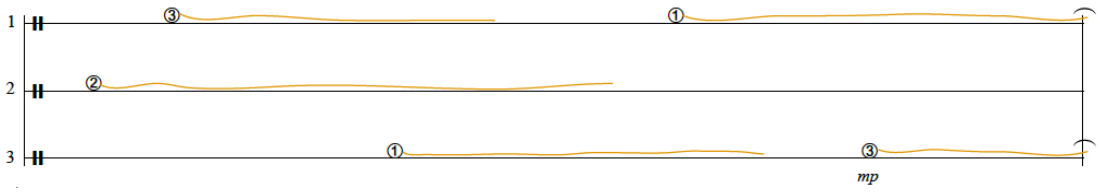


Fig.28: Lines from the score of E.B.

[61] Image by Chris Supranowitz.

Summary of Chapter 2

Throughout this chapter we have seen how lines of sound can be approached from a perspective involving physicality, by considering them either as three-dimensional entities or as the result of physical action. Taking Tim Ingold's basic differentiation between thread and trace types of lines, we considered first line materialization into a thread-like object (a string), giving rise to a variety of approaches and techniques in the solo guitar piece *Ludium et*, all of them related to aspects of the physical line such as tension and resistance. Accordingly, two ways of changing the tension of the vibrating string were explored in the piece: one by rotating the tuning pegs and the other by bending the string with the fingers in a decentring action. These in combination with other techniques allowed the creation of microtonal textures in motion as caused by obliquity and resonance.

Then, in contrast to the thread model we examined the trace model of line implemented in the piece *Engraving on Bronze*, where instead of pointing to a three-dimensional object the focus was put into the physical act of marking a surface, similarly to drawing. Such an action dealt with friction as its main activating mechanism, in which the resistance of material acted as the very enabler and enhancer of sound. In the piece, various types of lines were used involving different amounts of drumstick pressure and movement, each exhibiting different qualities of sound. Finally, the whole sound production mechanism was related and compared to that of the turntable, the cymbal being analogous to the vinyl record and the performer's hand with the pressuring drumstick functioning in a similar way to the needle mechanism.

In this and the previous chapter we have moved progressively from metaphorical materiality towards concrete materiality as displayed in physical lines, especially concerning the case of *Engraving on Bronze*. In the next chapter we will continue considering line in its singularity, but undergoing external operations such as fragmentation.

3. Pixelation

One of the many alterations that a line of sound can undergo is fragmentation into short point-like units while still maintaining its line identity as a continuous flow of sound. Fragmentation can be related to the granulation occurring naturally in acoustic circumstances such as multiphonics and beatings, where it is possible to hear fast pulsations breaking the smoothness of a continuous sound. While in such cases it arises as a natural acoustic phenomenon, in what follows we will approach pixelation as an artificial fragmentation of line, examining the implications of such a model.

The fragmentation of acoustic space, whether in time or pitch domains, has been the subject of a number of theorists and thinkers, most notably Pierre Boulez, who in his Darmstadt lectures (compiled in his "*Penser la musique aujourd'hui*"[62]) develops the opposed notions of smooth and striated in relation to frequency space, and pulsed versus un-pulsed or amorphous spaces in relation to time (notions later commented upon and extended further by Deleuze & Guattari[63]). "The continuum," for Boulez, "manifests itself by the possibility of cutting the space according to certain laws," and "the quality of the cut defines the microstructural quality of either the smooth or striated spaces in relation to perception; at their extremes, striated and smooth spaces merge in the continuous path".[64] Pixelated lines as presented here would come to represent the latter: a communion of the two opposed conceptions—between pulsed/chronometric space and continuous smooth space—as they render the idea of a fragmented smoothness through the use of microscopic or at least very short and "smooth-like" divisions.

[62] Boulez, 1987.
[63] Deleuze, Guattari, & Massumi. 2013.
[64] Boulez, 1987, p.95-96.

The use of the term pixelation is adopted here in that it implies a type of division of space into small parts where the figure or contour being pixelated maintains its essential form, so that it is not completely transformed but experiences graininess rather as a filter over its surface. Although the term is normally associated with a partition involving equal parts in digital media, here it is used mainly in its reference to a surface fragmentation that does not destroy the figure. Pixelation hence does not deeply affect the sinuousness or continuity of lines but rather provides them with a squared-like fragmented quality.

Pixelation of sound can occur both vertically and horizontally, meaning that a line can be fragmented in the temporal realm, or it can be pixelated as it moves across the frequency space. When related to time, fragmentation occurs horizontally hence implying rhythmical divisions of the line continuum, becoming a fast pulse that can involve a degree of mechanicity. Analogous to visual pixels, which are small, such iterations need to be short, otherwise they would not be capable of rendering a larger object. When related to pitch, on the other hand, pixelation implies dividing the frequency space into fixed packages or distances, which in traditional music theory correspond to the divisions of the pitch range conforming the discrete space where scales unfold, sometimes coinciding with that space as in the chromatic scale. In being divided vertically and hence acquiring different 'steps', line returns to the musical scale abandoning the continuous nature that had defined it in the first place. Although this represents a regression, it also opens up interesting possibilities for the line, as we shall observe later.

From the various composers that have approach pixelation, the work of Peter Ablinger stands out. He has notably used temporal and horizontal grids simultaneously for re-producing a sound object. This has been done in several of his works, as for instance in *Deus Cantando* (2009),[65] where he uses a pre-recorded audio file (an "acoustic photograph" or "phonograph"[66]) consisting of the recorded voice of a boy that is computationally analysed, quantized, and then

[65] More information at: http://ablinger.mur.at/txt_qu3god.html.
[66] As explained by the composer: http://ablinger.mur.at/docu11.html.

re-enacted by a robot piano-player in an actual piano. Jennie Gottschalk considers this process to be a *digitization,* consisting of "a reduction in complexity. An image, whether visual or sonic, is mapped onto a grid, and all of the information embedded in it is forced to conform to its divisions".[67] Next, we will examine pixelation as a constructive device in its creative potential by observing how it operates in two of my works.

3.1 Vertical pixelation in *Ludium et*

In the third and final section of the piece *Ludium et* (for solo guitar), vertical pixelation of line takes place by means of an illusion of smoothness produced by a continuous flow of small microtonal distances. The line is chopped into discrete parts, each corresponding to a particular frequency-pixel inside the continuum. This idea is perfectly described in visual terms by Vera Molnar in her *Jornaux intimes*[68] (trans. Intimate journals) through the connection of flat rectangles that work as segments (pixels) of a larger line (fig.29).

Fig.29: Detail from Vera Molnar's Journaux intimes.

Given that pitch distances corresponding to scales (coming from the equal division of the octave in 12) are too familiar and connoted, I created smaller microtonal distances by means of changing slightly the tuning of some strings of the instrument (1st, 2nd, 4th and 6th). As this section uses exclusively natural harmonic sounds from the guitar, by finding a different scordatura it was possible to transform the unisons and minor seconds (found in the standard tuning between natural harmonics) into new distances, often smaller than a semitone (fig.30).

[67] Gottschalk, 2016, p.162.
[68] Véra Molnar: Journaux intimes 1976-2003.

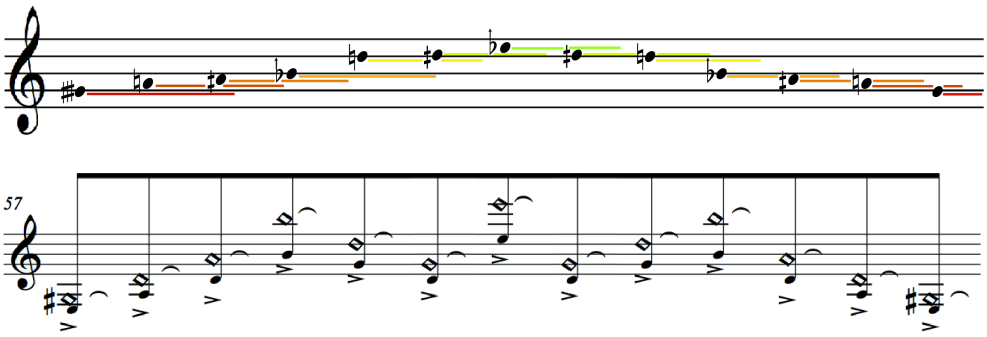


Fig.30: Pixelated line of sound made by guitar natural harmonics.

To enhance the perception of lines, all subsequent sounds are disposed unidirectionally: every line is either ascending or descending, including nonetheless occasional turns of direction (fig.30). As mentioned above, although by fragmenting vertically the line loses its smoothness, it experiences a gain with regard to its trace or resonance. This occurs when each pixel of the line is sustained while subsequent sounds continue to be played, leaving a kind of sound wake. One of the reasons for creating a pixelated line in *Ludium et* was in fact the possibility of letting each sound resonating by the use of natural harmonics, as the same string is rarely played immediately after being plucked, enabling the coexistence and collision of close harmonics. Such an image of resonance can be thought of as creating an acoustic *vitraux* effect (fig.31).

Fig.31: Light reflection of a vitraux.[69]

[69] From https://www.flickr.com/photos/53132575@N04/.

The *vitraux* analogy implies that the attacking sound (corresponding to the glass) and its resonance (as the newly formed lights and shades) create new intricate patterns. In that optic, the *vitraux* would correspond to the attack component of sound, and the reflection of light passing through it to the resonance of each sound, as on one hand each sound keeps its original light (or frequency), but at the same time their resonances merge producing new acoustic realities.

There is yet another type of visual construct that synthesises both moments of the stained glass—its original and its reflection—and which thematizes the diffraction and change of light but inside the pixelated frame itself. I am thinking specifically of the aquarelle technique often used by Paul Klee in works such as *Scheidung Abends* (1922), *Architektur der Ebene* (1923) and *Polyphon gefasstes Weiss* (1930) (fig.32), among many others. Each of these has a mosaic-like texture produced by the gradual change of light and tone in subsequent rectangular structures.

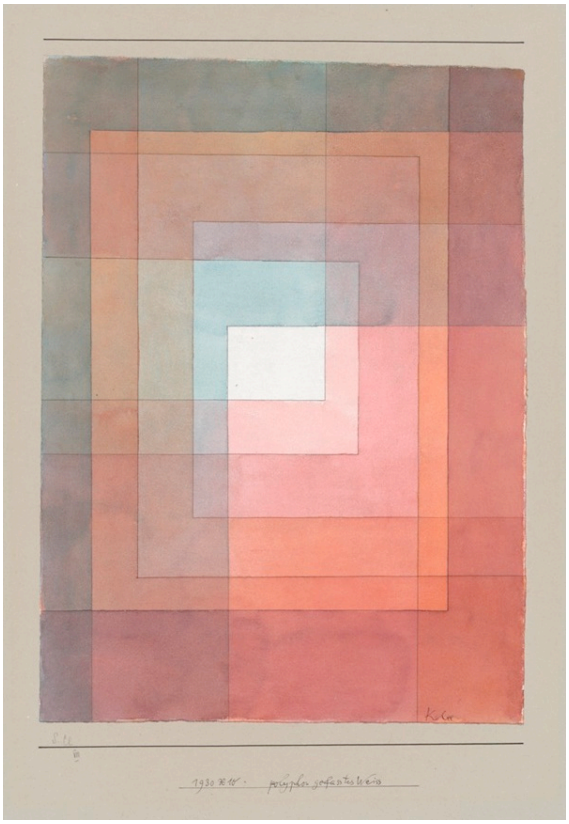


Fig.32: Paul Klee: Polyphon gefasstes Weiss *(1930).*[70]

[70] Image from http://paulklee.fr/.

In *Polyphon gefasstes Weiss* (fig.32, trans. "Polyphonic setting for white"), there is a gradual transition from light to dark, passing through different gradations of colour in an ordered progression in which each rectangular area is perceived as a big pixel, in what has been referred to as "squaring the picture plain".[71] Such a squaring of the transition from light to shade can be conceived as an abstract form of pixilation in which a continuum is presented in subsequent discreet steps, producing a pixelation of the path travelled by light as it goes from white towards darker tones. This in turn produces a stratification of colour.

Polyphon gefasstes Weiss can also be understood as depicting simultaneously the two moments contained in a *vitraux*, in which pixelation (squaring) would correspond to the window, and the gradation of colour to the resonance of light, as colours merge due to their similarity (rendered as gradation). In sound, the two moments described would correspond to the attack (each attack being a pixel) and its merged resonant decay. Inspired by Klee's squaring of light, I consider the last section of *Ludium et* a squaring of sound, in which each subsequent attack alters the overall resonance, producing new 'tonalities' which arise from the interaction of the sustained (resonating) frequencies. This occurs because subsequent 'colours' are fairly close in pitch, so that their partial content collides producing subtle changes as they continue to resonate together (fig.33).

[71] Kudielka & Riley, 2002, p.34.

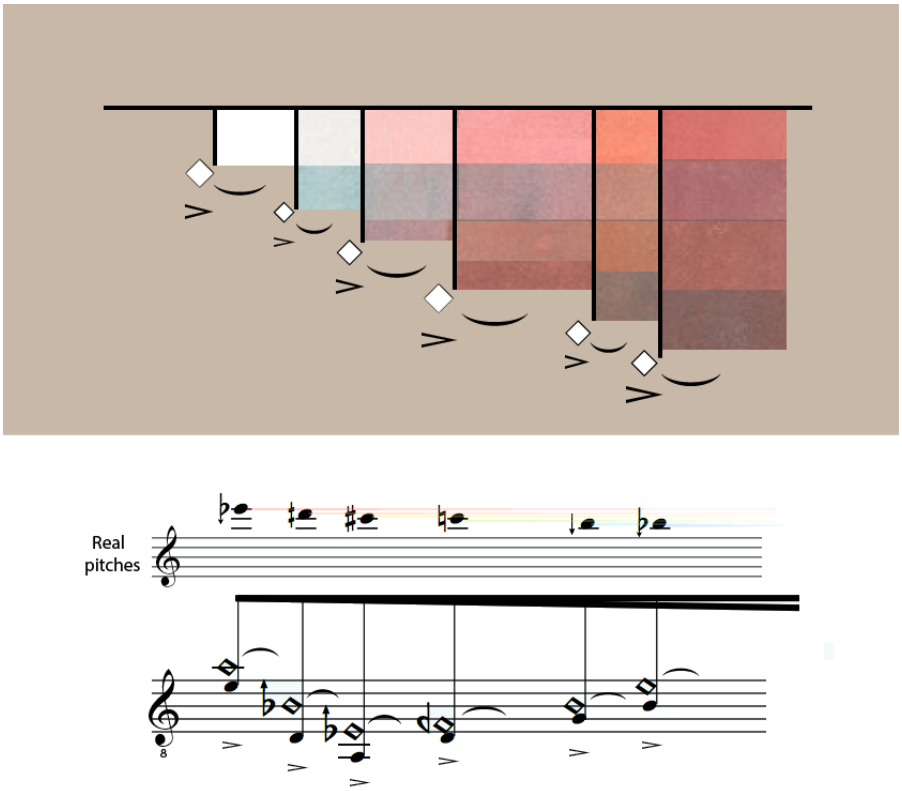


Fig.33: Changing resonance of sound in Ludium et *(after Klee's picture).*

In one of his notebooks, Klee explains the conception of the spreading of light in *Polyphon gefasstes Weiss*:

> *Polyphonic setting for white* illustrates the elementary form shown (fig.34, left). 'Polyphonic' refers to the interpenetration of several tonalities or colour values. The picture is centric in character with transparent illumination. The transparency, the 'pervasive light', increases towards the centre.
> As contrast: light falling from above; illumination and shadow accumulating towards the centre. The eye moves slowly from the centre 1 to the successively weaker values 2, 3, 4, 5, 6 (movement), then leaps back to the strongest energy (countermovement).[72]

[72] Klee, & Spiller, 1961, p.374.

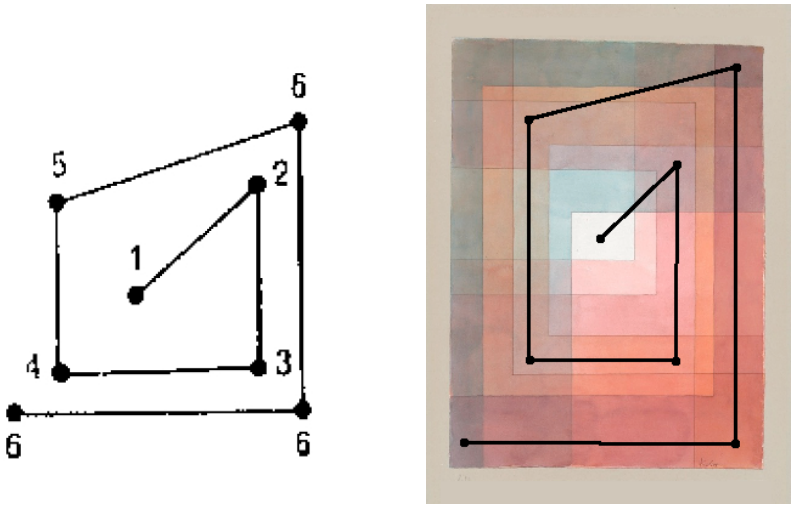


Fig.34: Klee's diagram showing the spreading of light.[73]

Interestingly, Klee suggests that the eye of the observer will naturally move from the lighter white zone towards darker ones, and then back by a "countermovement". The form and movement of his diagram suggest an outward spiral, squared by the rectangular macro-pixels fragmenting the gradation of light. Indeed, Klee refers later to the circles at the core of the image when explaining, "In view of the centric character of this product [additive action], I find that in drawing the *recept* [the way in which a form is perceive by the eye] I shall have to schematise the gradation of values as nine concentric circles".[74]

In an effort to translate this idea into the music of *Ludium et* at a larger scale across the entire third section, I interpreted the outward spiral movement in an horizontal way—that is, by imaginarily turning the spiral on its side and representing the observer's circular eye-movement and countermovement in time by mapping it into an *X-Y Plane,* similar to that of the musical score. Just as in *Polyphon gefasstes Weiss,* light is spread by opening gradually from the centre outwards in a 'squared-circular' motion; the sequential motion of every pixelated line of *Ludium et* spreads out starting from a central range of the register in a 'circular' way. By this movement, before changing to a new direction it needs to come from the opposite one (fig.35).

