Polyphonic Structures:

Modular models and modular forms

(a creative investigation of mobile musical architectures)

Portfolio of compositions and commentary

Thesis submitted for the degree of Doctor of Philosophy

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I hereby declare that the present work and the works in the accompanying portfolio are my own except as otherwise specified.

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To my sons.

ABSTRACT

Polyphonic Structures: Modular models and modular forms[1] is a creative research project that exploits the relations between independent pieces, structures and sonic events as self-contained moments. The dissertation describes a number of general and particular compositional strategies, techniques and constructivist explorations which are intimately related to the compositions included in the portfolio as a single body of work. The doctoral research includes a portfolio of the following compositions; *Apposition (figures of disorder), Archipiélago, 24-Modular Cells, Free Module Study n°1, Systematic Double Bind and Within Modular Objects.*

Combining different pieces as polyphonic structures, in part or in total, to create new works, and the development of novel compositional strategies through interrelated pieces, have been explored by many composers. The most influential of these is Karlheinz Stockhausen. His ideas to interconnect pieces within a distinctive variety of compositional procedures have been the prime musical concepts from which the research dissertation and original works germinated. However the exploration of the ideas develop by Iannis Xenakis in theory of grains of sounds and Curtis Roads in Microsound has been crucial to define the modularity. Ultimately, the conception of Brian Ferneyhough's figure and gesture has been crucial to incorporate micro-modules as self-contained singularities.

Moreover, the research is an attempt to establish methodological linkages between self-contained and self-sufficient units. In this manner, the study of Bertrand Russell's logical atomism help me to define the smaller unit in a musical context. Accordingly, modularity has been used as a key element to define the structural and analytical method throughout the dissertation. Furthermore, Gilles Deleuze and Pierre-Félix Guattari's rhizome theory turned out to provide a valuable framework to establish a conceptual link generator.

Thus, the commentary summarises a personal approach to some of the principal issues related to contextual discontinuity and multi-layer structuralism. However, no matter how vital rhizome theory has been, the use of dichotomies and the linear process has not been completely avoided. The inquiry into new forms of interaction has led the research to map possible strategies to break the traditional binary thinking and linear unidirectional processes.

The documentation of the compositional techniques, concepts and structures presented in the following dissertation has the sole intention of defining a particular and personal methodological framework.

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[1] ***Modular forms*** *– are functions with an enormous amount of symmetry which play a central role in number theory connecting it with analysis and geometry. They have played a prominent role in mathematics since the 19th century and their study continues to flourish today. They occur in string theory and played a decisive role in the proof of Fermat's Last Theorem. Modular forms formed the inspiration to Langlands' conjectures and are expected to play an important role in the description of the cohomology of varieties defined over number fields. There are five fundamental operations in mathematics: addition, subtraction, multiplication, division and modular forms. (Apocryphal statement ascribed to Martin Eichler, 1912) – (Bas Edixhoven, Gerard van der Greer, Ben Moonen, Modular Forms on Schiermonnikoog, 2008 – Cambridge University Press)*

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. Introduction

Polyphonic Structures: Modular models and modular forms is a creative PhD research that investigates the possible interactions between independent pieces that can be combined in larger works. It includes a portfolio of the following compositions: *Archipiélago, Apposition (figures of disorder), 24-Modular Cells, Free Module Study nº1, Systematic Double Bind and Within Modular Objects.*

Any doctoral investigation has as its basis the research of novel ideas or distinctive perspectives on existing ideas. In that sense, my experimentation has developed a relation between *momentform*[2] and modularity – *modular structures* and *modular forms* – in supra, macro and meso-structures. The starting point has been the development of a systemic unity of diverse categories with a distinctive use of different compositional techniques within the framework of a unifying model. In the following chapters, this dissertation attempts to relate philosophical, conceptual, analytical and musical parameters with working procedures developed by thinkers and composers that have been and are relevant to me.

Working with mobile structures that are considered self-contained musical moments which are recombined to create new polyphonic structures, has been explored by many composers. The most influential of those is Stockhausen due to his ideas to interconnect pieces within a distinctive variety of compositional strategies.

As starting point, to develop a systemic line of action, the research focused on the momentform theory and its possible subsequent application. The main characteristic of this subject-matter is the importance it attaches to individual segments. Therefore, the construction of larger structures gravitates around these individual structural segments. These segments are considered self-contained and self-sufficient units. Ultimately, (Whittall 2008) it is an attempt to substitute the goal-directed development by a non-cumulative structure which avoids the cause/effect action. Stockhausen (1963) describes the concept as "a non-linear development where the musical events do not take a fixed course between a determined beginning and an inevitable ending. The moments are self-sufficient structures and not merely a precedent or a consequence of any other musical idea."[3].

Later, Stockhausen introduced the idea of Inserts – *Einschübe*[4]. These are short excerpts inserted between moments. Consequently, the musical context into which the inserts are interspersed strongly modified their perceivable characteristics. Therefore, the focus was driven by two central ideas; how Stockhausen approached each piece with new strategies and how he constructed modular elements or formulas, referential for the development of independent but interrelated pieces. Consequently, one of the main issues has been how to implement a personal reinterpretation of Stockhausen's conception of momentform as the domination of the vertical over the horizontal

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[2] ***Momentform*** *– a concept of Stockhausen's which sought to focus maximum weight on the individual structural segments that make up larger wholes. By regarding each segment as self-contained and self-sufficient, Stockhausen was attempting to provide a definitive substitute for the cumulative, goal-directed formal design of classical and romantic tradition. (Whittall – Cambridge Introduction to Music: Serialism-Cambridge: Cambridge University Press, 2008)*

[3] ***Stockhausen*** *– 1963, p.250, translated in Wörner 1973, p.46-47*

[4] ***Einschübe*** *– Momente CD booklet 1975, Deutsche Grammophon 2709055*

dimension without rejecting the horizontal development of musical parameters.
Therefore, momentform, more precisely the "*Einschübe"*, has been the axis used to relate modularity with discontinuity. The concept has been expanded by the application of diverse compositional strategies and the consideration of the modular agents as an autonomous body. A key point has been the perception of micro units as self-contained moments with distinctive characteristics. It has been crucial to understand the micro units as independent elements not dependant of the relational material in the sequential macro-form. Likewise, this ideological subject-matter has been explored to develop a systemic interaction/combination/recombination, in a parametrically defined framework, of different pieces, sections of pieces, segments or fractions.