[73] Klee, & Spiller, 1961, p.374.
[74] Ibid, p.375.

Fig.35: Every pixelated line from the last section of Ludium et*, comprising a duration of 4 minutes.*

3.2 Into Open Noir

In the voice part of the piece *Into Open Noir* (2015-16, sop-fl-e.gtr) I approached pixelation in two different ways: first on a symbolic level, by means of the text created (both formally and semantically); and second at the sonic level, with horizontal pixelation approached by exploring different sizes of pixels, occasionally crossing the boundary into a wider time domain belonging to repetition.

3.2.1 Symbolic/semantic approach

The text setting of *Into Open Noir* (*I.O.N.*) consists of a pixelation of the word "repetition" into its constituent letters for their subsequent use as an acronym. Each letter of *REPETITION* becomes then the beginning of a new word, consisting of anagrams of the mother word (words formed using letters from the word "repetition"). The text is ordered in three short haiku-like sentences, corresponding to the letters grouped as REP-ETI-TION, including a variation for the last group (fig.36).

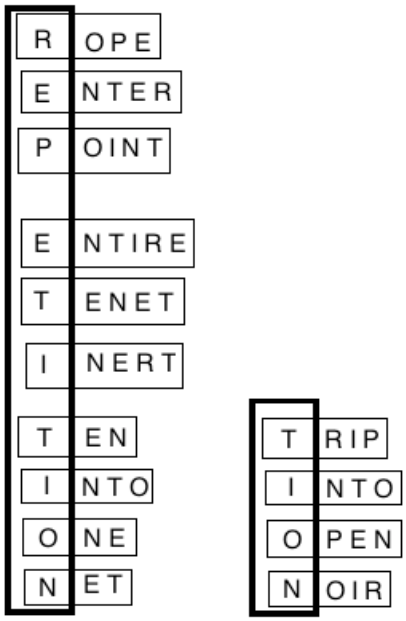


Fig.36: Anagrams made out of an acronym of the word REPETITION.

This atomization points to pixelation, as the compounded nature of the word—defined formally as a string of symbols conveying meaning[75]—becomes evident. The short text is often self-referential. For instance, the first phrase states: "Rope Enter Point", making reference to the division of the string (the word, the line) into shorter parts (the letter, the pixel), hence entering into a point-like dimension. This coincides with a change in the music, with lines starting to pixelate and fragment when the text appears. Another self-referential phrase of the text is "Ten Into One Net", which alludes to the ten letters of the word "repetition" and the way they generated a net of number relations from which I organized the musical events of the piece in time. The last 'verse' of the text is "Trip Into Open Noir", which I constructed as a reflection of the idea of submerging into the unconscious, as if literally going on a trip into the deep, dark areas of the brain, where repressed and unconscious drives lie, producing the often nonsensical surfaces of dreams through their interaction. These texts are used in the middle section of the piece either spoken or sung, though not always in an understandable way, usually because their emission is done purposely in a very slow manner.

[75] Dougherty, 2013.

3.2.2 Horizontal pixelation in *I.O.N.*

Pixelation was approached horizontally in the soprano part by means of working directly with different micro-rhythms and repetitions, via a guitar delay effects pedal,[76] through which the amplified voice passes, allowing a rapid repetition of small fragments of the sound-input in real time (fig.37).

Fig.37: Digital delay pedal used in the voice part of Into Open Noir.

With the delay pedal it is possible to control the rate (velocity of repetition), feedback (duration of the repetition) and volume (amplitude) of iterations, allowing a diverse range of repetitions and fragmentations of sound. In order to make the delay pedal work, the soprano has to set by hand each new repetition rate as they vary through the piece, by manipulating a set of knobs. This allows the voice, and hence the entire sound mixture of the trio, to acquire a pixelated quality, an internal subtle vibration given by the constant short repetitions, which on occasions are very fast, producing a quasi robotic tone.

The idea of having a mechanically cracked voice, and at times a kind of robotic fragmentation came from various sound experiments that I did when imagining the music at an early stage, which consisted of slowing down different audio files of speech and *sprechgesang* in order to listen to how they behave in slow motion. In those experiments, the slowed-down voice cracked, due to the technology used to process the audio, and the sonic results were very appealing as they

[76] Technical information about the pedal can be found in https://www.boss.info/us/products/dd-3/.

already contained a clear pixelation of sound. In an attempt to reproduce that sound world, I opted for the use of the delay pedal. Such experiments may be compared to the "phonographs" used by Ablinger in his *digitizations*, although I looked for a direct mimesis of the sound quality of the slowed-down audio files.

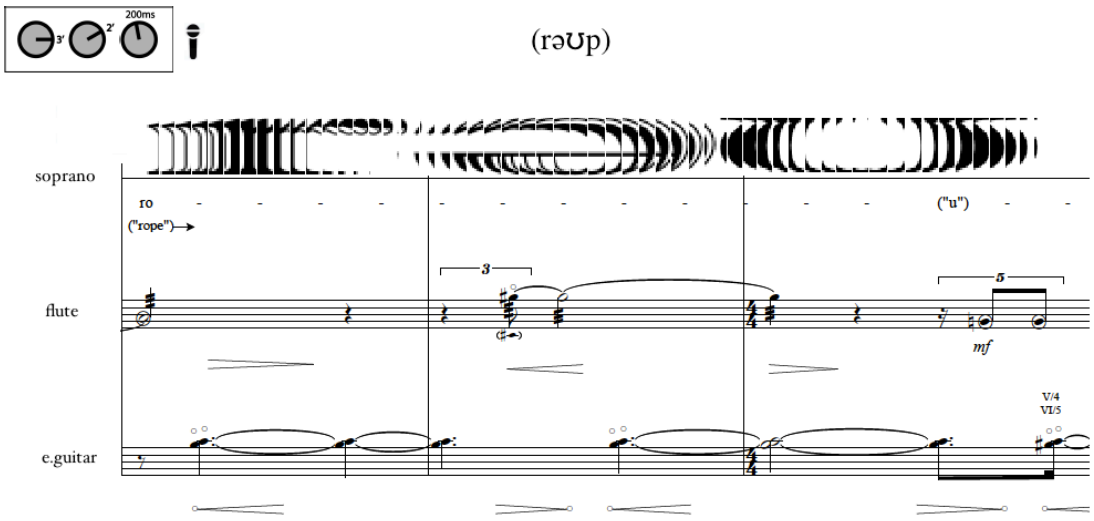


*Fig.38: The word "rope" executed in slow-motion speech and being pixelated by the delay effect. The figure gives an idea of how the word fragments by the action of the pedal. The settings of the delay effect are on the upper-left. "***Rəʊp"** *indicates of the phonetic notation for "rope".*

As shown in figure 38, the short repetitions made with the delay effect prolong mechanically, by means of short repetitions, the line being sung or spoken by the voice, producing a temporal pixelation. I find interesting that despite being mechanically fragmented and repeated, these lines do not lose their continuity nor their contour.

3.2.3 Pixel plasticity: Variations in size and shape

In considering the existence of artistic pixels—that is, pixels involving a creative purpose and developing a plasticity of their own—the work of painter Chuck Close comes immediately to mind. Close's work is characterized by a deep involvement with pixels: since 1967 his working method has consisted of dividing an existing photograph (of a face) into a grid of squares, to then proceed to laboriously paint each square separately, one by one, until re-producing the

entire picture, in a process involving various layers of colour for each pixel.[77] Although he started with a photorealist approach, the size and shape of his portraits have undergone great change across his career. Steven McCarthy writes,

> His portraiture from the 1980s to the present still uses a type of photographic realism, but with a painterly construction, and an allusion to digital filtering algorithms. Faces are now divided into small squares, comparable to the pixel on a computer screen raster grid.[78]

One of the remarkable aspects of Close's work is how his pixels have grown in size and complexity of shape along time, becoming more abstract but never losing their representational function in the larger context, as it can be observed in figure 39.

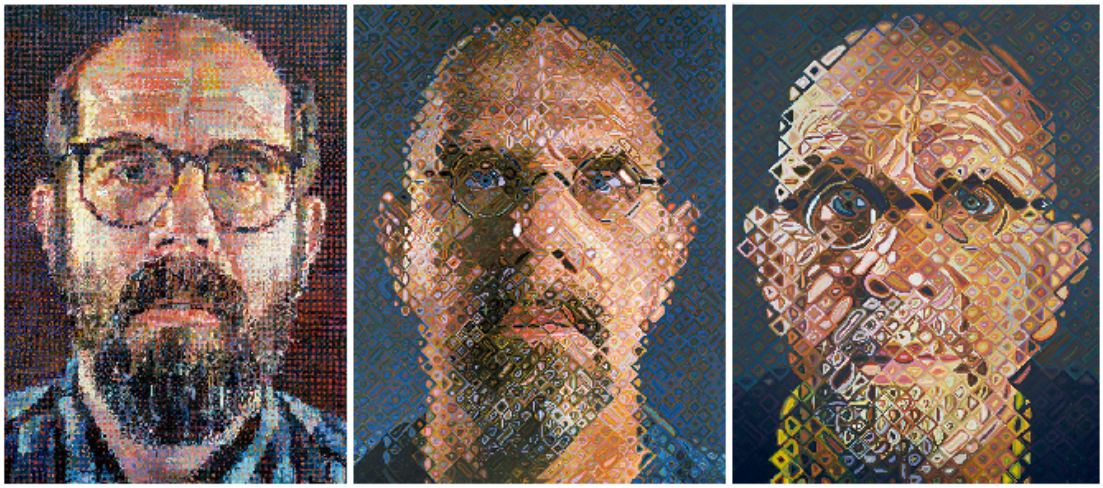


Fig.39: Chuck Close self-portraits from 1987, 2000-01 and 2010 respectively.[79]

In *I.O.N.*, I similarly explored different sizes, shapes and situations in which pixels unfold. Concerning their size, which here translates as duration, the rate of the repetitions produced by the delay pedal in the voice part goes from very short time-slices between 30 and 50 milliseconds to longer ones between 200 and 550 milliseconds. All of the velocities are nonetheless short enough as to be

[77] Friedman, 2005.
[78] McCarthy, 2005, p.65.
[79] From: www.chuckclose.com.

considered point-units or pixels of time as repetition goes on.

Considering the "type" or internal constitution of each pixel in *I.O.N.*, this depends on a series of factors given on one hand by the parameters that can be controlled on the delay effect itself, and by the voice on the other. The parameters of the delay contributing to the type of pixel are the energy or amplitude of the repetition, which is always at its maximum; the amount of feedback, which varies little, going between 90% and 95% of the total possible; and the most decisive for pixels, which is the rate or velocity of repetitions. On the side of the voice emission, the factors influencing the quality of pixels are first the relation between the amount of voice and air, as the voice is used in different ways, ranging from whisper to normal singing, with regular and slow motion speech in between; then the particular position of the mouth corresponding to each vowel and consonant defining a specific timbre; the contour of the voiced line and the energy or amplitude of the emission. The particular combination of each of these many aspects will determine how the individual pixel will be, and its gradual transformation according to how the voice changes in time.

In Close's works from 1980 onwards, there is an explosion of pixel diversification, a sort of liberation of the pixel itself. The factors conditioning such a variety include their internal shape, the number of layers of colour, their particular colour combination, colour contrast, and the number of squared cells used for each pixel, as some include occasionally two, three or even four cells, to the point that "the cell is now expressive, with aggressively combined colours on undulating oval shapes"[80] (fig.40).

[80] McCarthy, 2005, p.65.

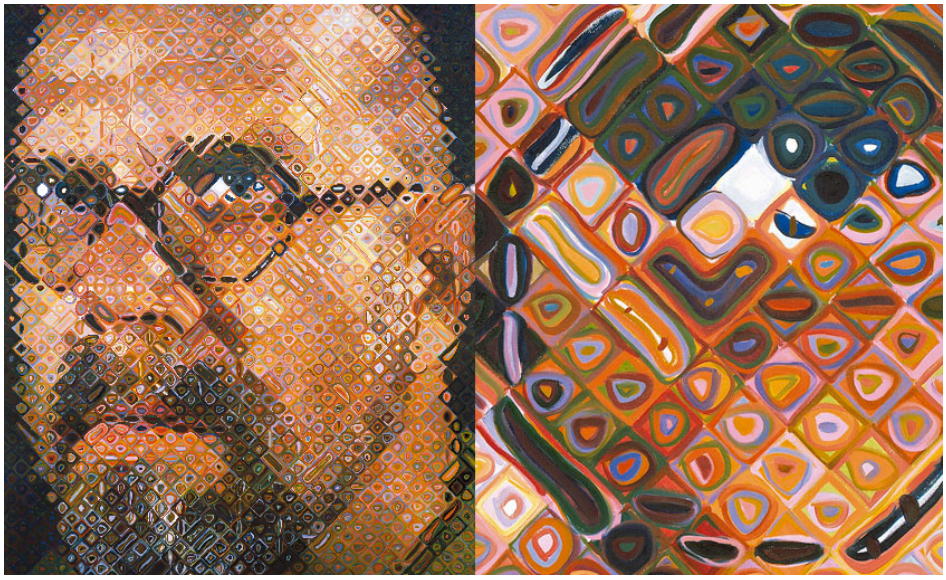


Fig.40: Self-Portrait from1997.[81]

An aspect that plays a fundamental role in Close's work, which is also at the base of the idea of pixelation, relates to the distinct aesthetic experiences that can be experimented depending on the distance from which the picture—and hence the pixel—is observed. In this sense, pixels

> serve the comprehensive image, while maintaining an abstract independence and coherence (…) When viewed from a distance, a specific face is revealed. When seen close-up, the squares present themselves as genetic materials: discrete, seemingly infinite in variety, and potentially endless in propagation.[82]

By being simultaneously independent and part of a wider whole, pixels perform a double function: on one hand, they are faithful to the mother-image, although each time more abstractly, and on the other, they grow a life of their own. What I find interesting is how this process reveals itself in direct relation to the distance from which the object is contemplated.

In *I.O.N.*, the analogous differentiation between looking from a close or a far distance was approached by the production of long vs. short time-pixels, as if changing the listener's time-relation to the object. In the last section of the piece I

[81] From: www.chuckclose.com.
[82] McCarthy, 2005, p.65.

attempted to create such a situation by using different sizes of pixels, presented in short temporal lapses in order to render the mentioned change of perspective for the listener, as if she or he would be almost simultaneously in three different places, experiencing sudden changes wherein the grain gets subsequently bigger or smaller. There, the voice has a long solo moment of continuous lines, which are constantly pixelated by the use of three widely dissimilar repetition rates that alternate, creating different surfaces by the interaction of their varying degrees (fig.41). Such changes in the pedal knobs are done manually by the soprano.

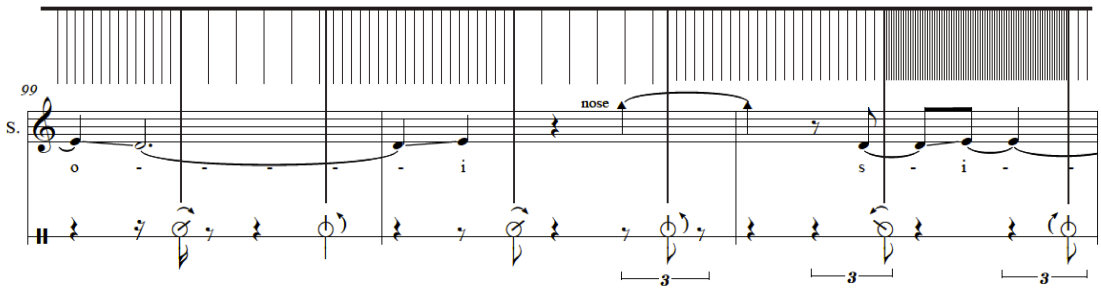


Fig.41: Graphical representation of the varying repetition-rates in the last section of I.O.N., *where the soprano changes the knobs manually while she sings. The three velocities correspond approximately to 35, 140 and 560 milliseconds each from short to long, keeping a relation of four times faster or slower from the middle rate.*

The changes in the repetition rates produce the appearance of texturation in the surface of the continuous line, as if "disintegrating the subject while, at the same time, redefining it as something constructed from tiny, abstract modules".[83] The idea points to Close's work: the repetitions disintegrate the line and re-produce it by the iteration of small chunks of information. This allows an emergence out of the different rates, the sung lines and the breathing, in an interaction with the line present and past-forms, as the past is being brought back over and over by the delay effect. Indeed, a remarkable aspect of this particular delay pedal is that, when switched from one rate to another, it 'freezes' the previous action, saving it in its memory, and keeps running it silently so that when the repetition-rate is set again to that velocity it brings back exactly what was sounding before without losing energy (feedback) from the previous situation.

[83] By Robert Rosenblum in Close, C., 2005, p.9.

This phenomenon plays an important role in the music, since when the slower repetition-rate returns, brings back an entire harmonic world recorded previously. This is as if time were cut, enabling different dimensions of it to be observed, producing pixelation at a bigger scale. In that sense, the three velocities of the delay can be considered from what they actually are in terms of hardware: three different types of memory, analogous to our short, middle and long term memories. By experimenting with them I intend a sonic representation of the perpetual unconscious activity in our minds, as different memories interact, creating new mental content by a random interaction. This character was sought in the music in order to render the idea of the text "Trip Into Open Noir" —a momentary journey into the unconscious.

Summary of Chapter 3

We have examined in this chapter the idea of line pixelation first from a perspective involving vertical fragmentation and later by adopting a horizontal point of view. Using the last section of the piece *Ludium et* as an example of line's vertical pixelation, we examined the illusion of smoothness produced by a flow of small microtonal distances, done by finding a scordatura that made a microtonal scale possible. Then, a metaphor involving the attack and resonant components of sound was presented, as if corresponding to the painted glass and the mingled reflection of light in a *vitraux,* suggesting a similarity with the acoustic situation produced by multiple guitar harmonic sounds resonating together. Going further into that metaphor, we saw that Paul Klee's squaring aquarelle technique could be considered as containing simultaneously both moments of the *vitraux,* but including pixelation of light rendered as a squared gradation of colour (particularly in his work *Polyphon gefasstes Weiss*). Klee's thoughts about the spiral formed by the hypothetic movement and countermovement of the observer's eye were translated into the music and rendered as a long opening spiral seen from its side, formed by the subsequent ascensions and descents of the entire third section of the piece.

Then we briefly analysed the text setting of the piece *Into Open Noir*, created through the pixelation/atomization of the word *REPETITION*. And next we approached the idea of horizontal pixelation as used sonically in the voice part by means of the production of very short repetitions via the utilization of a delay effects pedal. There, artistic pixels were commented in relation to the work of painter Chuck Close, who has thoroughly explored pixelation throughout his career. It was shown how pixel plasticity and differentiation was produced in sound by the interaction among its conforming parameters. Later, taking the issue of how Close's pixels are experienced differently depending on the distance from which they are regarded, we saw an attempt at mirroring such phenomenon in sound through the construction of a solo voice moment in the last section of the piece. The analogous differentiation of pixel sizes was rendered in sound by having distinct speeds of repetition (produced by the delay effect) superimposed on the continuous lines sung by the soprano, generating emerging surfaces.

In the next chapter we will enquire about lines through different combinatorial optics, continuing the examination about line-objects but now in relation to some conceptual and sound considerations stemming from their combination.

4. Line Combinations

In previous chapters I presented a conception of the line as single phenomenon. In this chapter, I will examine how lines combine to create new musical situations, for instance through various forms of blurring and the formation of sound environments of a fluid quality. Through illustrations from my own pieces, as well as from the work of other composers and artists, it will be possible to track the combination of single lines into the construction of objects of a higher magnitude, characterized for being usually of a rather blurry nature. At the end of the chapter we will observe how the aggregation of mechanically produced repetitions in the work *Computer p* for robot piano-player provides a good example of the combination of pixelated lines.

4.1 Blurring

When two or more simultaneous lines of sound differ slightly, it is common to perceive a blurring quality acoustically speaking, comparable to the blurred images produced by artists and photographers working in the visual realm. In those domains, blurriness stands for being out of focus, pointing to the lack of definition of the content inside the picture. Such imprecisions tend to be more evident in the contours defining the limits of entities inside the image, affecting in that sense mainly delineation.

While the technology of photography facilitates blurring, in painting the same phenomenon requires an elaborated technique, as in the one developed by German painter Gerhard Richter (see figure 42). Concerning the function of blurring in his work, he stresses that "I blur things to make everything equally important and equally unimportant (...). I blur things to make all the parts a

closer fit. Perhaps I also blur out the excess of unimportant information".[84] By omitting information about particular details it is possible to regain an awareness of the whole, giving space to a more auratic perception of the picture.

Since blurring involves a loss of focus or precision of the image, it requires a 'gestaltic' response of the viewer/listener in terms of perception, as Richter indirectly suggests:

> I've never found anything to be lacking in a blurry canvas. Quite the contrary: you can see many more things in it than in a sharply focused image. A landscape painted with exactness forces you to see a determined number of clearly differentiated trees, while in a blurry canvas you can perceive as many trees as you want. The painting is more open.[85]

This implies that the observer completes the image by mentally filling in the intentional gaps in the content, projecting his/her own imaginary content into the blurred image.

Fig.42: Confrontation 1 *(1988) by Gerhard Richter, Oil on canvas.*[86]

[84] Richter, Elger, & Obrist, 2009, p.33.
[85] Ibid, p.81.
[86] From: www.gerhard-richter.com/.

In photography, *motion blur* refers to the blurring of the image as a product of the movement of the subject being captured or by the camera itself. It can also refer to "a digital effect added to images to give the impression that they are moving at speed".[87] In an interview, Richter is asked: "*In your pictures, does the blurring stand for the transitory nature of the content, or does it emphasize the content itself? "*.[88] I think this question is revealing for the discussion about the function of blurring in the musical arena, especially concerning the nature of a musical object in relation to movement: is the acoustic object moving and hence being captured in movement? Or is movement an essential property of the sounding object? The function of blurring could also be in accordance with Richter's answer: *"*This superficial blurring has something to do with (…) my own relationship to reality; and this has a great deal to do with imprecision, uncertainty, transience, incompleteness… *"*.[89] That is, to push a more realistic (and hence imprecise) reception by part of the contemplating subject.

4.1.1 Blurring in music

I have identified two primary situations in which blurring occurs in music. One corresponds to textures in which a contoured gesture (melodic figure) is slightly displaced in time or pitch when sung or played (intentionally or not), as in heterophony. The other common form of blurring relates to the expansion of the frequency radius of a given pitch (either upwards, downwards or both), as the thickening of a pitch centre. These types of blurring are related to each other: we could say that the latter is a focal or static version of the former.

Heterophony describes the "simultaneous variation of a single melody", in "reference to minute discrepancies in singing or playing in unison or octaves", which are "likely to occur frequently in group singing within orally transmitted traditions".[90] It refers to the idea of having different sound sources doing similar

[87] Chandler & Munday, in A Dictionary of Media and Communication (Oxford).
[88] Richter, Elger, & Obrist, 2009, p.60.
[89] Ibid.
[90] Sadie & Tyrrell, 2001.

but slightly different contours (melodies) displaced in time by very short distances.

Heterophony is a good model for the blurring of lines in sound because the small differences comprising it produce a distortion of the sound-object contours, which are in turn perceived not neatly but blurred, enabling the emergence of a three-dimensional-like quality. This is similar to what happens with stereoscopic visual images, also known as anaglyphs, where an image is duplicated and displaced in order to produce a three-dimensional effect on the viewer. In anaglyphs that involve cartoon images visual heterophony is more evident because of the stronger line content involved, as shown in figure 43.

Fig.43: 3-D Anaglyph by Mark Smart.[91]

In stereoscopy the 3-D effect works because the two images have slightly different perspectives, and by using the red/blue glasses "each lens will block a different layer in the eye they are covering, and each eye will see a different image".[92] Analogously, with heterophonic lines it can be assumed that perception is tricked by the closeness of different line contours, which produce a perceptual dissonance. It can be further speculated that in its effort to combine the differing

[91] By Mark Smart.
[92] On *The tech blog*: http://www.techeblog.com/.

acoustic information, the mental ear produces volume, an acoustic relief similar to the one experimented visually with 3-D glasses.

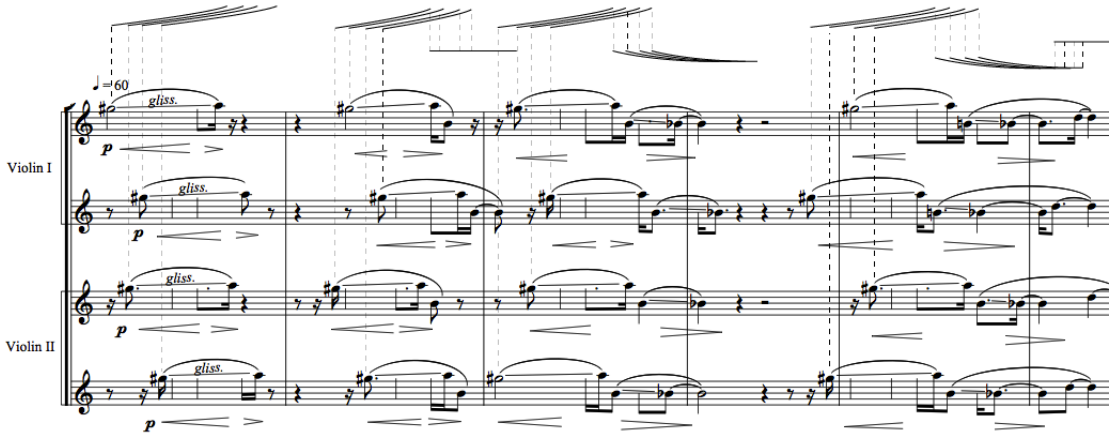


Fig.44: Beginning of Desfases *for Orchestra (2010).*

I used a heterophonic effect in the beginning of a piece for Orchestra from 2010[93] as shown in figure 44. There, the same ascending line gesture is played by four groups of violins with a small time delay (a semiquaver), which produces a deferred quadrophony. As the gesture changes direction the effect becomes more evident by the overlaping, producing acoustic blurring.

Another situation that involves blurring in music takes place when a single pitch is widened by the addition of close frequencies, producing a cluster around a specific note. Such a cluster could have a vertical pixelated nature, i.e. formed by fixed frequencies, or have a smoother quality as one formed by smaller fluctuations and glissandos. Whatever the case, we can speak of a certain de-hierarchisation of frequency limits—that is, a blurring of boundaries around a pitch area. Several composers of the second half of the 20th century have used this device, for instance in the works of Scelsi, Penderecki, Ligeti, Xenakis, Haas, Ablinger and C.J.Walter, among many others. Giacinto Scelsi was certainly one of the pioneers creating a music highly reliant on this type of blurring, particularly in pieces from his last compositional period.[94] In such pieces, he worked sound environments of a continuous nature consisting in the constant reaffirmation

[93] *Desfases* (2010).
[94] Dickson, 2012.

and insistence on a single pitch centre, but within a rich universe of subtle variations of both pitch and timbre, inside intense dynamic arcs. His music is characterized by the development of diverse ways to engross a line always in movement, although such movements are often small and suggest something closer to fluctuations.

The repertoire in which Scelsi best accomplishes this type of blurring is his music for bowed strings. This is not surprising since with such instruments it is possible to obtain continuous smooth changes in pitch by the use of glissandos, plus the constant use of double stops, all of which allows the construction of complex vibrating sound entities through the aggregation of individual lines. A good example of this is his *Duo* for violin and violoncello from 1965, in which he creates a wide variety of sound textures and movement around the central note G' (fig.45).

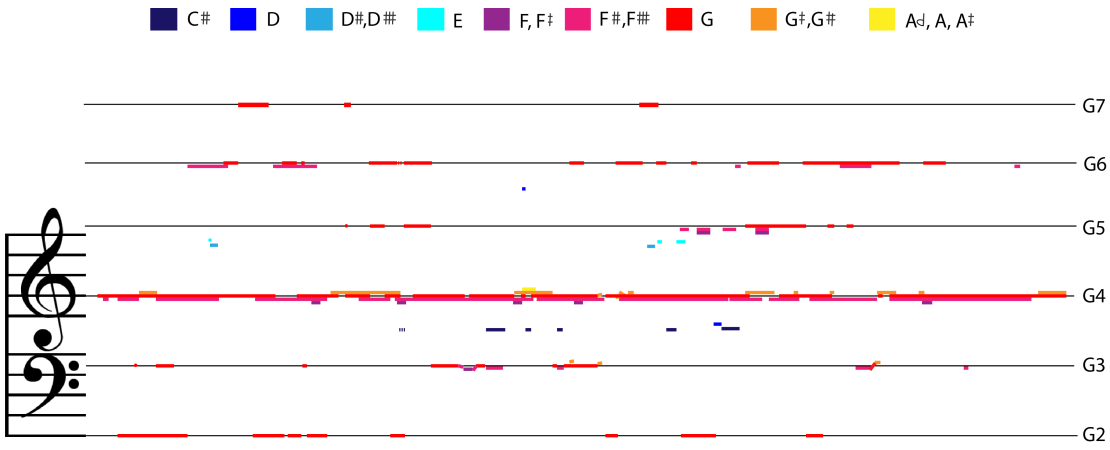


Fig.45: Pitches corresponding to the first piece of Scelsi's Duo for violin and violoncello *(1965), consisting mainly of G's and its immediate neighbour pitches.*

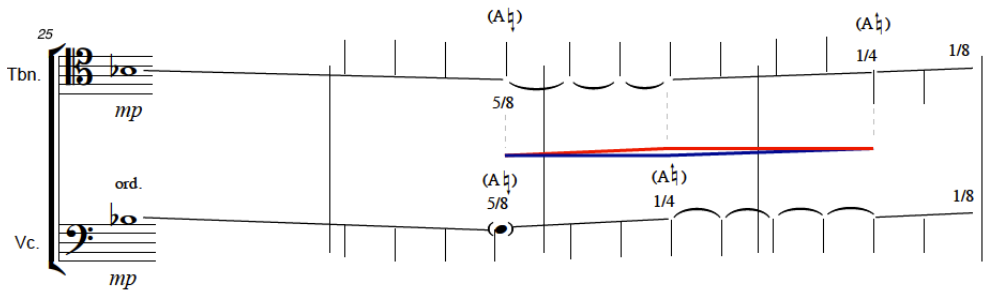
Fig.45 demonstrates how the flux of sound around G4 is constantly being thickened and hence blurred by the addition of neighbour pitches. On the other hand, the diverse and constant octave doubling is reminiscent of the idea of hyper-lines presented in Chapter 1. Scelsi's hyper-lines are composed only of octaves, and although they do not fluctuate in the same direction in a coordinated motion (as *d'uno*'s hyper-lines), they certainly build up a higher

order line. In this music sounds tend to melt and individual lines are not perceived as distinct objects, but rather as one massive object, experienced as a result of all of the small sound interactions and movements.

4.1.2 Blurring in my recent music

I have often used blurring in my music via the generation of small distances by the oblique or contrary motion of lines. Indeed, I have approached blurring from both perspectives mentioned above, whether in situations in which unisons gradually split apart (applied sometimes to more than one tonal center simultaneously), or by creating contours that deform as their internal lines change. This type of line interaction describes sonically the way in which Richter describes his relation to the world as imprecise, in constant movement and transformation. In that sense, blurring works as a movement device for sound, just as it does in painting (from Monet to Richter, through Bacon and many more).

For instance in the piece *d'uno* (presented in Chapter 1), I create blurring in various ways, including a subtler approach in which the blurring is thin and almost unnoticeable, and a wider and stressed expansion of a unison, in a rendering closer to Scelsi's line thickening. Figure 46 shows three examples of the subtle version of blurring, in which a small degree of acoustic distortion/imprecision arises out of the tiny displacement between moving lines, producing short periods moving in and out of phase.



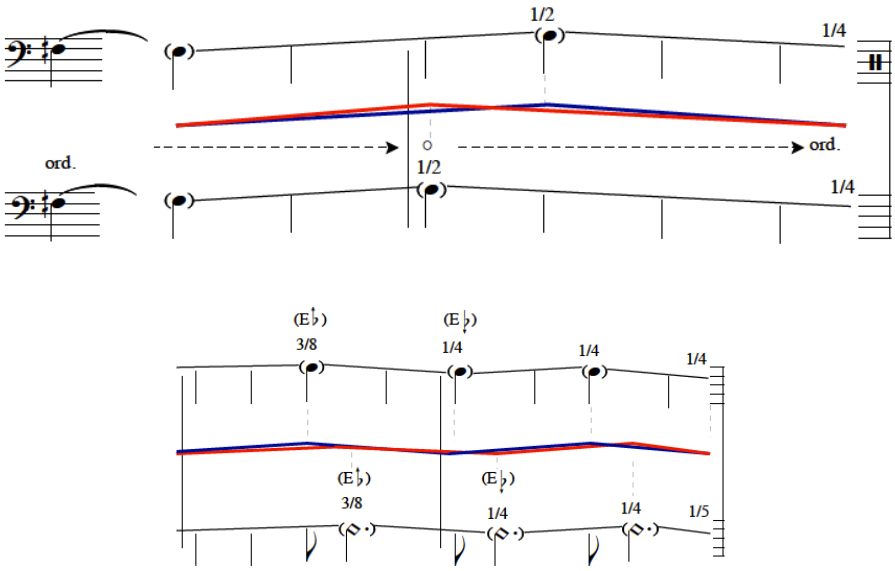


Fig.46: Subtle outs of phase occurring in d'uno.

From the first fragment we can observe how blurring is produced by the oblique motion between the trombone and cello parts, with a misalignment of one quartertone that rises as the cello ascends, and later the trombone fixes the distance by ascending, while the cello stands still, until they get in unison again. The second situation shown is similar although it does not imply any oblique movement but only parallel and contrary motions. The third example presents continuous short ascending and descending parallel and contrary motions with a displacement of an eighth note between the two instruments.

As mentioned above, I also use a centre-engrossing approach in some moments of the piece, especially in the transition occurring between bars 58 to 68. There, as shown in figure 47, I create a greater pitch area around the note A'3, making use of the possible double-stop unisons in the cello, smoothly changing the notes on the second string (either ascending or descending), and using a voice multiphonic on the trombone. The sum of the activity of both sound-sources produces a constantly changing blurring on that frequency area.

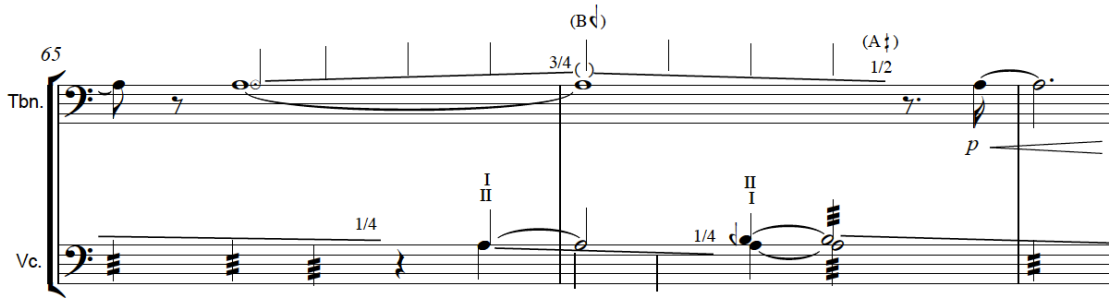


Fig.47: Scelsian blurring in transitional section of d'uno.

4.1.3 Escritos diferidos

The title and the idea of blurring for the piece *Escritos diferidos* (*E.d.*)(trans. *Deferred writings,* 2 fl., bsn., tbn, 2015) come from a poem by the Chilean poet Gonzalo Millán called "El mausoleo de Narciso"[95] (Narcissus' mausoleum). In it, there is a fragment that states:

> Cuando poco queda, crece el amor
> por las palabras concretas, indescriptibles.
> Digo que no quiero decir otra cosa
> que lo que digo, pero al decirlo fallo
> porque el blanco siempre se mueve.
> La palabra sigue con retardo al grito.
> Escritos diferidos como calcos que no
> calzan, como duplicados infieles.