Hence, the hypothesis of a self-contained and self-sufficient moment is reinforce when applied to elements developed in longer timescale – meso-timescale – as well as to elements developed in very short timescales – sound object timescale. As a consequence, this relationship has reinforced the personal interpretation of the timescale as the primary delimiting element of the moment. Consequently, the moment is defined by the perceptual characteristics of each segment in the timescale. Likewise, the conceptual combination of momentform and modularity allows the development of a simple idea that can be used in very different formal and sound environments: that is, to develop a systematic plan that can define the structural organisation as well as embrace a common principle to be applied to all strata of the compositional process.

Thus, it has been crucial to my research to understand the moment as a module of a variable timescale. Such an understanding will help establish a versatile strategy to define the procedures through which distinctive independent mobile structures interrelate.

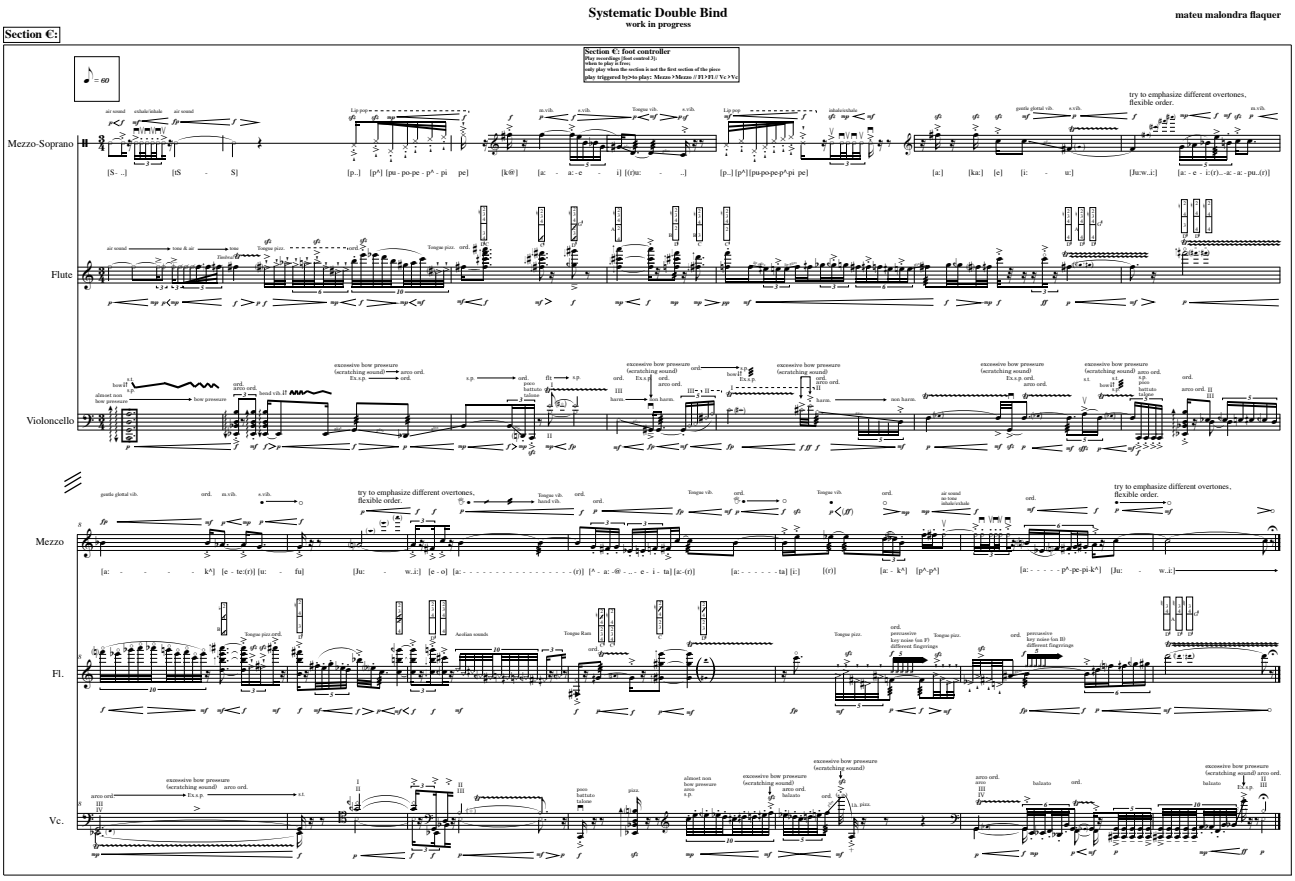

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Fig.1.1: Score example: Systematic Double Bind. For detailed explanation, see chapter 7

2. Musical and creative context

Throughout the research process, I developed modular composition strategies to clarify remote relations within disassociated elements. I believe that modular agents are able to define and encapsulate the musical material in a concise and ductile manner. Moreover, I also established a structural formalism derived from the modularity theory. This strategy has been a way to relate the inner architecture of my work with the sonic event and the musical process. In this respect, the conceptual search for an elementary particle to formalize the work in all its dimensions, was influenced by the philosophy of Russell's, more precisely by the *logical atomism* hypothesis.