> When there is few (time) left, the love
> for concrete, indescribable words grow.
> I say that I don't want to say anything other
> than what I say, but in saying it I fail
> because the target always moves.
> The word follows delayed the scream.
> Deferred writings as traces that don't
> match, as unfaithful duplicates.[96]

The text speaks of the inherent imprecision of every creative act, meaning that one always ends up doing something different than what was intended. It is not

[95] Millán & Zaldívar, 2007.
[96] My translation.

clear if the target moves because the artist changes or if because precision simply does not exist in relation to art, as one cannot really foresee what it is doing before actually doing it. The poet then longs for concrete words as they point to univocal things, knowing that such a reality is nonetheless utopic given that everything perpetually changes and moves, hence words and concepts cannot be pinpointed.

Millán speaks also of the two seemingly different times of creation, one where the vision comes or expression takes place (*the scream*), and the other corresponding to the slow and laborious time of the writing of the idea itself (*the word*). He visualizes these differing times in form of deferred writings, "traces that don't match, as unfaithful duplicates", which bring back the idea of a heterophonic kind of writing (or a stereoscopic one as in fig.43), as change and time condemns objects to be constantly displaced from themselves.

I attempted to translate the ideas contained in the poem into concrete elements and techniques by stressing the imprecise character via lines that differ and displace from each other, producing blurring across the piece. For instance, figure 48 shows a moment of the piece in which the two flutes are displaced in the first two gestures (bars 21-23), and then in bar 24 continue the ascending motion of the *B*-flat as a short fifth (mini hyper-line), leading to a relay of a slightly higher G in bar 25, then continuing blurring again in bar 26.

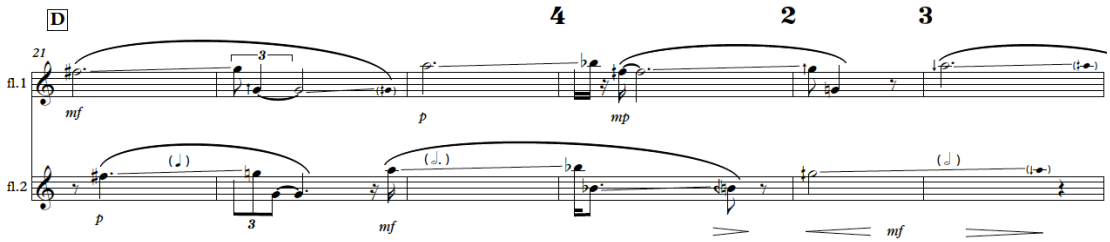


Fig.48: Moment of E.d. *where the flutes produce a blurring effect by their subtle differences.*

Another function of the blurring in *E.d.* is to create a melting sensation, a liquid and sometimes viscous materiality where slow glissandos continually produce moments of expansion and contraction, as in a sort of warping of the acoustic

surface. Such a merging quality was reinforced by the use of multiphonic sounds as figure 49 shows below, consisting in the beginning of the piece. As can be observed in the example, the piece starts with a multiphonic in the bassoon corresponding to the natural spectra of the B fundamental, reinforced by the other instruments via the duplication of the partials corresponding to the fifth (F#), which in turn produces a blurring of the sound image by splitting apart gradually. The melting continues by other doublings and the deferred entrances of both still and moving multiphonic sounds in a series of fusing events.

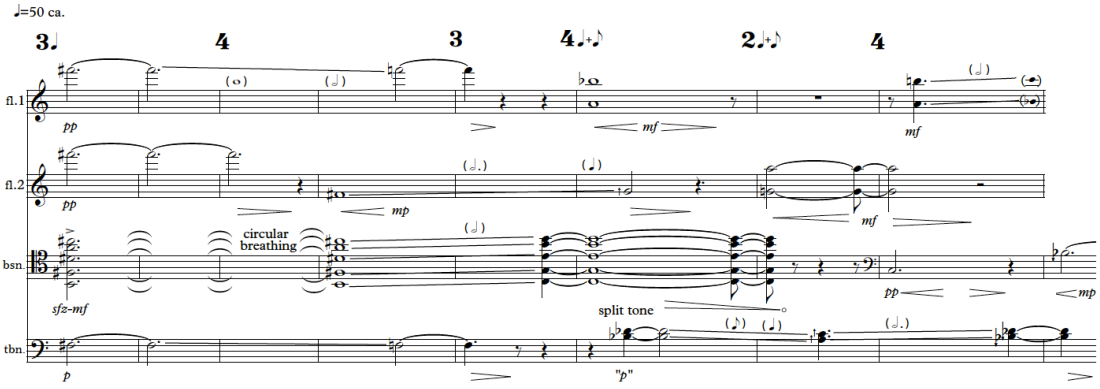


Fig.49: Beginning of Escritos diferidos.

This tendency to merge sounds in the piece as well as the use of multiphonics, was directly influenced by *Multiphonic Objects Gliding Through 43-Tone Space* (2014) for trombone and cello by the German composer Caspar Johannes Walter, in which he constantly makes use of split-tones (natural multiphonics) in both instruments, which, as the title suggests, glide within a tonal space corresponding to Harry Partch's 43-step just intonation scale.[97]

[97] From programme notes to concert by Two New Duo at University of Huddersfield on March 2017.

4.2 Fluid behaviour

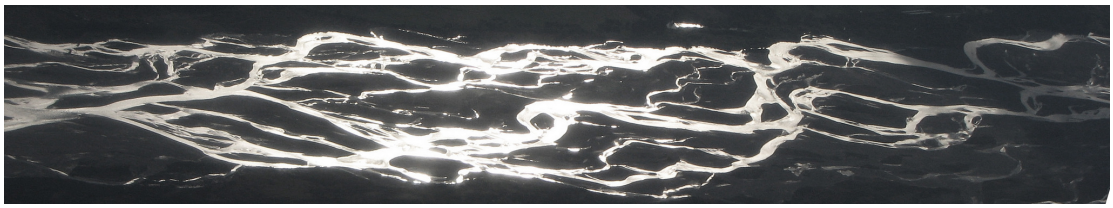


Fig.50: Braided river.[98]

Another way of conceiving the interaction of lines relative to their combination is in analogy to liquid states of matter, characterized by their fluidity. This way of understanding the comportment of combined lines considers each as a streamline, that is, a line that together with other lines form streams of sound. By their interweaved superposition, the collective behaviour of lines develops a permeability of membranes so to speak, in which boundaries are dissolved and stream-ness arises as an emergent property. In order to belong to this streaming category, the texture needs to be imbued with movement by a certain amount of regularity of action (fig.50). Situations of this nature are commonly found in polyphonic settings of the late renaissance (i.e. Lassus or Palestrina) which exhibit this behaviour as formed by the interaction of independent voices, in which "continuous musical movement, be it in the harmonic fluidity or the melodic flow, stands as the prime attribute of the period's compositions".[99] The fluid texture characteristic of this music (when set polyphonically) is produced by the perpetual entrance and exit of individual voices (fig.51).

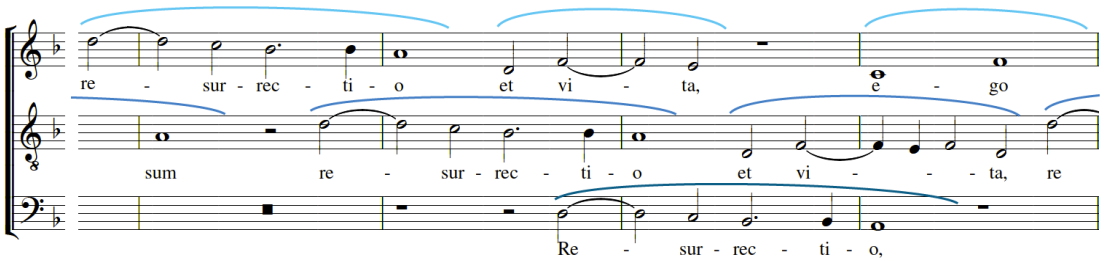


Fig.51: Excerpt from Orlande de Lassus motet Ego sum resurrectio et vita*, illustrating the deferred entrances of voices as interweaving streams of sound.*[100]

[98] Photo by David Hood.
[99] Chase, 2003;2004, p.38.
[100] Lasso & Sandberger, 1926.

A tidal effect is hence generated given that before one line ends another line enters and before the second one ends yet another enters and so on producing continuous fluxes of sound. It is crucial within this conception the sense of movement generated by the constant and complementarily distributed appearance and disappearance of lines. Such movement emerges from the rhythmical situation generated by the entrance and course of action of each line across the texture (although not in a pulsating sense). This 'rhythmic' character enhances an interweaving illusion.

In the first section of the piece *Into Open Noir*, I worked similarly with streams of sound by overlapping lines that increase and decrease their amplitude, which in combination produce an overall sense of flux and swell. Figure 52 shows how this was done not only by having continuous lines entering and leaving the acoustic space, but also by simulating more than one 'stream-line' as in the case of the flute, which alternates between two registral strata.

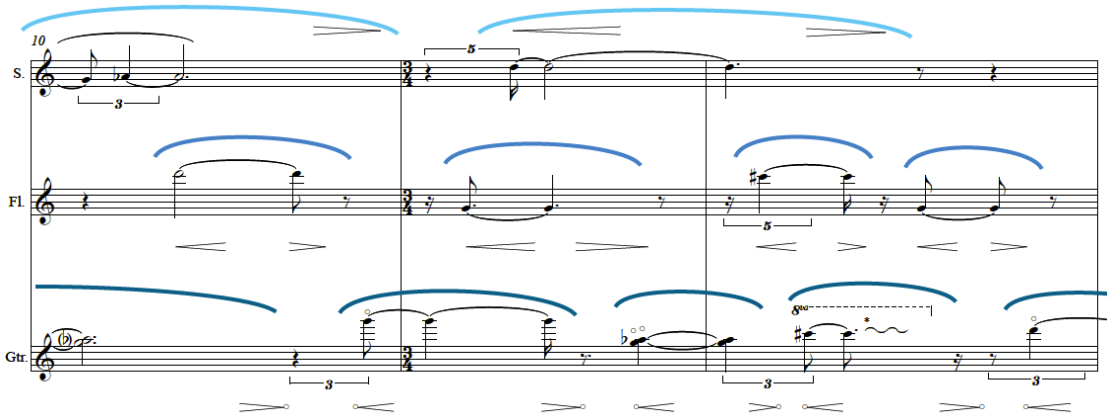


Fig.52: Streams of lines in first section of I.O.N.

In *Escritos diferidos* there are also some moments marked by a constant swelling. An example of this occurs in bar 29 (fig.53), where such an impression is enhanced by the intermittent activity of hyper-lines that succeed one after another, forming also constant superpositions. This can be considered to be a blurring of hyper-lines following their displaced behaviour. Since most lines are

in a constantly deferred movement, plus an increasing/decreasing energy, the texture evokes a liquid swelling state.

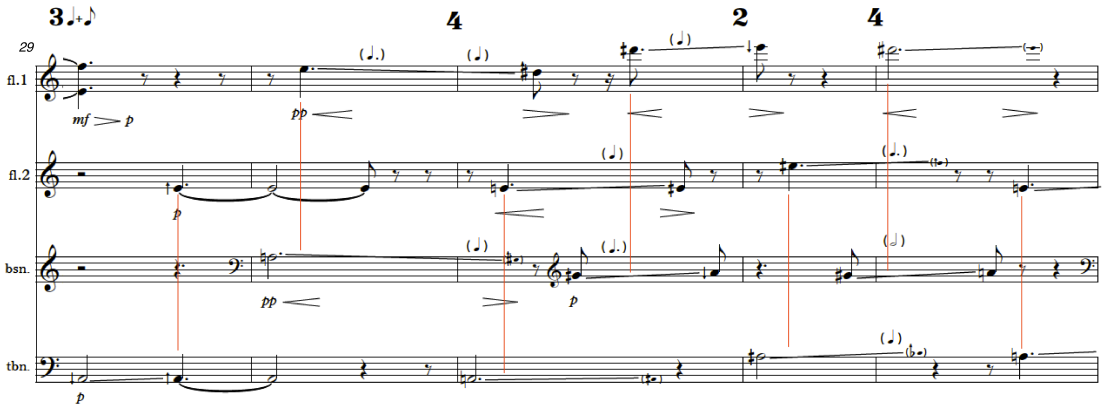


Fig.53: Subsequent hyper-lines interacting and producing fluidity in Escritos diferidos*.*

4.2.1 Mechanical waves in *Computer p*

Computer p was composed for the Robotic Piano Workshop lead by Peter Ablinger and Winfried Ritsch at the University of Huddersfield in October 2015. It consists of the interaction of gradually appearing and disappearing torrents of sound, each 'tide' made by the superposition of ten pixelated lines that form semitone clusters, which grow gradually in time and then fade out. In that sense it is possible to say that *Computer p* consists of the interaction of pixelated waves.

One of the reasons for having constant flows of sound was my interest to "de-pianify" the piano, which means making the piano sound and behave as something else, removing it from its own tradition. This was done as mentioned by producing torrents of sound made of fast repeated notes that go from *niente* to piano and again to *niente* as if they were continuous sounds, with rather long durations in a way similar to how a wind or bowed string instrument develops a long and sustained tone. This somewhat utopic behaviour for an instrument such as the piano, given its mechanical and percussive nature, makes reference nonetheless to its uniqueness as compared to previous keyboard instruments, namely being able to produce different degrees of amplitude in relation to the

amount of energy applied to the key, particularly *piano* (a 'computed' *piano* here).

The main aspect of the de-pianification is the continuous character of each line. In the piano tradition, a common way to sustain a sound for a longer time has been by the use of trills, since by their persistence they render imaginary continuous sounds that do not decay as normal piano sounds do, an illusion created by the fast re-iteration involved in trills. In *Computer p*, given that the player is a machine with a mechanical performance capacity superior to human capabilities (88 fingers, faster repetition rates without exhaustion), the continuous character of lines was done by repeating single notes very rapidly, producing sustained pixelated tones as result. Each sustained pitch is repeated at a rate between 70 to 90 milliseconds, with slight differences in speed so that a complex polyrhythm is heard instead of a macro regular pulsation. These speeds are however so fast that it is impossible to hear any specific rhythmic relation inside the flux.

Inside each appearing/disappearing torrent of sound there are a total of ten individual lines forming a ten-note cluster of semitones. These internal lines start from the center and move towards the periphery in both directions, widening the ambitus of the torrent (in a pixelated version of the centre-thickening type of blurring discussed earlier in the chapter). By doing this, each group of lines forms a greater and thicker line of a different and bigger scale. A similar behaviour is assigned to the evolution of amplitude: each note of the group does a crescendo from niente and decreases to niente again. Thus, the fluid-like behaviour of each group is given by the gradual increment of both the pitch area and the dynamic energy.

Concerning its evolution in time, the piece progresses by the interaction between three torrents, each entering and exiting sound at deferred times. Two of them descend from the high register progressively between one entrance to the next, while a third group exhibits a slowly ascending motion starting in the highest register. In deciding the behaviour of the sound-torrents in the pitch domain, I

was influenced by Vera Molnar's series *Variations Sainte-Victoire* (1996) (fig.54). In this series, Molnar works with a computer algorithm that generates successive random lines that gradually cover in black the whole area below the contour-profile of St. Victoire's mount. The gallery presentation consists of a number of 'frozen' intermediate steps of that process (twelve in the example below).

Fig.54: Vera Molnar Variations Sainte-Victoire *(1996), series nº 0-12.*[101]

It is interesting how Molnar transforms the contour of the mountain into a big wave of ink that traverses down the whole *Y-plane* in the form of a slow-motion cascade. This is reminiscent of the idea from Chapter 1 concerning the fluid movement of rock when seen from a geological perspective. Mountains could then be conceived as slowly developing waves of rock through long periods of time. In *Computer p*, I used a slow and gradual descending motion as the overall long arc of the piece, similar to the flux of ink going down in Sainte-Victoire's *Variations.* Figure 55 shows how the three groups (clusters) move in time across the piano register during the entire piece.

[101] Picture from "Vera Molnar - Solo" exhibition at DAM Gallery (Berlin), on April 2014.

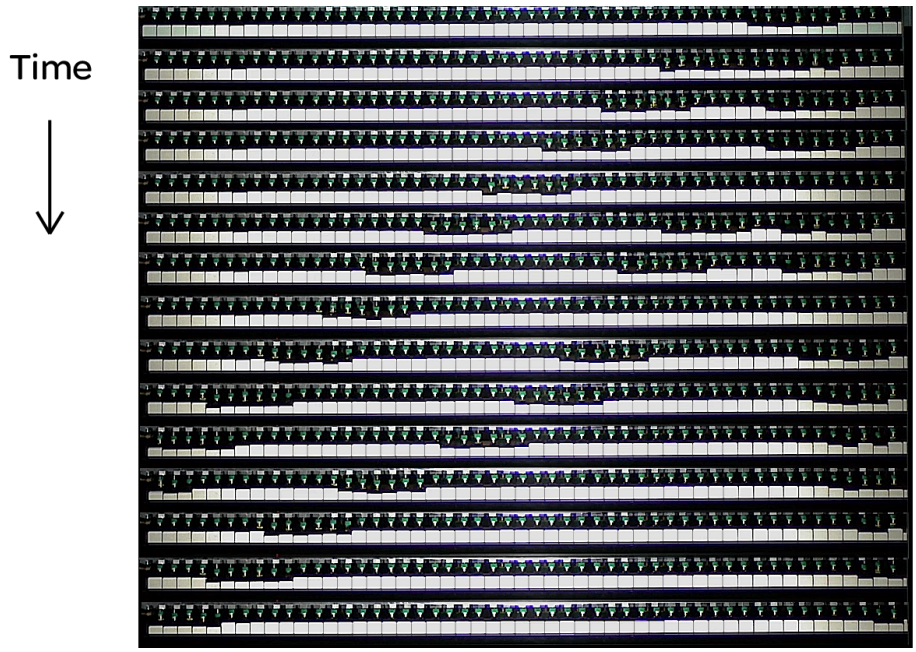


Fig.55: Pictures of the piano keyboard grouped horizontally displaying 15 sequential moments of Computer p*, showing two clusters (torrents) descending in pitch against one ascending.*

In relation to sound, an unexpected event appeared during the realisation of the work, as when creating the piece I did not think of the sound that the mechanic 'fingers' of the robot piano-player (fig.56) would produce while striking the keys of the instrument. Indeed, the fast repetitions over each key produced a significant amount of key noise. Such noises ended up being a crucial component of the soundworld of the piece, as at certain moments there are thousands of pulsations occurring per second, in which the key noise is heard clearly especially when keys are not depressed with enough depth as to make the hammer strike the string, creating a motor rumble sound as result, revealing the mechanic aspect of the work.