> The reason that I call my doctrine logical atomism is because the atoms that I wish to arrive at as the sort of last residue in analysis are logical atoms and not physical atoms. Some of them will be what I call "particulars" — such things as little patches of colour or sounds, momentary things — and some of them will be predicates or relations and so on. The point is that the atom I wish to arrive at is the atom of logical analysis, not the atom of physical analysis.
> (Russell 2010, p.3)

During the early stages of the research, the application of a modular theory as related to momentform was an attempt to define encapsulations of musical elements and musical relations in the macro-structure. Gradually, the development of a compositional system based on modular structures and modular forms was expanded to all strata of the compositions. Introducing the concept of logical atomism enabled the inquiry to navigated from the macro to the micro. The *modularity hypothesis* and the use of *modular agents* as a strategy to independently deal with fragmented parts of a problem with a higher level of complexity is a general model for many disciplines. I have been working on a model where the musical elements are locked within the modular agents or *modular-cells*[5]. The modular-cells are self-contained sonic events that can be considered, at any moment, as independent units not dependant on the local context or of supra-structures. However, there is not a stratified hierarchy to subjugate the contextual elements. On the contrary, each set of independent pieces – henceforward called *set of sub-pieces* – can develop distinctive relational strategies.

Considering this framework, I have to highlight that modularity is a simple idea that can connect macro and micro formal structures and defines the use of distinctive sets of sub-pieces that will be finally used to create the culminating piece. It is also a useful model to define the work with harmonic material and other sonic elements. The modular-cells can be understood as a structural formal agent, pitch organisation sets and non-pitched sonic sets. Nonetheless, the applicability of modularity can be extended to the methodologies applied to density, timbre and harmony and it can be traced down to the vertical and horizontal contextual relation of the micro segments, the logical atoms. It is also applicable to gestures, motives, phrases and themes embedded in a framework for short and long-term developments. Within the module, these musical elements are locked, fixed and parametrically defined as units. Modular-cells have, by themselves, a distinctive identity that can be replicated. The use of modular-cells defines different levels of flexibility in the sound production

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[5] ***Modular-cells*** *– Is a term I used to refer to modules as a systemic idea. It is not a concrete element in the system. Modular-cells are sound objects that behave as musical unities of diverse time scales. Modular-cells can be understood as musical objects.*

but also communicates with the performer in a very structural and concise way. However, at an organisational level, modularity is a useful tool to define and located the fragments and analyse the ties and linkages between element.

Furthermore, when introducing free formal structures, the precision and thoroughness that modularity provides to delimit the elements and materials helps to communicate schematically and to illustrate which modules are horizontally or vertically exchangeable. It essentially clarifies and simplifies the decision making; it establishes clear boundaries between approximate and exact sonic events; it is a concise method to assign each modular-cell to a time scale. Therefore, in a relational matrix, time position and modular agents facilitate the use of units of a variable number of elements. Likewise, if fixed and approximate notation are interrelated in a sub-piece, modularity offers a clear model to delimit sections, musically and graphically – implementing the use of different notational methods. The modular-cells, in such cases, help to clarify which are the musical elements that are locked together and which explore a higher level of freedom, especially when the modules are juxtaposed in a discontinuous context. Chapter 7 is an attempt to shed some light on my personal use of modularity as a model to formulate a hybrid framework of fixed notation and guided improvisation instructions.

Thus, in a broad sense, the inquiry for relational operators to interconnect mobile modular-agents across different levels of the musical discourse, led me to research theories developed in other domains, two in particular: relational data and philosophy. This particular investigation has favoured the establishment of a common principle to define the use of modularity in a model that can navigate between relational and non-relational elements.

In the field of relational data, the focus has been directed towards social network, particularly the theory of *stochastic-models*[6] (Holland and Leinhardt 1981) *and block-models*[7] (Faust and Wasserman 1994). The stochastic-models are based on the unpredictability and indeterminacy of the events. This model has been applied in my free form and free choice musical material work, *Systematic Double Bind.*

Nevertheless, an analogy of the block-model theory has been applied extensively to the musical structural framework of the compositions. The application of the concept was influenced by the reading of *Social Network Analysis: Methods and Applications* (Faust and Wasserman 1994). According to the authors, "a block-model is a model or a hypothesis about a multirelational network".

In short, two key elements, the mapping and the matrix, form the basis of the block model:
1. The designation of agents or units to a unique position is described by the mapping. Therefore, the elements are divided into subsets which are attached to a position.
2. The inclusion or exclusion of ties between positions and those contained in the subsets are determined by the matrix. Likewise, the relationships generated by the ties remain consistent between positions.

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6 ***Stochastic-models*** *– A model which is base on unpredictability, indeterminacy and aleatory events. (my own definition)*

7 ***Block-models*** *– A blockmodel consist of two things:*
(i) A partition of actors in the networks into discrete subsets called positions
(ii) For each pair of positions a statement of the presence or absence of a tie within or between the position on each of the relations
(Stanley Wasserman and Katherine Faust 1994, Social Network Analysis : Methods and Applications – Cambridge University Press, New York)

The mapping and the matrix help to define the overall characteristics of the network which are determined as ties between positions and not as individual features.

Thereupon, if this idea is applied in the meso-timescale – or macro structure – the modular-agents positioned in a piece and sub-piece are related by the ties, connectors or inserts that link them. These ties can be defined by the compositional strategies and musical processes: by the polyphonic interaction and texture; by interpolation of generated inserts; by dynamics; by instrumentation; by the instrumental grouping and physical position of the instruments when dealing with the space situation or by the fragmentation of the primary material. Therefore, the information about the modular individualities is defined by the distinctive palette of primary materials. At the macro-level, the investigation has been towards a systematic non-linear modular approach in a conceptual platform where the interactions between references of equal importance and distinctive modular agents, are potentially endless.

In any given structure, when diverse and distinctive parts are fragmented and reassembled, the study of new forms of development by dissociation, concatenation or juxtaposition and the use of detached musical elements, makes continuity an essential issue. Hence, my first attempt to work with discontinuity as a compositional strategy was based on the disruption of the linear and circular developments by inserting new and unrelated modular-cells.

I was interested in a system that enabled linear developments [A-B-C-D and so on] or circular developments [A-B-C-B-A]. However, I also used unrelated modular inserts to disrupt the linear or circular progressions. Understandably, the introduction of inserts and fragments increased the level of disruption and discontinuity. This allowed me to understand fragmentation, not as an end point but as a new reference for novel connections. Thereby, discontinuity became a dominant element of my musical syntactic research. Therefore, elements are delimited and disconnected, but in a framework of potentially unlimited interconnections. Thus, some modular agents became considered nodal points to connect or relate with other modules in the matrix: linearly or between sub-pieces. The nodal points can be considered as inserts or fragments of a module, depending on the level of linear interconnection with the preceding and consequent elements. Accordingly, the adjacent multiplicity of modular-agents, which are modified by their context, has been a consequence of the fragmentation procedure.

> That is why the most resolutely fragmented work can also be present as the Total Work or Magnum Opus. Most modern methods for making series proliferate or a multiplicity grow are perfectly valid in one direction, for example, a linear direction, whereas a unity of totalization asserts itself even more firmly in another, circular or cyclic, dimension.
> (Deleuze and Guattari 1987, p.6)

The philosophical thought developed by Deleuze and Guattari started to influence the formal development of the interrelations between the pieces in a set and between sets. Nonetheless, rhizome concept is a philosophical attempt to provide an alternative to the classical binary thinking of cause/effect. Likewise, momentform aims to transcend the classical dichotomy of [A-B] form and the goal-directed musical structure of action/reaction. Moreover, my personal approach to this

issue is an attempt to emulate the principles of connection, heterogeneity, multiplicity and asignifying rupture to define and establish a preliminary conceptual ‘maquette’ as to where to interrelate the polyphonic structures.

Deleuze and Guattari (1987, p.1-25) define principles of *Rhizome* as follows: the first two principles are connection and heterogeneity. These principles define a rhizome as a network where “any point of a rhizome can be connected to anything other, and must be.” (Ibid, p.7) My personal interpretation of the theory has been the materialisation of subsets in time positions (mapping) and the definition of ties of relational material (matrix). Any piece or sub-piece can be and must be connected with ties, processes and strategies applied in other pieces and sub-pieces. Multiplicity is the third principle of a rhizome and “it is when the multiple is effectively treated as a substantive, *multiplicity*” (Ibid, p.8). In Deleuze and Guattari’s words, “multiplicity is a concept that ceases to have any relation to the One as subject or object.” (Ibid). This enables the modular-cell to be a recombined/replicable unity with multiple musical contextual references and it relates to Stockhausen’s *Insert;* self-contained fragments modified by the contextual syntax and not as an element with a fixed function.

As a fourth principle, a rhizome is defined by the “asignifying rupture”. “A rhizome may be broken, shattered at a given spot, but it will start up again on one of its old lines, or on new lines.”(Ibid, p.9) This postulation had significant implications to how the material has been modified. The approximation to fragmentation as an asignifying rupture is essential to understand the continuity of the musical elements – my personal approach to fragmentation is explained in subchapter 3.1. However, it is influenced by the use of crossroads through pieces and sub-pieces and the segmented modules as a potential beginning for new connections. Nonetheless, this idea against attributing too much significance to breaks which separate structures or which cut across a single structure, enables and favours the embedding, reuse and the economisation of the material.

Deleuze and Guattari’s concept, is defined by two more principles: the cartography and decalcomania. They assert that “a rhizome is not amenable to any structural or generative model” (Ibid, p.12). The research does not contemplate the application of these two principles in a nullifying or essential way due to the implicit structuralist principle in block-model and modularity. However, it influences the conceptuality of momentform, where the musical events do not take a fixed course between a determined beginning and an inevitable ending.

In this manner, rhizome as a framework is a strategy to develop the conceptual and structural – supra and macro – relational context to establish a primary model for interspersing musical information. Henceforward, my personal interpretation of rhizome abstraction was expanded to the work environment. The consequence has been extending the idea to the preparation and sketching process; generating outlines, flowcharts or graphic scores to define all the elements related to the creation. Hence, in a chain of expanded sets, the outline is reworked as graphic tablature that fruitful in the final notated score. Considering this versions of the same idea as a shadow score or a footprint, the material is transformed from a more or less unidimensional to a polyhedral idea. Ultimately, different states of the same sound reality can potentially be exposed simultaneously. This is a subject-matter and a process to be developed in further research.