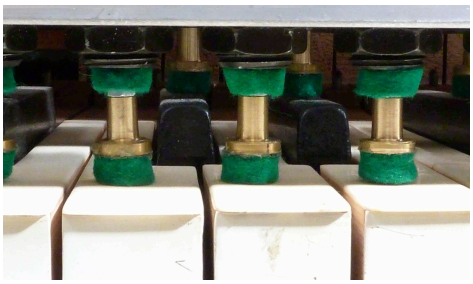


Fig.56: Mechanic 'fingers' of RHEA*, the computer piano player.*[102]

The situation of having a machine (a piano) controlled by another (the robot piano player) suggested strongly the idea to control them by means of a program (a virtual-machine). This program coordinates all aspects of the performance of the robotic player, which consists of a series of fixed parameters on one hand, and random outputs on the other. The fixed elements correspond to the functioning of each group independently, i.e. the speed of each note, the grouping at semitone distances, and the time of the first entrance of each group. The random parameters correspond to the duration of each flux and the descending interval (in semitones) between appearances. Such randomness works nonetheless inside previously defined thresholds, so that the piece is similar each time, but the amount of appearances of each mechanic wave, and the superposition (the 'counterpoint') between the different groups is determined by randomness. I initially worked out the simulations in the software *Open Music*, but later Winfried Ritsch (constructor of the computer piano player) implemented a much optimal version in terms of realtime outputs in the software *PD*.

[102] Image by Winfried Ritsch, constructor of the computer piano player.

Summary of Chapter 4

In this chapter I have presented different criteria for approaching lines in combination, mainly through the idea of blurriness in sound and fluid-like behaviours formed by independent streamlines. Considering blurriness, we analysed it first from a visual perspective involving photography and the visual realm. Then two possible ways of understanding blurriness in sound/music were presented, first as the heterophony formed by slightly differing lines, and then in situations where a pitch center is engrossed, producing continually shifting microtonal clusters (as it was shown to occur in Scelsi's late music). Next, the blurring taking place in the works *d'uno* and *Escritos diferidos* was explained and discussed (including some reflections coming from the poetry of Gonzalo Millán for the latter).

Later, the idea of fluidity was presented as criteria for multiple line dispositions, in which each line is to be considered as a streamline in the conformation of wider streams or fluxes of sound. There we saw that stream-ness arises from certain types of configuration, characterized by the perpetual entrance and exit of lines filling the temporal space in complementary ways. Such behaviours were observed in the pieces *Into Open Noir* and *Escritos diferidos*, both exhibiting swelling and a tidal effect at determinate moments. Finally we observed in the piece *Computer p* a fluid behaviour emerging from groups of pixelated lines, forming 'mechanical waves'. There, it was shown how three torrents of sound formed by collections of polyrhythmical fast pulsations displayed fluid qualities in their internal constitution and produced fluid environments by their interaction, all of it triggered in real-time by a set of rules involving controlled degrees of randomness.

In the next—and last—chapter we will approach the creation and orchestration of a structural line following different constructive and aesthetic criteria in what can be considered a case study since it involves a specific piece from the portfolio.

5. Line Construction and Orchestration

In the piece *Ohne* (2014) for small ensemble (vln., vla., pno. and perc.) I approach a type of line different from the ones previously discussed: a line constructed from a series of points. A phase of construction was followed by the orchestration of the line, which was distributed, divided, transformed and transferred into various other layers, involving other considerations related to sound, economy of means and emergent layers. In that sense, the constructed master-line functions as a *cantus firmus* upon which a series of subsequent structures (usually derived from it) were superimposed producing a modular compound somewhat different from its originating structure.

The line of *Ohne* can be characterized as a fractured type due to its zigzagged contour, a feature that was approached in the orchestration stage by the creation of a crystalline and rather thin sound world. The zigzagged nature of the constructed line evokes images of brittle surfaces, what Tim Ingold refers to as a 'cracked' line in his taxonomy of line types.[103]

This piece constitutes a further step from the idea of pixelation explored in Chapter 3, but here fragmentation is applied to various formal levels of the music, through a modular approach in the construction stage of the line. The section below examines both phases of the composition process.

[103] Ingold, 2007.

5.1 Construction of a line made of points

The process for constructing *Ohne*'s structural line is based on the progressive crystallization of space into small segments, moving from the macro towards the micro by gradually narrowing the space. This was done by working with a series of eight different numbers that were approached in their proportional relation on both the vertical and horizontal planes. The criterion for such a crystallization is based on the incrustation of new layers inside previously existing ones, applied to three distinct moments in time, as three frozen stages in the growing of a structure, which were then connected in sequential order. Although the initial intention was that the structure encompassed the entire duration of the piece, the constructed structure ended up comprising nearly four and a half minutes that correspond roughly to half of the piece's duration. The remaining sections were composed by reshaping and recombining the previous modules and mini-sections.

5.1.1 Freezing space

The structuring process consisted of freezing points in pitch and time by working with proportions, starting from longer divisions of time towards smaller segments. The numbers used for this proportional segmentation were derived from the alphabet position of the letters corresponding to the word *DISTRACTFOLD*, after the name of the ensemble that was to premiere the piece. Those letters correspond to 4-9-19-20-18-1-3-20-6-15-12-4. After observing the repetition of similar long values in the letters *S-T-R* (19-20-18) I decided to remove the *S, R*, and last *T* as I preferred to have only one long value in the series. The resulting numbers were 4-9-20-1-3-6-15-12-4, corresponding to *DI*(s)*T*(r)*AC*(t)*FOLD.*

I initially designated an arbitrary total duration of eleven minutes, corresponding to the initial space to be fragmented. Then, I divided the total

number of seconds (660) by the total sum of my numbers (74), which gave a unit (8.9 seconds) that corresponds to the amount needed for each small section (each number of my series) to be multiplied by in order to complete the eleven minutes proportionally. Therefore, since the first mini-section corresponds to the first number of the series (4), it would have a duration of 35.6 seconds, the second mini-section a duration of 80.1 seconds, the third mini-section a duration of 178 seconds, and so on according to the series.

As previously mentioned, the division of space was subsequently applied to different layers going from the macro to the micro level, involving the inclusion of two additional layers inside the one explained above. In order to do this, numbers were used both in their proportional relation, and as indicators of the quantity of elements inside each module (fig.57). This process implies a self-similar relation between the three orders of magnitude as shown in figure 57.

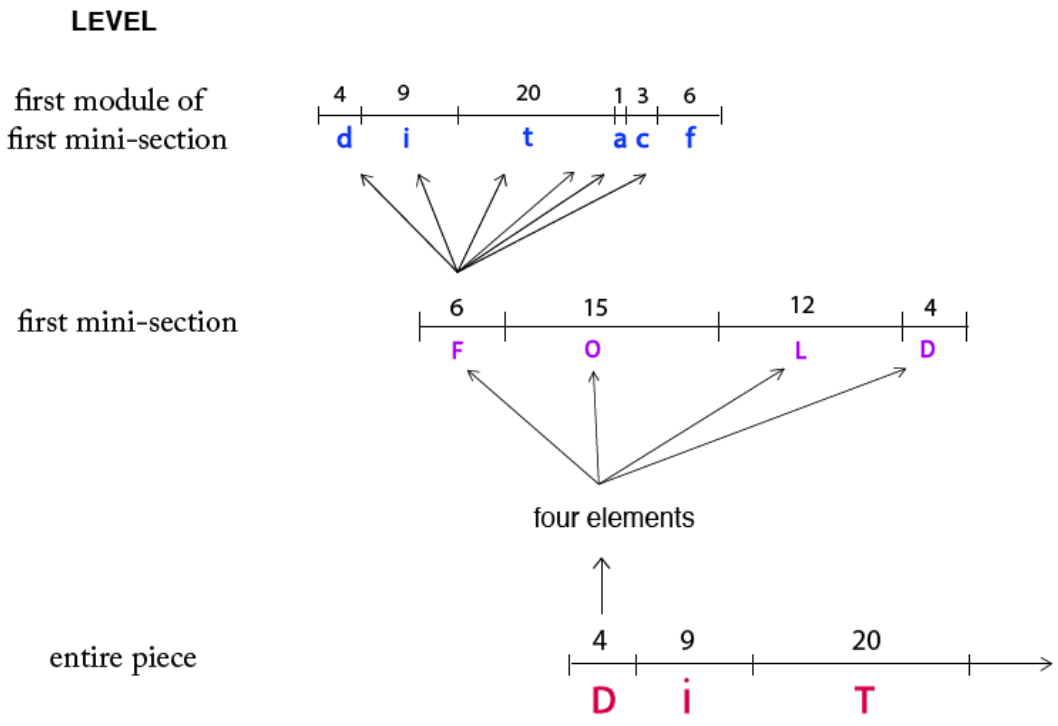


Fig.57: The division of space according to proportions at three different scales.

Concerning the organization in time of the first mini-section (corresponding to the second level of figure 57), its duration of 35,6 seconds was rounded to 37, since I used the letters F-O-L-D, corresponding to 6, 15, 12 and 4, the sum of which is 37, close enough to 35.6. This means that the durations for the modules inside the first mini-section—which are the containers of the next level of structure—correspond to those numbers in seconds. Accordingly, meter was composed to correspond those proportions, over which the next structural level is to be constructed (fig.58).

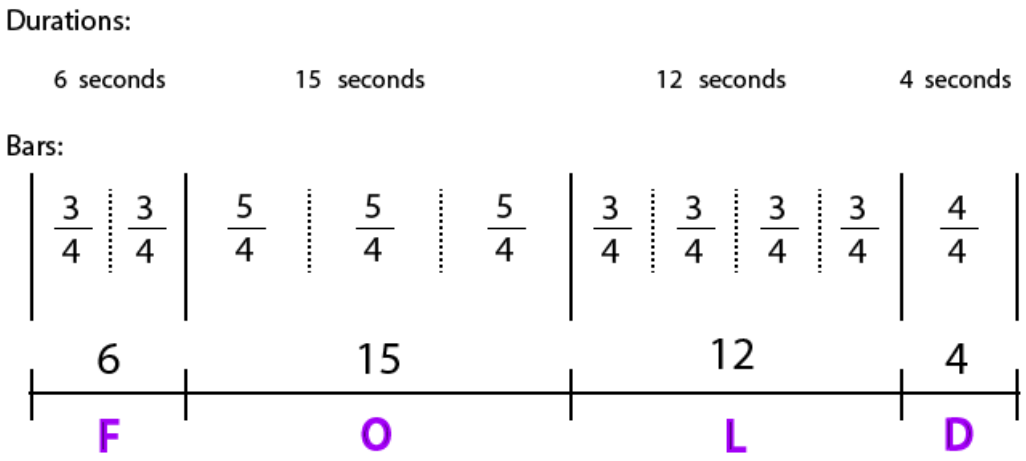


Fig.58: Bar structure of the four modules comprising the first mini-section of Ohne.

The principle used to determine the pitches inside each module follows the same proportional logic as the one used for time segments. Each number contains the information needed for both its pitch as well as its duration: in the case of pitches, the proportion is linked to a predefined register-space. For example, if the space comprises 20 semitones, with middle *C* at the bottom (as number 1), the pitches of the first module (of the first mini-section) would correspond to *Eb* (4), *Ab* (9), *G* (20), middle *C* (1), *D* (3) and *F* (6). But as I was interested in having frequencies inside a wide range, I applied the proportions to an *ambitus* of six octaves plus a sixth, closer to the register of the piano (which comprises seven octaves plus a minor third). The chosen pitch registral space was then divided by 20, providing the pitch positions for numbers inside modules (fig.59).

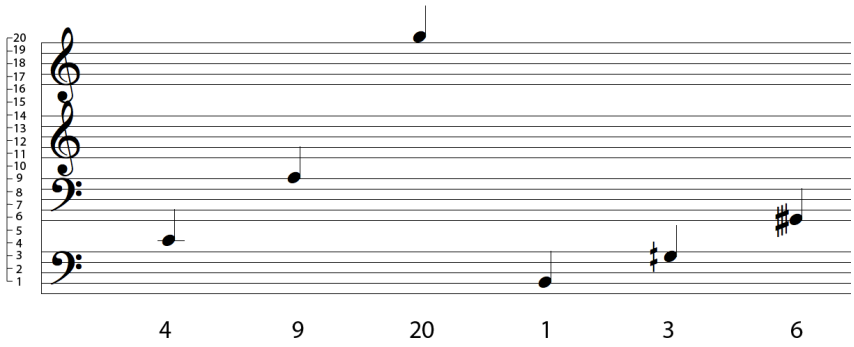


Fig.59: Pitches corresponding to the first module of the first mini-section.

This decision generated a problematic situation; each time that a number appeared I would have the same pitch, resulting in an excessively repetitive harmony. The solution was to devise a randomised distorter that applies small variations to the pitches each time they are used, generating constellations of similar pitches around the nodes corresponding to each number. The small possible distortions assigned to the frequency distorter were based on the proportions of my numbers at a tiny scale, and each distortion could potentially shift the original pitch slightly higher or lower, or could potentially generate no deviation from the original pitch (fig.60). (Most of the calculations and procedures for the piece were done with the aid of the computer software *Open Music*.[104])

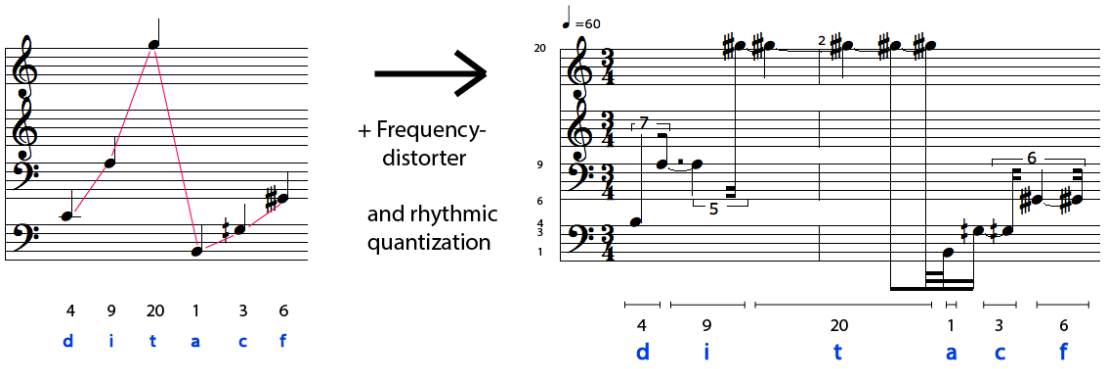


Fig.60: First module before and after pitch distortion and rhythmic quantization.

[104] A software designed and developed by the IRCAM Music Representation research group, 1998 - 2013 Carlos Agon, Gérard Assayag, Jean Bresson.

Figure 60 shows that the random distortion affected only two of the original pitches by different degrees, the first pitch (4) by a semitone downward and the third pitch (20) by three quartertones upwards (I set a pitch quantization to the scale of quartertones as I was interested in constantly producing pitch blurring by such small differences). Figure 60 also demonstrates the way that rhythmic quantization operates on numerical proportions, assigning internal durations to the module. The quantization for rhythms was based on a 32nd note as the minimum for this mini-section, including all possible divisions of the quarter note up to that value.

The remaining structure for the first mini-section was generated likewise, although after completing the transformed word *DITACFOLD* on the first module and beginning of the second, the following number-orderings were generated by a device set to pick elements randomly from the same list of numbers (1, 3, 4, 6, 9, 12, 15 and 20). The resulting contour for the line corresponding to the entire mini-section is shown in figure 61.

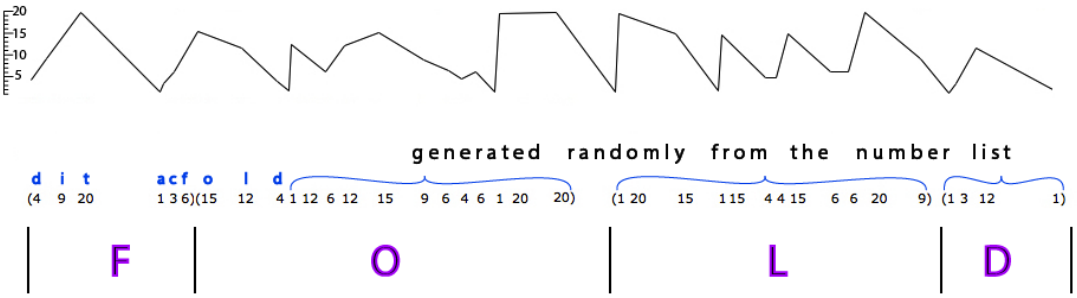


Fig.61: Graphic representation of pitch and time relations from Ohne*'s first mini-section.*

5.1.2 Representing growth

The internal organization of the second and third mini-sections was generated then by applying a growth model to the structure. The model consists of the emergence of a structure from inside the pre-existent one (the first mini-

section), as if new cells were growing from boundaries pushing their way out (fig.62).

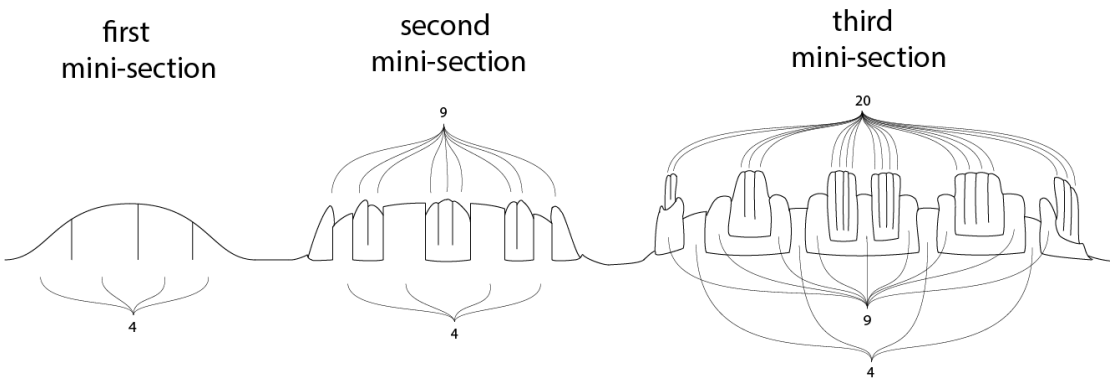


Fig.62: Growth within the structure of the piece.