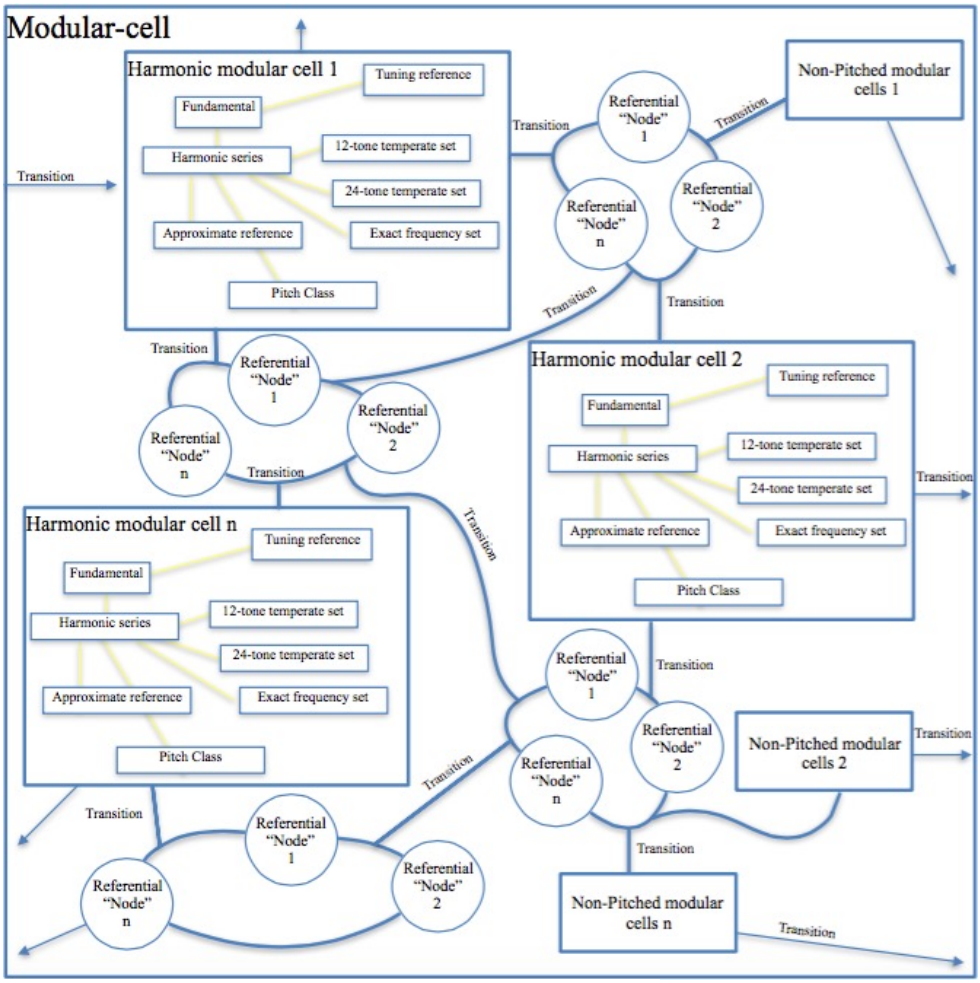

Fig.2.1: Schematic modular-cell outline (abstract produced as an illustration)

In this dissertation, the reader will have to accustom to a diversity of terms to identify basic categories defined as a collection of modular-agents. The research attempts to elaborate a basic modular epistemology based on time scales[8]. The formal modular-cells are modular-agents related to macro and meso time structures influenced by the idea of time scales of music (Roads 2001, p.3-4). However, within these time scale definitions, the modular-cells can develop independent strategies, parameters and distinctive musical processes. The primary generative modular-cells are: modules, blocks, capsules, microcapsules and envelopes – for an epistemological definition, see chapter 4.

The modular-cells are distinctive structures likely to be reproduced indefinitely. An obvious application of replicable forms is the repetition. Nonetheless, I do not approach modular structures as replicable models in a chain of clones. However, in recent works, I have introduced the use of repeated modules in various contexts.

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[8] ***Time scales of music*** –
1. Infinite: The ideal time span of mathematical durations such as the infinite sine waves of classical Fourier analysis.
2. Supra: A time scale beyond that of an individual composition and extend- ing into months, years, decades, and centuries.
3. Macro: The time scale of overall musical architecture or form, measured in minutes or hours, or in extreme cases, days.
4. Meso: Divisions of form. Groupings of sound objects into hierarchies of phrase structures of various sizes, measured in minutes or seconds.
5. Sound object: A basic unit of musical structure, generalizing the traditional concept of note to include complex and mutating sound events on a time scale ranging from a fraction of a second to several seconds.
6. Micro: Sound particles on a time scale that extends down to the threshold of auditory perception (measured in thousandths of a second or milli-seconds).
7. Sample: The atomic level of digital audio systems: individual binary samples or numerical amplitude values, one following another at a fixed time interval. The period between samples is measured in millionths of a second (microseconds).
8. Subsample: Fluctuations on a time scale too brief to be properly recorded or perceived, measured in billionths of a second (nanoseconds) or less.
9. Infinitesimal: The ideal time span of mathematical durations such as the infinitely brief delta functions.
(Roads 2001, Microsound – The MIT Press, Cambridgw, Massachusetts, London, England, p.3-4)

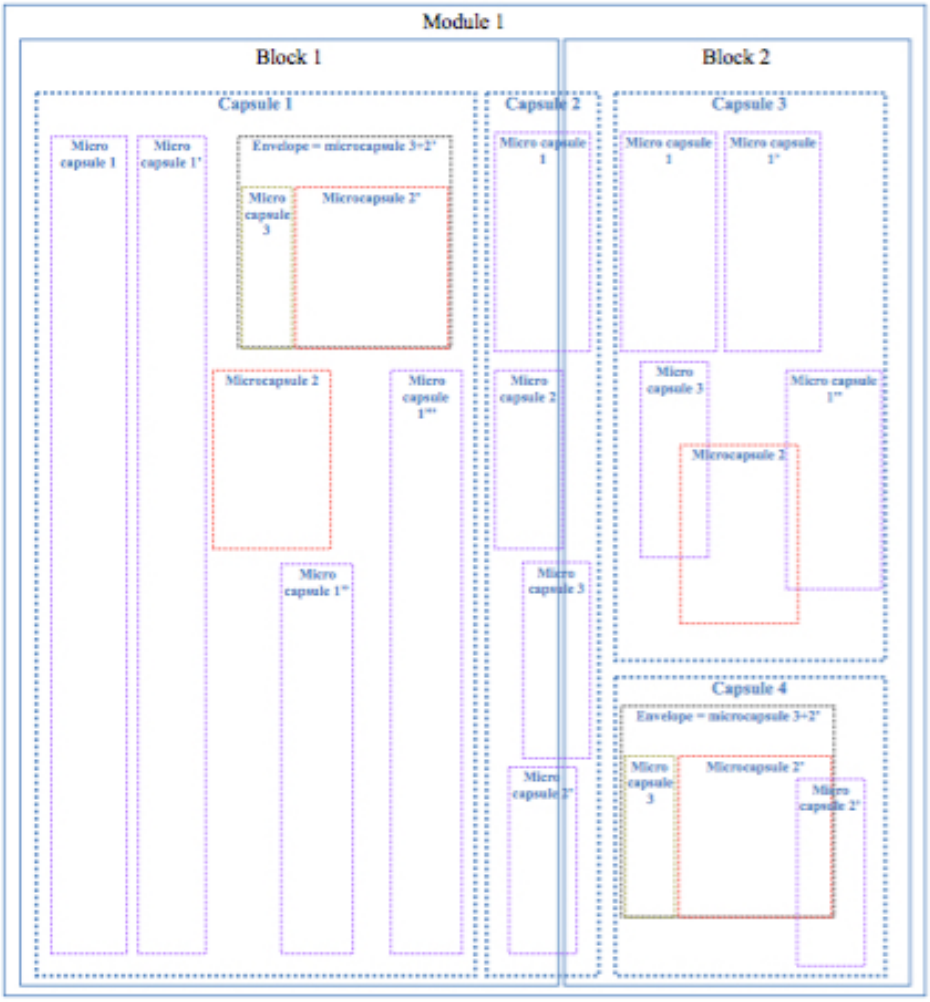

Fig.2.2: Outline example: draft version of module 1 (bar 1 and 2) of Archipiélago-string quartet nº2

Considering the modular-cells as individualities, enables the referential information of the cell to be understood as structurally-tied cross sets where the fragments are disseminated and dissociated throughout the sets. Hence, the mapping and the matrix which define the structural components of the compositions transcend the formal aspects of a sub-piece. This idea generates new connections by inserting segments into multiple contexts. Consequently, any material in a sub-piece can be at the same time a generative structure, an insert or a processual component. Therefore, the musical and sound units cease to have the "One as subject or object" (Deleuze and Guattari 1987, p.8) in a contextual multiplicity. Nevertheless, the concept was developed by the systematic use of related and non-related musical elements at the macro-structural level.

It is interesting to note that the composition techniques applied to each modular-cell can differ enormously from one another. This can be related to: experimentalism, spectralism, serialism, structuralism, post-structuralism, complexity, musique concrète and concrète instrumental. Since the inquiry focuses on the relation of a vast number of compositional strategies in a discontinuous context, a priori one could think that the resultant work is strongly related to a clash of aesthetics. Traditionally, sound collages and montages have comprehensively explored these aesthetic confrontations. Therefore, a significant concern is the avoidance of ending up composing a mere compilation or catalogue of juxtaposed materials.

Ultimately, the exploration of possible strategies – related to form, syntax, symmetry, repetition and sound morphology – enriched the palette of compositional resources.

> …as everybody knows, aesthetics does not prescribe laws of Beauty but merely attempts to infer their existence from the effects of art (Kunstwirkungen[9])…
> (Schönberg 1983, p.9)

The inquiry of the defined artistic parameters developed by the main movements of musical thought and their possible linkages and in-betweens, has been a way of establishing a quantitative and qualitative element to evaluate the work rather than the subjective analysis of an 'style' or a "repertory of surface elements" (Ferneyhough 1995, p.255). Ferneyhough, in his interview with Richard Toop (1983), states: "I would define style far more in terms of continuity in the employment of certain types of material from one work to another" (Ibid). Hence, my creative interests focus on the process of the transformation of the material and the different types of musical substance that are used "from one work to another". To sum up, my creative impulse is driven towards the syntax, the contextual perception of the inserts, the ties between various compositional techniques or strategies and the types of materials that transcend both a single and a set of sub-pieces.

In Ferneyhough's (Ibid, p.26-27) opinion, the implementation of different processes in a particular sonic event is not "the cause of the decay of compositional credibility". He advocates that the cause of this "is the decontextualization of parametric structures". Ferneyhough denotes that "the resultant dematerialisation of the sonic event is essential to establish integrated linkages, without which the sonic event becomes an isolated element from larger formal structures". In his view, the sonic event must be defined in a precise context. It is the primary requisite to later develop relational material. In this manner, this idea has profound implications on the perception of the event itself as a self-contained unit. I must emphasize the important consequences that this subject-matter had on my musical development. If we consider how the parametric development is so vital, there is a conceptual tension between self-contained events as moments and as processual developments. Likewise, it is worth highlighting that within the dissociated relational structure I have never proposed an absence of processual developments, but the isolation of some specific decontextualized elements.

Among many other characteristics of Ferneyhough's work, the richness of parallel processes in a multi-layered parametric compositional strategy has always fascinated me. The density creates a characteristic and perceivable timbre that acts as a unifying body of sound through his work. Moreover, this idea has implications in the perception of the linear time where (Fitch 2013, p.24) "different densities create the illusion of tempo changes". Fitch (Ibid) points out "two particular traits" that can be considered significant in Ferneyhough's work: the parametric linkages between musical elements and the time frame – "time-space". The great significant of this concept lies in the close relationship that the assigned musical material establishes with the designated time frame. For Fitch (Ibib), "This allows him to create different densities of material… forcing the listener to develop strategies for appraisal based on his or her own organisational preferences and instincts".

Another interesting characteristic is the use of different parameters to fix the sonic event as a self-contained unit. The fundamental process of multiple parameters, together with the active engagement of the listener, surpasses the principles of structuralism. However, this research

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[9] ***Kunstwirkungen*** *– German word for the effect of art or the action of art.*

embraces some of the structural serial compositional strategies and methods. Therefore, the techniques used in serial music can be related to the linkages between various modular agents.
In this manner, the linearity implied in the serial thinking is disrupted by unrelated inserts. As a consequence, the cause/effect dichotomy is abandoned in favour of dissociation and fragmentation. This consideration opened up a post-structuralism approach demanding an active listening to stabilise remote ties between dissociated modules.

> the music evokes an almost physical impact or immediacy. Different densities might be heard as a speeding up or slowing down, even where there is no tempo change, pointing to one means by which Ferneyhough prioritizes multi-layered experience.
> (Fitch 2013, p.24)

Hence, my first attempt to interrelate various compositional strategies/processes has been the exploration of multiple graphic representations of the sonic event. Consequently, I studied notation as a way to define the sonic event through performing instructions. In this manner, the notational outline of the self-contained unit is linked to the compositional strategy developed at each moment. Therefore, the sonic event as a self-contained moment and the precise notation needed to produce that sound event is considered as an indivisible unit. This concept develops in my work an indissoluble relationship between the sonic event, the instrumental technique and the notation. Therefore, working directly with particular performers, turned out to be indispensable. Undoubtedly, this close relationship with the performer enables to gain the optimal compositional result.