As the example shows, the representation of growth is displayed in three moments of an imaginary continuous process, which are later connected sequentially to produce the three mini-sections forming roughly half of the piece. This model is characterized by the accumulation of information, as each subsequent section includes the modules of the preceding one, making the structure increase in density.

In practice, the process was carried out by inserting structural units (modules) between the spaces separating the previous units. Since the second mini-section had a predefined duration of 80 seconds, it was necessary to define a relationship between durations of old versus new structural layers, as they had to fit together into that amount of time. I opted for a relation wherein the first layer was compressed to 30 seconds, leaving 50 seconds for the emerging layer of nine modules. The most practical way to do this was through a new tempo (74 BPM), so that the modules of the first mini-section would remain the same rhythmically (although their pitch register was slightly reduced to mark the change), and the rhythmic proportions of the new modules were calculated to the new tempo.

Figure 63 shows the four modules of the first mini-section and the way in which the new modules are interpolated in between them on the second mini-section.

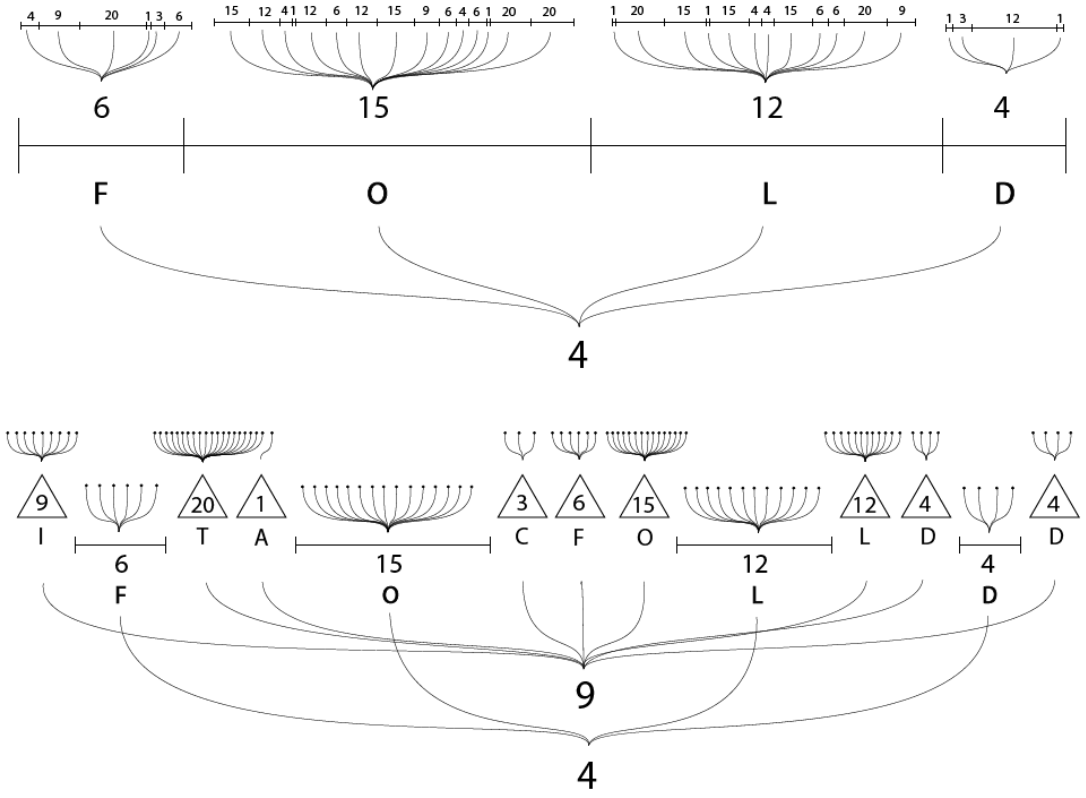


Fig.63: First and second mini-sections in their three orders of magnitude.

As figure 63 shows, the second mini-section has nine interpolations distributed symmetrically in five groups, although they differ in duration and number of events. The third mini-section was generated in the same way: it has 20 modules interpolated between the nine modules that appeared in the second mini-section. The increase in the number of modules from each previous structure corresponds to the numbers assigned to the macro-structure, as previously explained (*D*: 4, *I*: 9, *T*: 20), which accumulate in each subsequent mini-section.

The density of the third layer was increased additionally because I reduced the repertoire of numbers to exclusively the four higher values (9, 12, 15 and 20). This was done to enhance the growing idea by raising the last emerging layer in the pitch register. The decision to use only those numbers meant in practice that

there would be many more elements within that layer as compared to the preceding mini-sections, since such a numerical restriction was applied not only to the smallest order of magnitude but also the middle one controlling the number of elements for each module. Consequently, this brought a higher density of relatively similar rhythmic values in the high register. (For reasons that will be explained later, the 20 modules corresponding to the third emerging layer consist of only seven different modules, differently repeated.)

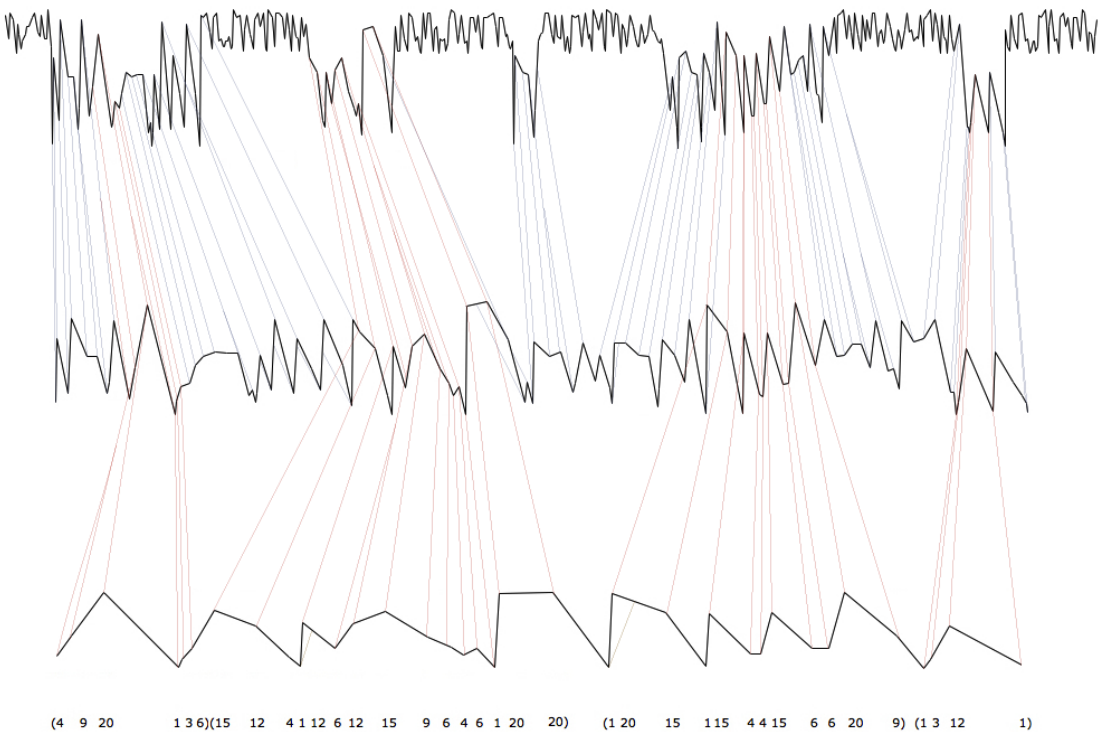


Fig.64: Zigzagged lines corresponding to the three mini-sections and their interpolations.

Figure 64 gives an idea of how line contours were transferred to each subsequent line, from the first mini-section (represented at the base of the diagram) to the third mini-section (above). (It should be noted however that the graphic does not reflect time proportionally since in the actual structure each mini-section has a different duration.) After a tedious process in which all of the calculations concerning pitch and time proportions were done, the three mini-sections were connected sequentially, together creating a long sequence that forms the main line-structure of the piece.

5.2 Orchestration of the structural line

In the orchestration phase of the process I needed to somehow 'see' the pre-existing realities in the structure, to look out for potential musical ideas in the rough zigzagged line just as the sculptor reveals the "imprisoned image" out of the rock, "veiled by the shapeless substances that encases it".[105] Similarly, the orchestration phase required carving the music out of the structural line, somehow giving life to it. Such a task involved a number of actions such as omissions of points, changes of octave, the elaboration of compounded gestures and a series of other devices as we shall see next.

5.2.1 Basic procedure

The basic way to proceed was by assigning pitches and durations conforming the line to the available instruments, highlighting gestures emerged by proximity of pitch and/or time. The actions most commonly employed (besides the simple placing of notes) were the omission of certain nodes, changes of octave, duplications, prolongation of sounds and the addition of spectral harmonics, especially in the case of the piano. Rhythmic adjustments and displacements also took place occasionally (fig.65).

[105] According to the neo-Platonic theory of Plotinus, as explained in Fernie, 2016.

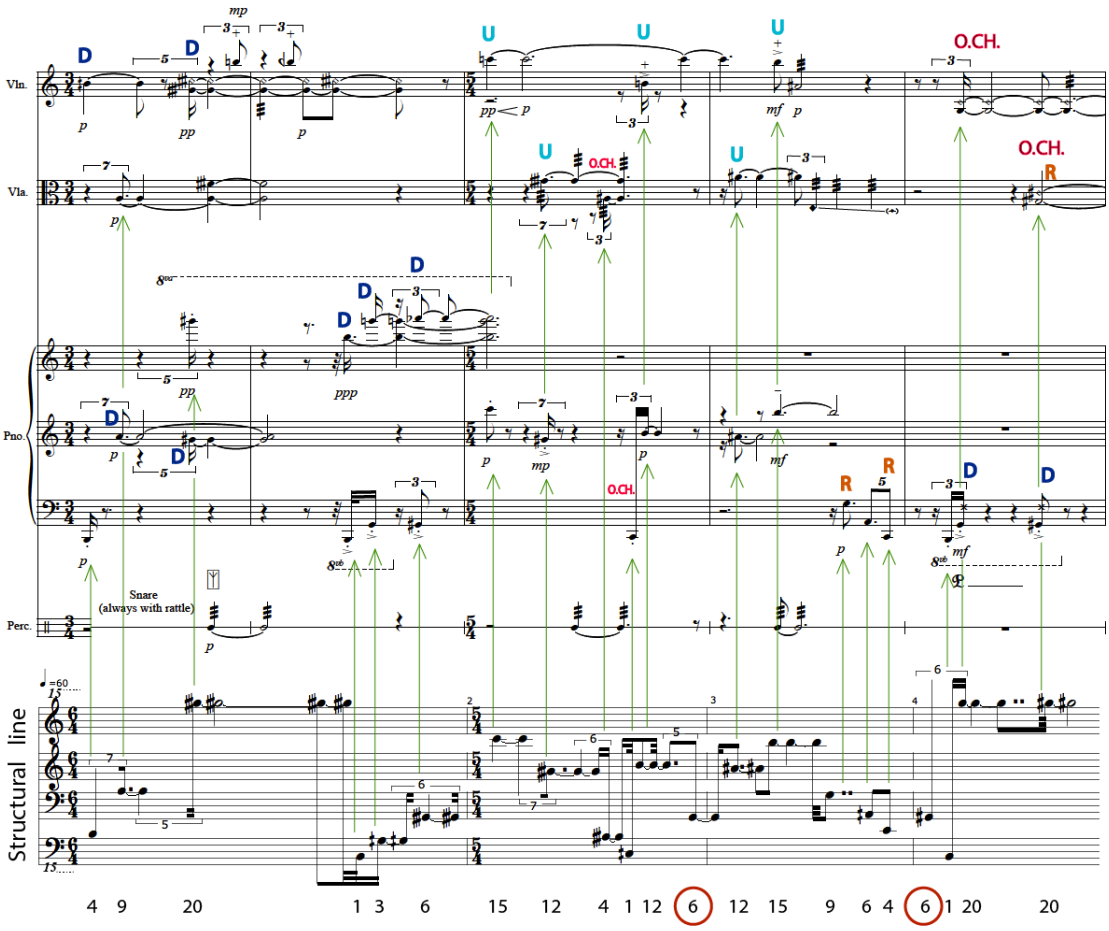


Fig.65: Beginning of Ohne *showing placements, duplications, rhythmic and octave changes.*

Figure 65 demonstrates all of the previously mentioned devices: the placing of notes shown by green arrows; the omission of points shown below in red circles around numbers; various octave changes ("O.CH." in red), the first two of them sounding two and one octave higher respectively than the structural line, and the other two sounding two octaves lower; duplications at different octaves (indicated with *D*); unisons (*U*); and small rhythmic displacements (*R*).

In terms of sound, I was interested in the creation of hybrid timbres by thickening and duplicating the points given by the structure, similarly to hyper-lines discussed in Chapter 1. I was also fascinated by the coordination effort required to produce such doublings. As the example shows for instance, the main criteria used for thickening sound was to separate attack and resonance when duplications occur, with one of the sounds functioning exclusively as attack—

usually *staccato*—and the other adds its resonance with a sustained tone. This approach is clearly demonstrated in the second bar by the piano, in which the low and short sounds work as attacks and the high doublings of the right hand keep resonating. While the piano tends to have the attacking role because of its percussive nature (and the strings the sustaining task), there is occasionally an inversion of these functions, as in the case of the Bs in bars 3 and 4, which are attacked by left hand *pizzicato* on the violin and sustained in the piano.

5.2.2 Emerging line-layers

One of the most interesting situations to be noted and highlighted from the structure was the proximity in time of pitches with tiny divergences corresponding to points generated by the same number. As explained above, these small differences arose from the mechanism that made small pitch distortions for each point of the grid-line, which often generated points with microtonal distances between them, producing displaced thickened areas around a pitch node. Due to their pitch and time proximity, these points produced flat trajectories that were orchestrated both monophonically and polyphonically (fig.66).

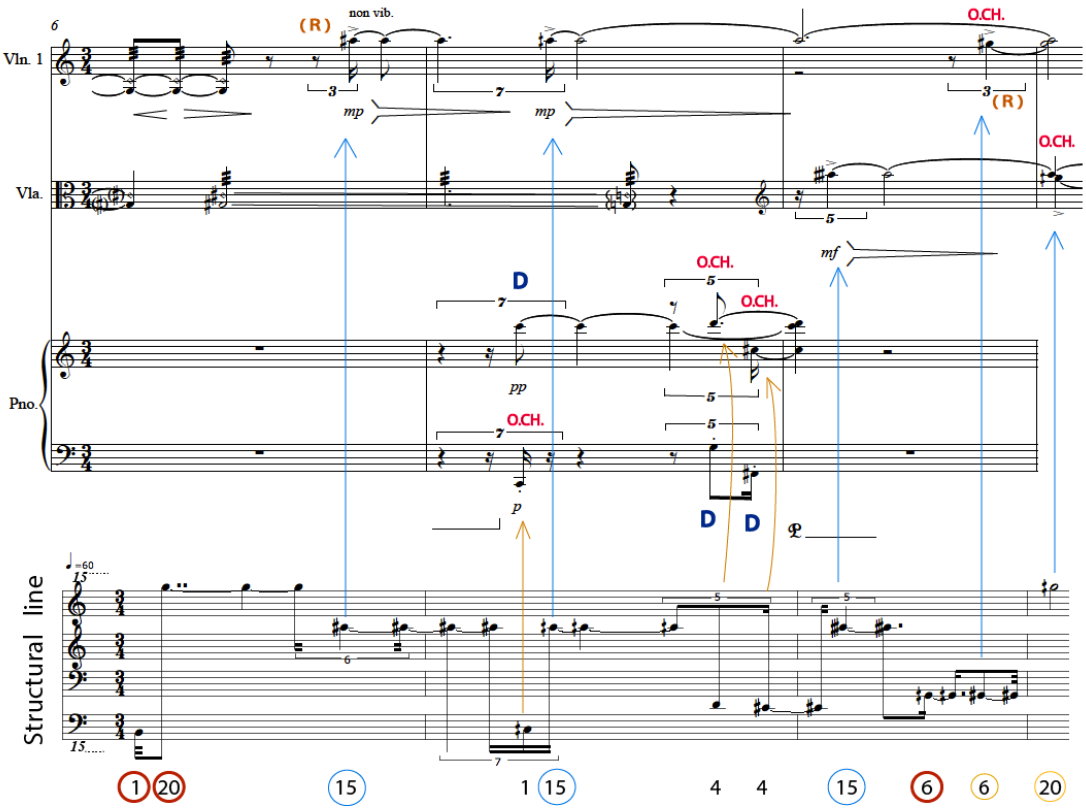


Fig.66: New line-layers emerging from the tiny distortions applied to the same number.

In figure 66 blue arrows indicate the points grouped highlighting an independent gesture. The first three correspond to the repetition of number 15 in the structural line, and the fourth and fifth elements come from different numbers but were incorporated into the gesture through the change of their octave position. The line is rendered sequentially first by the violin attacks, and then it becomes polyphonic by the entrance of the viola; later a second voice appears on both string instruments. Changes of octave allowed the densification of gestures through the addition of sounds close in pitch, which could then be perceived as participating in those gestures. Transferences of this kind are very common throughout the piece.

Another interesting issue to be noted from the example are the doublings in the last quarter note of bar 7 in the piano. The original notes from the structure are presented on the top of bichords, and the doublings take the form of sub-harmonics, at a lower fifth (octavated), using the attack/resonance orchestration

technique described above. Harmonic fifths were used frequently in the orchestration phase as a timbral thickening device.