Moreover, I have considered how to address notation both as an instrumental individuality and as an instrumental collective. On the one hand, the work as an individuality navigates towards the possibility of magnifying multiple aspects of the sound identity of the instrument. On the other hand, when working with a collective the amalgamation of sounds to generate a mixture of processes is spotlighted as an essential issue. This is related to a more or less traditional sound reference as well as the use of overlapping and sequentialisation strategies befitting individual or collective interpretations. In this manner, when the work focuses on the individual instrument, the denaturalisation of the instrumental sound, the use of extended techniques and the technical challenges are extensively explored. Thus, when it focuses on the instrumental collective, these objectives are obtained by the mixture of instrumental interactions. These interactions explore extensively the overlapping of the material. Hereby, the level of perceivable sound actions, along with the challenges related to the collective instrumental relations, is the main area of work when it comes to the collective. Therefore, the personal compositional interests are worked in detail in relation to the instrumental methodologies applied and the layering of the musical material as a means of obtaining a concrete sound or a precise musical result.

Furthermore, I explored different notational conventions to produce a predictable response (with fidelity and exactitude) or unpredictable response (stochastic). This has been a consequence of exploring some technical instrumental methodologies and in particular the concepts developed by Ferneyhough (1995) on the topic. He advocates that “the interstice between fidelity and exactitude in performance can be considered as a centripetal creative force generated by a detailed notation”.

As mentioned above, this dissertation has taken into consideration the interaction between different compositional processes. One of the most critical issues of that interaction has been the detection and implementation of common bonds between all the layers. This conceptual development has been carried out concerning modular-cells using the principles described above. Consequently, the importance of a concise and defined musical modularity must be highlighted. In this manner, diverse musical elements can be related to various compositional techniques framed in a collection of sonic classes. To sum up, the organisation of the modular-cells in sets of classes within modularity theory has been stablished by delimiting the modular frame by time scales.
The modular-cells' recurrent parameters can be analysed as adjustments or expansion joints of related units which match a general criterion. Therefore, the use of unrelated modular cells expands the function of the units so they can be considered limiters instead of connectors. Thereby, following concatenative principles the modular-cells can develop different and unrelated musical materials with diverse sound morphologies and sonic events.

In the compositions, concatenation is essentially a strategy to work with pivotal nodes or joins.
The different time scales of modular-cells have been enquired with an epistemological description of the modular units – for an epistemological definition, see chapter 4.2. The process is a conceptual extrapolation to frame devices in a correlative time scales, creating parallelisms in parameters such as formal-structural and harmonic/sonic-structural[10]. As a result of the exploration of the ideas developed in the field of electroacoustic music, my personal development became influenced by the sound phenomena and physical acoustics. Therefore, the instrumentation in the overall process became a critical issue to develop.

In this manner, the research helped to evaluate the instrumentation as an independent parameter or as a formalized element into the overall process. As the work developed further, it incorporated relations between different acoustic models, instruments, e-instruments and electroacoustic means (synthetic and analogue). Instrumentation emerges as the generative principle of the creative impulse from which the primary material, that transcends the various sub-pieces sets, arises and develops.

> Therefore, for me, the essential defining character of style is: how can, through a series of works – also, on a different level, in the development of one work itself – how can these various elements, these means of working, these strategies, be seen to exhibit themselves in different lights, with different potentials for interaction with future works? How can they learn to speak to one another, and to us, in an optimal fashion?
> (Ferneyhough 1995, p.256)

[10] *Concept developed from the article "Rhythmic Concatenative Synthesis for Electronic Music: Techniques, Implementation, and Evaluation", Cárthach Ó Nuanáin,Perfecto Herrera and Sergi Jordà - Music Technology Group-Universitat Pompeu Fabra.*

3. Polyphonic Structures.

Frobenius (Grove Music Online) defines polyphony as "a term used to designate various important categories in music: namely, music in more than one part, music in many parts, and the style in which all or several of the musical parts move to some extent independently".

Considering this definition as the possibility of using musical elements independently, the development of relations between polyphonic structures of diverse and distinctive self-contained units, opened-up the path to various lines of study. Accordingly, this idea has multiple implications when it refers to superimposing different modular-agents in a more or less contrapuntal manner. Therefore, we could argue that structural polyphony can be understood as a term to designate the modular interaction in which all or several self-contained structural units are developed, expanded, fragmented and recombined to some extent independently.

The above definition considers polyphony as music written in "more than one part and with parts that can move independently"; this concept when applied to structural self-contained modules, not as an isolated sound or pitch-class, is the generative idea to investigate a possible polyphony of structures. Therefore, the modular structures can develop the same general strategies as in traditional polyphonic compositions. The main issues are the horizontal disposition and the vertical stratification of the modules. With this in mind, the compositional strategies were divided into two primary categories; sequentialisation (horizontal) and overlapping (vertical). As a consequence, the work developed towards defining common horizontal and vertical techniques and the basic strategies of the model. Moreover, when considering such relationships, it has been essential to analyse the level of discontinuity and the balance, including density and texture. The research has been a process of learning and understanding how these parameters behave.

3.1.Modular models and modular forms; General Strategies

Primarily, when defining musical modular models and modular forms, we have to consider that the modular agents are sets of classes or types of materials which are classified not only by duration but also by sound characteristics or harmonic relations. The terminology *modular forms* refers to structural relations between moments. Additionally, the term also refers to a structure based on a concatenation or juxtaposition of a flexible number of modules without considering the level of unifying compositional strategy, ties or linear process. Thus, a flexible number of modules with a non-established formal plan, makes it necessary to start delimiting the work process itself – the action of planning –, the primary modular-class sets and their ties.

Since one of the issues has been maintaining certain flexibility in the number of modules used, the final work could potentially be changed and modified indeterminately. Ultimately, this idea culminates as a permanent work in progress within a defined or limited model.
Therefore, two primary working categories of the model were developed: *delimited sets* and *non-delimited sets*.