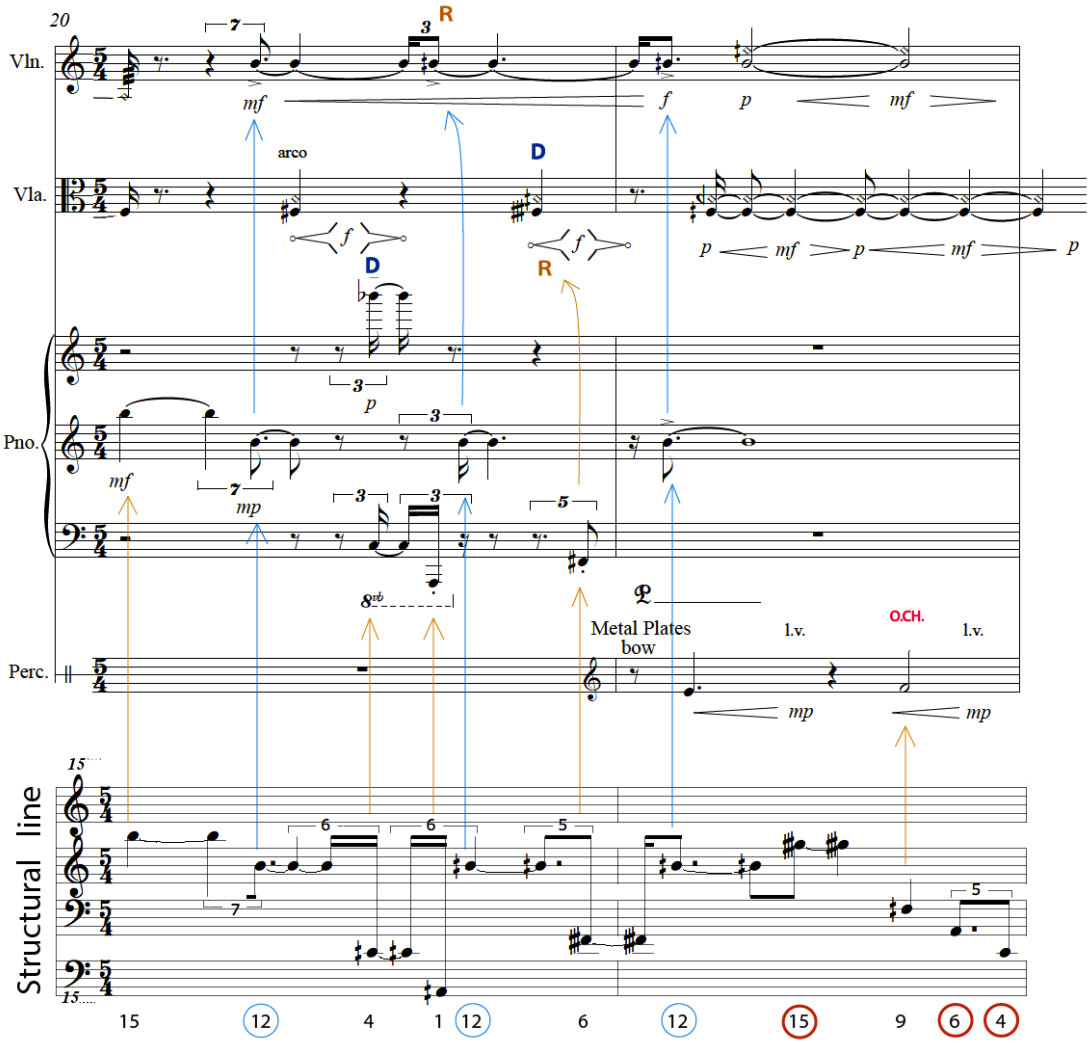


Fig.67: Line gesture reinforced by deferred partial content.

Figure 67 presents another example of a line gesture stressed by the orchestration. Here, the gesture is of a compounded nature, formed by the notes corresponding to the repetition of the number 12 (assigned sequentially to the violin), plus deferred harmonic fifths in the viola as artificial harmonics. The idea for this type of thickening action came from the structural line, since the last number of bar 20 (corresponding to an *F* three-quarter-tone sharp) happens to be a fifth from the *B* quartertone sharp preceding it (though in a different octave). The same action was then placed after the first note of the violin (in the

viola) and then assigned to the percussion. The third entrance of the viola is not a fifth in relation to the violin, but instead drops to *F* quartertone sharp to merge better with the pitches of the singing bowls in the percussion, prolonging the compounded gesture.

5.2.3 Treatment of the third structural layer

As seen earlier, the third emergent layer of the structural line is characterized by its high register pitches and its denser configuration of events, and marked also by a more regular rhythmic distribution as compared to the previous behaviour of the master-line. I decided to exaggerate the crystalline nature of the third layer by creating a denser pointillist texture. The means used to produce a surface of sound with that quality consists of rhythmically blurring the already existing text (the structural line), proliferating it into various instruments. This was done by simply superimposing the text onto itself from different starting points and in different instruments, in a cyclical or canonical way (fig.68).

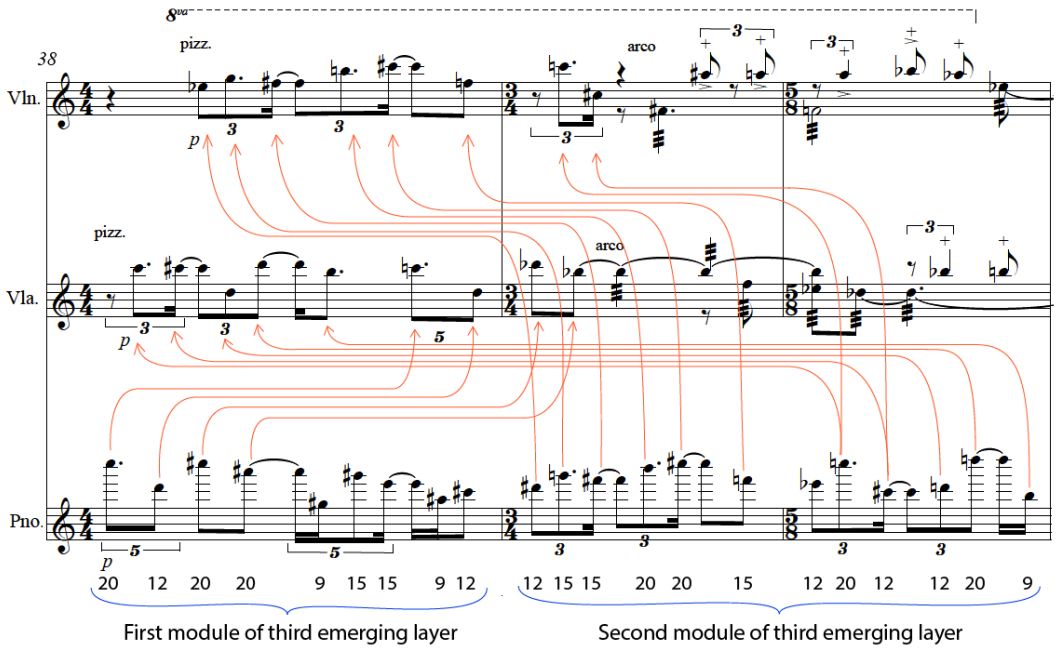


Fig.68: Deferred repetitions of the text in the first appearance of the third emerging layer.

As the example shows, the structural line was integrally assigned to the piano. While the violin part in the example presents a direct copy of the piano text, in the viola there are some octave changes, as for instance in its first five notes, where the high pitches from the structural line corresponding to the number 20 and the *D* corresponding to the number 12 were dropped an octave, producing a new line of similar characteristics. This way of blurring the text was used in most appearances of this structural layer.

To produce a textured result it was also important to have similar timbres between instruments, as pizzicato on the strings and woodblocks in the percussion part merging timbrally with the high register of the piano. All of these sounds have more attack than resonance, and I've chosen very soft dynamics so that they can amalgamate optimally.

This texture has six appearances in the third mini-section, and is present more often than not in that place of the structure, and can be seen hence as a kind of *ritornello*, producing a certain circularity of coming and going. For that reason I opted to vary each appearance to avoid monotony, mostly by making subtle timbral variations and by including other actions as well.

5.2.4 Addition of another layer of action

At a certain point of the composition process, I decided to create a different, superimposed structural layer that acted in a subtler and different sonic way. The idea was that such a structure would not coincide with the modules of the structural line, but instead created a juxtaposed sound reality, acting as a sound filter activated and deactivated occasionally at apparently random times. In order to create such new structural layer, I used the letter-numbers that had been originally excluded from the number list and macro-structure order: 19 (*S*), 18 (*R*) and 20 (the last *T*) from the word *DISTRACTFOLD*. By recalculating the original (and hypothetical) duration of the piece with the now complete generating word, I obtained a new structure different in its macro-proportions to the one used for the original structural line (fig.69).

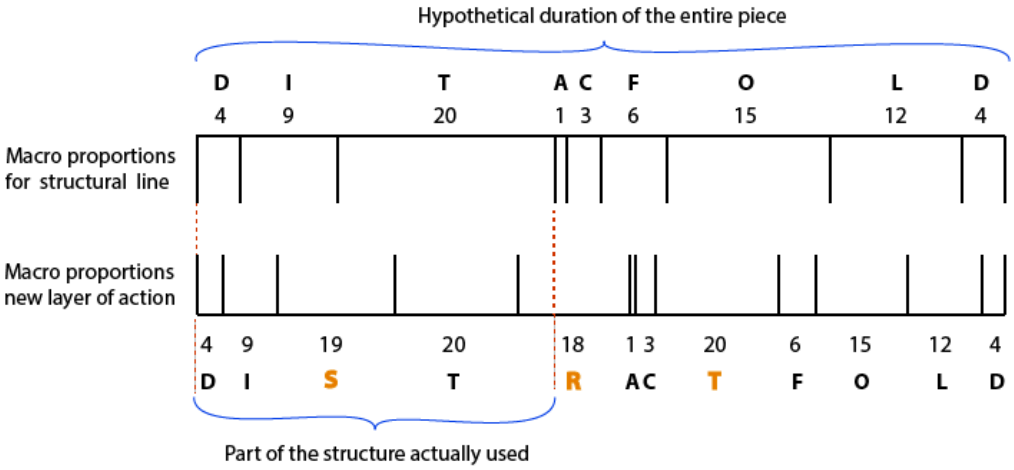


Fig.69: Structure of additional layer of action, constructed using previously omitted letter-numbers.

After the first level was calculated from the entire hypothetical duration of the piece, I proceeded to create one more layer of structure at the next smaller scale, consisting of inserting the word *DISTRACTFOLD* proportionally into the spaces recently created. I decided that the activity would take place during the time-spaces corresponding to the originally omitted letters *S-R-T*, and next in their negative spaces and so on. This can be observed in figure 70: the hatched areas correspond to the zones where the additional layer acts.

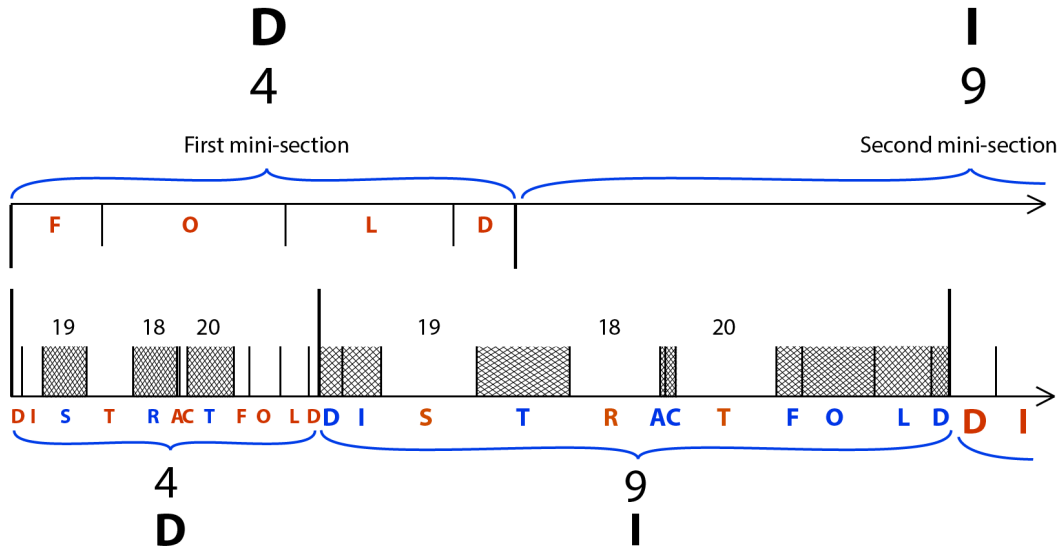


Fig.70: Additional layer of sound activated at the hatched areas.

The important thing now was to decide what type of sound activity would occur within the new layer. I decided to use an analogy of wet and dry sound for this level of action, assigning a sustained tremolo to the wet parts in the structure, and doing nothing in the dry parts (indicated by the blank spaces of the figure shown above). In the 'wet' spaces (occurring in the hatched areas) one or more instruments would perform a tremolo either as a single element, or as an additional action to the text from the mother-line. The case of a tremolo occurring as a single gesture was assigned often to the percussion, specifically to the snare drum played with metal brushes. The other case, where an ongoing musical text 'gets wet' by the addition of a *tremolando* technique, was assigned usually to the bowed strings (fig.71).

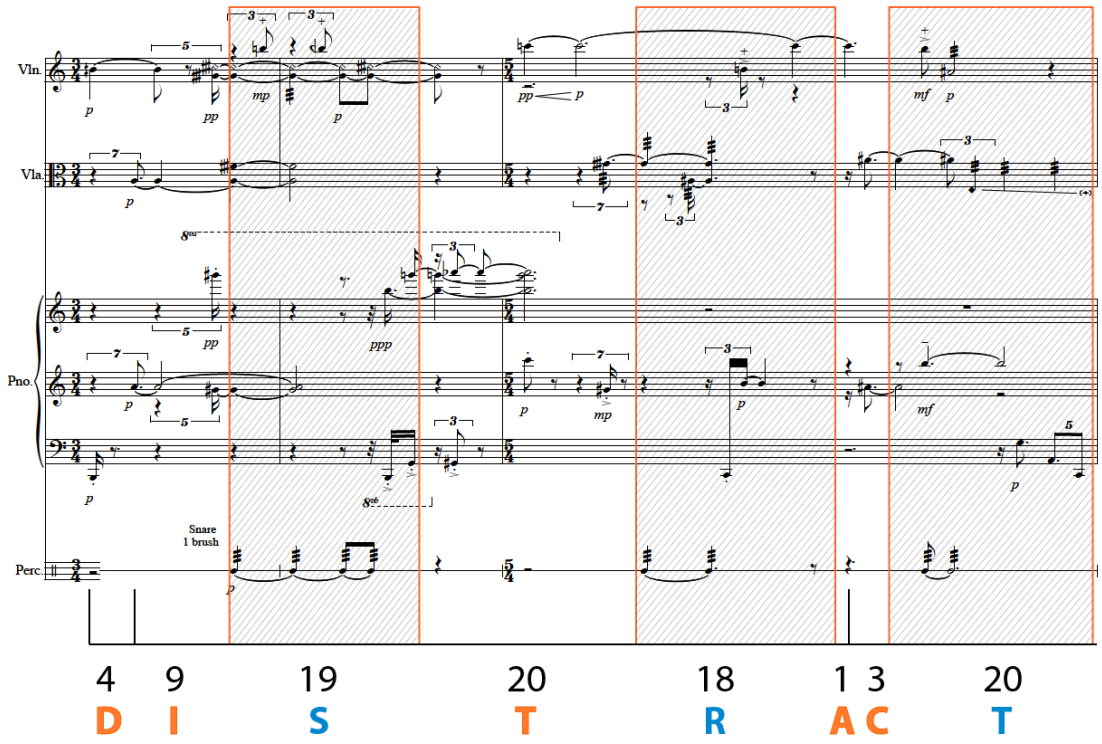


Fig.71: 'Wet' and 'dry' moments in the first measures of Ohne.

Figure 71 shows how the wet action was activated and deactivated through the inclusion of various tremolo actions in the string and percussion parts. (The

most apparent is the tremolo done on the snare drum, as a single action). In the case of the strings, the superimposed layer affects the execution of other texts constituting an additional action.

5.2.5 Economy of construction means

As can be inferred from the mechanisms used to produce the different materials, one of the premises in the composition of *Ohne* was to apply an economy of means in order to gain unity from a structural and sound point of view. The structure examined in section 5.1 occupied roughly half the duration of the composition, with the intention to reuse some of the previous structures generated instead of continuing to create new structures in the same manner. In that sense, the second half of the piece was constructed exclusively by recycling structures from the first half.

In terms of instrumental density, the piece starts to narrow from the moment that the third mini-section ceases, as the percussion makes its last appearance in bars 94-95; the viola ends in bar 123, there is a piano solo that ends in bar 152, and the violin remains from bars 148 to 161 playing a sustained double stop of harmonics to mark the end of the piece. In its entirety, the second half of the piece comprises subsequent short trios, duos and solos. The idea behind this progressive modular reduction, contrasting with the first half, was to imagine that I start looking at the structure from its side, as opposed to a frontal view. In such a shift of perspective, modular layers could be seen and ordered differently. This is like being in a library and observing a shelf that is not completely full of books from a frontal perspective, and seeing through the gaps what the shelves from behind contain, completing the total image through those ‘windows’. The second half of the piece, on the other hand, corresponds to walking to a position where the shelves can be seen from the side, separated from each other by corridors. That is how I progressively treated structures and instruments in the second big section, as separated entities isolated by corridors.

For instance, the long piano solo situated close to the end of the piece contains in the left hand all of the modules from the third emerging layer glued one after another, as if they were being observed from the side as a separated row of events. As explained earlier, this layer contains seven different modules, all of which repeat at least once. The piano texture of the solo was enriched by a second additional voice in the right hand that was constructed using the same modules in the same order, but now inverted, with lower values becoming longer in duration and higher values shorter, contrary to how the mechanism worked in the first half of the piece (fig.72).

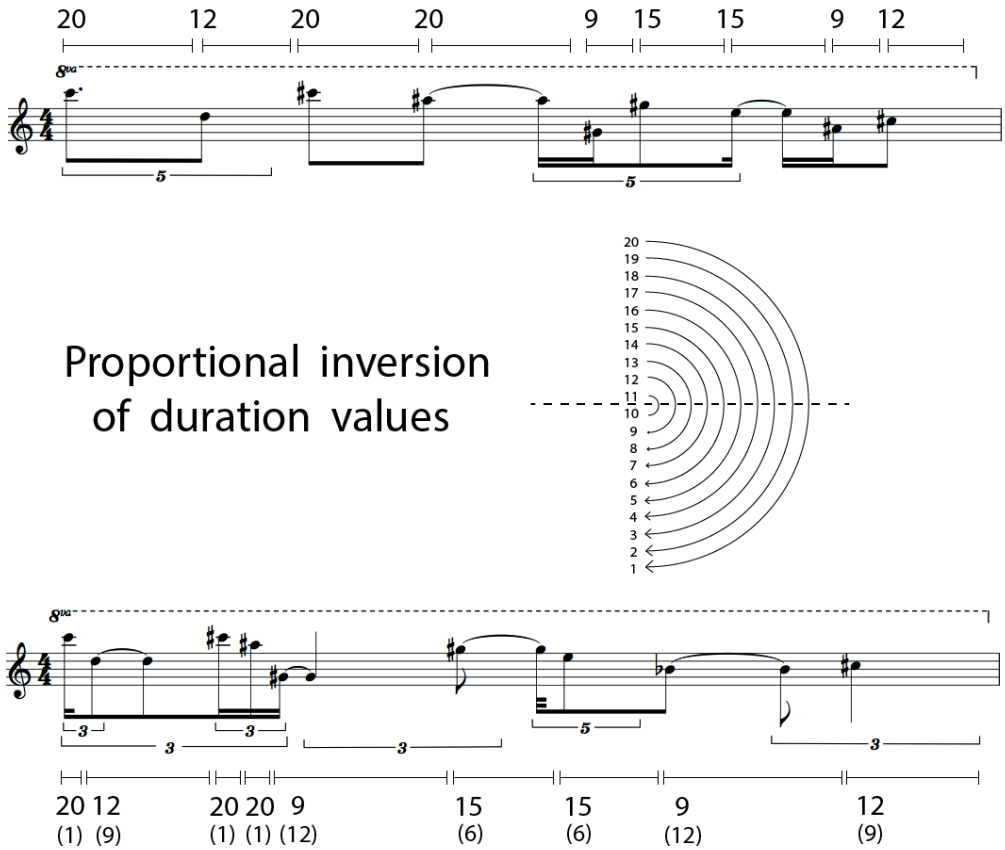


Fig.72: First module of the third layer with direct and inverted rhythmic proportions.

The first part of figure 72 shows the first module of the third layer with its rhythmic proportions interpreted directly: the higher the number, the longer its duration. The second part demonstrates the result of inverting that relation proportionally—the higher the number, the shorter its duration—which

produces an interesting variation of the module since pitches maintain their original place. This new rhythmical material was used previous to the piano solo, first by the violin in the third appearance of the texture corresponding to the third structural layer (shown in 5.2.3), and then in short fragments made by the piano as an additional layer to the duos and trios of the second half of the piece.

Later in the solo piano section, the two versions of the material are collapsed together, one in each hand, but with the exception that the left hand is transposed down a fifth. This transposition was done first to avoid the collisions of the two hands (hindering each other because of playing the same notes with different rhythms), and second because I preferred to use the fifth as a sub-harmonic, enriching the harmony (instead of the octave or any other interval). The result then is a crystalline texture formed by a series of displaced fifths, which are nonetheless heard simultaneously each time that a new module appears (fig.73).

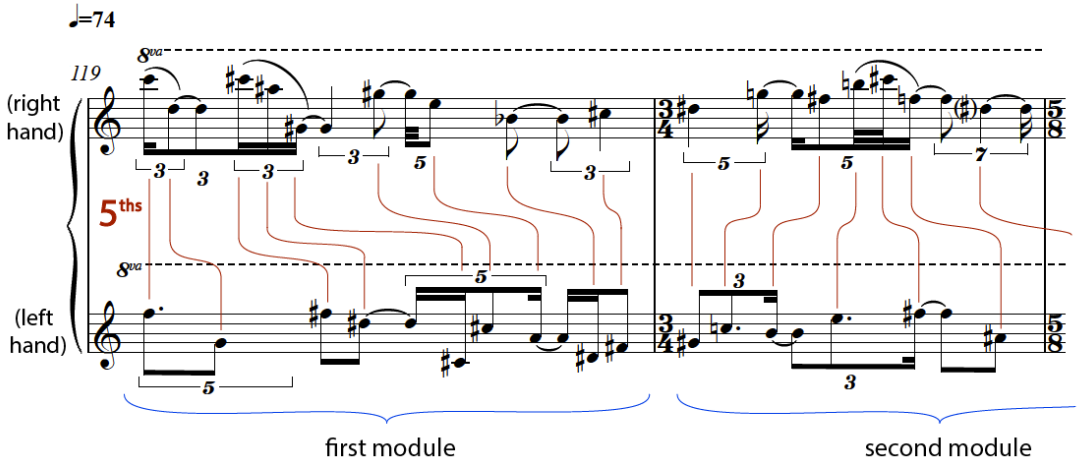


Fig.73: Direct and inverted rhythmic proportions producing displaced fifths in piano solo section.

The decision to have only seven different modules instead of 20 in the third emerging layer of the third mini-section was both aesthetic and practical. Such a decision enhanced a perceivable circularity in the solo that I was interested to produce, which is indeed one of the main attributes of the entire piece, given its modularity and formal fragmentation. On the other hand, using only seven

modules made the job of the pianist easier, as the solo section is very difficult to play due to the different rhythms on each hand plus the registral leaps: learning seven modules instead of 20, and repeating them with slight variations, certainly makes the task easier. It also helps that the left hand plays all modules (of the third layer) in the same order than already played (though transposed a fifth lower), and that the right hand plays all of the pitches of the third layer in the exact order already played (although with a different rhythm).

Summary of Chapter 5

In this chapter we have examined the two phases conforming the composition process of *Ohne*: the first consisting of the construction of a line by connecting points in pitch and time and the second comprising the orchestration of such a line. In the construction stage of the process we examined how different points in time and pitch were fixed by using a set of numbers. In that procedure, three different levels of magnitude were progressively frozen from the macro-level towards the micro, and the subsequent sections involved an accumulation of old and new structures. Throughout the process the line gradually became denser as new sections formed, involving a series of operations and calculations.

The second stage, consisting of the orchestration of the structural line, unveiled other types of concern in relation to local decisions, such as highlighting fortuitous events formed by proximity and a more direct approach to sound. In this phase the constructed line functioned as a *cantus firmus*, since a number of structures and layers derived from it were superimposed at different moments. Then we saw the creation and superposition of a new and similar macro-structure intended to add a subtle sonic layer to the overall piece, and later the display of a marked concern with economy of means (especially in the second half of the piece) involving the constant reutilization of previously created structures.

In the aftermath of this composition I realised that two main criteria were unconsciously applied during the process. The first can be defined as *disguising intention as randomness,* which means trying to encode a desired behaviour into the generation mechanisms of the system in order to obtain a sought musical result, but involving at the same time randomness in order to hide *intention* by the production of a rather statistical outcome. This relates for example to sonic ideas that I intuitively wanted to attain prior to defining the line construction mechanisms, and the subsequent ways in which I tuned the rules in order to generate the desired outcome. The second criteria used alludes the opposite view, consisting of *disguising randomness as intention,* which refers to the attitude of assuming a given random outcome—in this case the structural line—as a locally intended act, by presenting it through orchestrational means that highlight their particularities as if having involved a conscious local construction. Such criterion was ever-present in the orchestration phase, just as the former criterion was constantly present in the construction stage.

Final thoughts

As it has been elucidated throughout the commentary, using lines as the basic building blocks of music has allowed exploring different aspects of the imagination of sound in time, and to implement a combined approach involving the visual, the aural and the haptic. For instance, conceiving slowly changing sounds as line-objects made it possible to consider the idea of materiality from a creative perspective and to push that idea further towards more concrete aspects such as lines' physicality, by conceiving them as either physical objects in themselves or as being the result of physical actions. This opened a range of creative possibilities in relation to the forces involved, such as friction, bending and certainly a great deal of resistance. Later, it seemed as a natural course of action to explore the fragmentation of lines, by taking into account their two basic dimensions: pitch and time. Such a perspective questioned and at the same time confirmed the continuous essence of lines, proving to be fruitful by unveiling lines' capacity to endure small fragmentation (pixelation) and revealing lines' resonating potential by doing so. Concerning the different approaches to line combination commented on Chapter 4, namely blurring and fluid behaviours, they provided useful ways to confront the use of multiple lines, which were consistently helpful in the composition of the pieces from the portfolio, especially the ones involving several instruments/performers. At last, the idea of line construction and orchestration brought about the possibility of conceiving lines as collections of points to be worked and transformed subsequently using imaginative approaches. Although the music in *Ohne* challenged some of the defining features of lines due to its marked modularity, it also opened other possible approximations such as applying the idea of brittleness to lines.

During the development of this set of ideas I have come to realize that the richness of sound sought in lines' materiality as well as the search for interesting acoustic situations produced by their fragmentation and combination have all arisen from the necessity to somehow compensate lines' general lack of figure-like information, due to their slow and smooth movement. This became clear gradually as I saw that most of my line-models pointed to aspects surrounding line phenomena rather than affecting their formal or figural nature, which remained untouched once their movement 'axioms' had been established.

By looking retrospectively, I realize that my compositional approach when beginning the PhD studies was at the end of a stage marked by a preoccupation with construction means and the formalization of techniques of material generation, which is reflected in the first piece of the portfolio: *Ohne* (presented here in the last chapter). After that certainly worthwhile experience, I decided to start over from a very different approach with the composition of *d'uno*, in which, inspired by past experiences that I had in the Chilean desert, I focused for the first time almost exclusively on long and smooth lines (*d'uno* being in that sense a foundational piece in embracing a smooth-line approach). From that point onwards it felt natural to continue enquiring about the different sound worlds that may emerge from these line-objects as well as imagining other conceptual and practical investigations, as I did in the following pieces.

In considering some hypothetical developments and possible paths to explore in the future within a line approach, I think that the main aspect to be addressed next is lines' inner temporality as determining the long formal trajectory of pieces, since in most works from the portfolio the macro formal idea was approached in rather sectional ways, involving often pre-compositional formal divisions. That being said, I believe that all of the approaches embarked upon in this thesis—line materiality, physicality, fragmentation, blurriness, fluidity and orchestration—have great potential to be developed further and to be combined in endless ways.

Bibliography

Ablinger, P. (2004). *Metaphors*. (Unpublished translation of *Metaphern* (2004). In Sanio, S., Scheib, C., Kulcsar, F., Klein, N. M., & Musikprotokoll (2004). *Übertragung - Transfer - Metapher: Kulturtechniken, ihre Visionen und Obsessionen*. Bielefeld: Kerber.

Albers, A., & Danilowitz, B. (2000). *Anni albers: Selected writings on design*. Hanover, Conn;London;: University Press of New England.

Bell, A., Harris, N., and Rothery, D. 2008. *Block 3: Internal Processes*. Milton Keynes: Open University Worldwide.

Bell, F. G. 1983. *Fundamentals of engineering geology*. Hyderabad: BS Publications.

Boulez, P. 1987. *Penser la musique aujourd'hui*. Paris: Denoël u.a.

Butler, C. H., Zegher, C., & Museum of Modern Art (New York). (2011). *On line: Drawing through the twentieth century*. New York: Museum of Modern Art.

Chase, R. (2003;2004;). *Dies irae: A guide to requiem music*. US: Scarecrow Press.

Close, C., 1940. (2005). *Chuck close: Recent paintings: May 10-june 18, 2005*. United States.

Danchev, A. (2011). *100 artists' manifestos: [from the Futurists to the Stuckists]*. London: Penguin Books.

Daubresse, E., Assayag, G., and Fineberg, J. 2000. "Technology and creation — The creative evolution". *Contemporary Music Review.* 19 (2): 61-80.

Deleuze, G., Guattari F., and Massumi, B. 2013. *A thousand plateaus*. London: Bloomsbury.

Derrida, J. 1996. *Speech and phenomena, and other essays on Husserl's theory of signs*. Evanston: Northwestern University Press.

Dickson, I. (2012). Towards a grammatical analysis of scelsi's late music. *Music Analysis, 31*(2), 216-241.

Dougherty, R. C. (2013). *Natural Language Computing: An English Generative Grammar in Prolog*. Psychology Press.

Emmerson, S. (1986). *Language of electroacoustic music*. Houndmills: MacMillan Press.

Fernie, D. (2016). *Hawthorne, sculpture, and the question of American art*.

Friedman, M. L. (2005). *Close reading: Chuck close and the art of the self-portrait*. New York;London;: Harry N. Abrams.

Gottschalk, J. (2016). *Experimental music since 1970*. New York: Bloomsbury.

Ingold, Tim. 2007. *A brief history*. London: Routledge.

Johnston, I. 2002. *Measured tones: the interplay of physics and music*. Bristol: IOP.

Kanach, S. E. (2013). *Xenakis matters: Contexts, processes, applications*. Hillsdale, N.Y: Pendragon.

Klee, P., & Spiller, J. (1961). *Paul klee: The thinking eye: The notebooks of Paul Klee*. London: Lund Humphries.

Kudielka, R., & Riley, B. (2002). *Paul Klee: The nature of creation : Works, 1914-1940*. Aldershot: Lund Humphries.

Lasso, O. ., & Sandberger, A. (1926). *Magnum opus musicum: Lateinische Gesänge für 2, 3, 4, 5, 6, 7, 8, 9, 10 u. 12 Stimmen ; T. 11 ; für 8, 9, 10 und 12 Stimmen*. Leipzig: Breitkopf & Härtel.

Lucier, Alvin, Gisela Gronemeyer, Reinhard Oehlschlägel, Douglas Simon, William Duckworth, James Tenney, Daniel James Wolf, and Alvin Lucier. 2005. *Reflections: interviews, scores, writings 1965-1994 = Reflexionen : Interviews, Notationen, Texte 1965-1994*. Köln: MusikTexte.

McCarthy, S. (2005). The art portrait, the pixel and the gene: Micro construction of macro representation. *Convergence: The International Journal of Research into New Media Technologies, 11*(4), 60-71. doi:10.1177//1354856505061054

Millán, G., & Zaldívar, M. I. (2007). *Veneno de escorpión azul: Diario de vida y de muerte*. Santiago, Chile: Ed. Univ. Diego Portales.

Molnar, V., & Bacle, G. (2009). *Véra Molnar: Journaux intimes 1976-2003*. Rennes: Université Rennes 2 Haute Bretagne.

Molnar, V. (2014). *Vera Molnar – SOLO*. Exhibited at the DAM GALLERY, Berlin, 11.04-11.06.

Newton, I. 1687 (2016). *Philosophiae Nturalis Principia Mathematica*. S.l.: Forgotten Books. Dinslaken: Anboco.

Nonhoff, N. 2005. *Paul Cezanne: life and work*. Konemann: Koln.

Picard, M. D. & High, L. R. 1973. *Sedimentary Structures of Ephemeral Streams. Developments in Sedimentology, vol. 17*. Elsevier Scientific Publishing Company, Amsterdam, London, New York.

Richter, G., Elger, D., & Obrist, H. U. (2009). *Gerhard Richter: Text: writings, interviews and letters, 1961-2007*. London: Thames & Hudson.

Sadie, S., & Tyrrell, J. (2001). *The new Grove dictionary of music and musicians*. New York: Grove.

Szlavnics, Ch. (2006). *Opening Ears: The Intimacy of the Detail of Sound*. *Filigrane, 4*. Sampzon. Éditions Delatour France.

Xenakis, I., & In Kanach, S. (1992). *Formalized music: Thought and mathematics in composition*. Stuyvesant, New York: Pendragon Press.

Xenakis, I., & Varga, B. A. (1996). *Conversations with Iannis Xenakis*. London: Faber and Faber.

Webography

Billone, P. (2006). *On 1+1=1*. Retrieved from http://www.pierluigibillone.com.

Chandler, D., & Munday, R.motion blur. In A Dictionary of Media and Communication. : Oxford University Press. Retrieved 24 Sep. 2017, from www.oxfordreference.com.libaccess.hud.ac.uk/view/10.1093/acref/9780191800986.001.0001/acref-9780191800986-e-1784.

Fallowfield, E. (2010). *Cello map*. Retrieved from http://www.cellomap.com.

"Porrectus." *Grove Music Online*. *Oxford Music Online*. Oxford University Press, accessed September 25, 2017, http://www.oxfordmusiconline.com/subscriber/article/grove/music/22127.

Riley French, J. (2014) Reflections on process in sound, issue 3, summer 2014 p.10-23. http://www.reflections-on-process-in-sound.net/issue-3/.

The Tech Blog. (2010). *3d-technology*. Retrieved from http://www.techeblog.com/index.php/tech-gadget/3d-technology.

Images

Barbosa, L.V. (2007). Triangular prism dispersing light. , retrieved from https://en.wikipedia.org/wiki/Prism.

Berson, B. (2013). Used guitar string. , retrieved from http://www.optics.rochester.edu/workgroups/cml/opt307/spr13/ben/.

Close, C. (1987-2010). Self portraits. , retrieved from www.chuckclose.com.

Colantonio, P. (2009). quebrada humahuaca. , retrieved from https://www.flickr.com/photos/argentravel/4626113063/.

Ferro Martins, J. (2010). Cymbal scratching. , retrieved from http://cargocollective.com/joaoferromartins/INSTALLATION.

Hood, D. (2014). Braided River. , retrieved from https://www.flickr.com/photos/thoughtfulbloke/.

Klee, P. (1930). Polyphon gefasstes Weiss. , retrieved from http://paulklee.fr/.

Molnar, V. (2015). Sainte-Victoire Blues II nº1. , retrieved from www.veramolnar.com.

Molnar, V. (2012). Six millions sept cent soixante-cinq mille deux cent Six millions sept cent soixante-cinq mille deux cent une Sainte-Victoire. , retrieved from https://www.bernardchauveau.com/fr/.

One Million + views (2013). Stain Glass Reflection. , retrieved from https://www.flickr.com/photos/53132575@N04/.

Richter, G. (1988). Confrontation 1. , retrieved from www.gerhard-richter.com/.

Ritsch, W. (2014). finger_klavier_detail. , retrieved from http://algo.mur.at/.

Smart, M. (2010). 3-D Anaglyph. , retrieved from www.marksmart.net.

St. John, J. (2015). Faulted interbedded metagraywacke-slate. , retrieved from https://www.flickr.com/photos/jsjgeology.

Supranowitz, C. (2005). Record groove sample. , retrieved from http://www.optics.rochester.edu/workgroups/cml/opt307/spr05/chris/.

Ugarte, F. (2013). Untitled (line of graphite and wall). , retrieved from www.franciscougarte.com/.