Delimited sets: are modular-class sets divided by time periods or by a fixed number of sub-pieces which integrates the set.

Non-delimited sets: are modular-class sets within which the number of modular-cells, used in the sub-pieces, can change permanently. Consequently, the sets are embedded within the concept of a permanent work in progress. It opens the possibility of a *supra-structure* in an unending chain of

changes with the apparent impossibility of creating a final composition. Thereby, the sub-pieces are open sets with open dates of creation and a permanently modifiable work. As time goes by, the newly composed sub-pieces act as a changeable modular structure which materialises as an ever varying piece.

The use of *modular models* for approaching parallel and diverse compositional strategies is a process through which the musical material is susceptible to permanent fragmentation and insertion. The model is, by itself, a process of taking out (abstraction) or inserting (adhesion) fragmented modules containing relevant musical information.

3.1.1. General Strategies: Adhesion, abstraction, fragmentation, overlapping and sequentialising

Adhesion Model

The *adhesion model* refers to the strategy based on combining smaller modular-cells to create larger structures. The fragmented material is the basis from which to construct the final work, but it does not necessarily involve compositional strategies entirely based on disconnected modular-cells. The independent elements used in the sub-pieces are primary modules or formulas from which each sub-piece can explore different compositional techniques. The adhesion model refers to the approach used to compose the final piece to which all the sub-pieces are related. The model is based on the creation of modular formulas to develop sets.

Abstraction Model

The *abstraction model* refers to the strategy based on the process of subtracting smaller modular-cells from more significant structures. The material is fragmented to create smaller cells which are related to the main structure, but it is not necessarily exclusively based on interrelated modules. Likewise, the modular-cells in the sets can use the material included in other sets and develop larger structures. This is a process to generate and organise the delimited sets by abstracting the material from other sets or works. Therefore, the fragmentation of a single or various finished pieces, is the main action to generate the material-set for a new work. It is a procedure that enables the relation of different materials from diverse non-related sets. It is also a way to connect delimited and non-delimited sets.

Since the process refers to the abstraction of musical elements from delimited sets, it also works as a generator of unexpected, rather than planned, parametric and instrumental relations. The subtraction of musical material from the finished sets allows the instrumentation to determine the linkages between the modular-cell. Therefore, the instrumentation of the new work is a consequence of the non-planned instrumental combinations. One of the distinct aspects of the abstraction model is the retrenchment as a strategy and the reuse of the musical material linked, attached or locked to the precise instrumentation. The strategy implies discontinuity as the primary procedure to reorganise or recompose the musical material. Compared to the adhesion model, the abstraction model offers a different perspective of linear constructivism. The subtraction of musical elements from non-related sets and the subsequent recombination, culminates – by juxtaposing the existing material – in the new sub-piece. Hence, it focuses on the short-term interaction as well as creates new contrasting sections in long-term development.

Thus, rhizome concept influences both models, due to the interaction between elements in a potentially endless chain and the interrelation with the reused sets in a unifying relational network. Recycling the musical material has been expanded by emphasising on the processes of recirculation. A consequence of introducing such an element is the experimentation and applicability of feedback, both analogue and digital: one of the main issues in recent works when using the circular action of reused material has been the unending circular chain. To avoid the *cyclic conflict*[11] fragmentation became a cross technique. However, this is a framework to be developed in further research.

Fragmentation

Fragmentation is a way to investigate how we perceive time and long-term relations and how memory can identify these relations. The process is straightforward: fragment the modular-cells though a set of sub-pieces. When the sub-pieces are fragmented, the exploration of the material focuses on what linkages or ties should be cut in the existing module: the new relations are created when the fragments are inserted or combined with other fragments. The outcome is a cohesion of distinctive modules, without direct or close relations between them. Unity relies directly on individual perception of the material. However, through the sets, the fragments can develop as secondary passages or are transformed into much more intense or more audible elements.

Fragmenting and recombining independent sets generates non-preplanned instrumental relations. It enables the possibility of introducing new forms of notation to redefine the interaction and flexibility between groups of instruments. Similarly, we cannot deny the idiosyncratic evidence of a communication phenomenon. Consequently, in this particular case, the score acts as a channel of communication with the interpreter. Therefore, the semiotic aspects of notation should be explored as singular processes and as significant structuralism. In this way, fragmentation evokes and relates the model to the flexible or even free form within a concise compositional framework. Accordingly, an important issue is the notational, musical and performative functions acquired by the abstract modules that set a dissimilar level of interaction within new and diverse contexts.

The dilemma of reusing, quoting or transforming musical materials of one's own or another's work brought me to the obvious question of why not co-create with other composers/performers in a situation where the musical material is exchanged freely in a performative environment and with modularity as a unifying process? An example of this can be seen in the exploration of co-creational formats and free improvisation which germinated in a recently created trio of laptops, *Placa Base Concrète*[12].

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[11] ***Cyclic conflict*** *– In addition to the well-known case of resource or goal conflicts, a temporal-cycle type of conflict may arise due to the temporal sequences in agent actions. Say an action of agent A triggers agent B. Agent B's action may trigger C, which, unfortunately may trigger A again. This results in an unending chain, which we call a cyclic conflict (Artificial Intelligence Review 17: 39–64, 2002.© 200s2 Kluwer Academic Publishers. Modular Models of Intelligence – Review, Limitations and Prospects Amitabha Mukerjee and Amol Dattatraya Mali Center for Robotics, I.I.T. Kanpur, India 208016 Department of Elec. Engg and Computer Science, University of Wisconsin-Milwaukee, Milwaukee, WI 53211, USA)*

[12] ***Placa Base*** *– is a non-profit cultural association dedicated to producing and promoting cultural projects related to technology, with a specific interest in disseminating artistic creation in the field of new music and science from a multidisciplinary perspective. Placa Base has, since its foundation, been planning and managing cultural events with technology as their common thread and content quality and rigour as indispensable requirements, always aligned to the thirst for disseminating complex topics in an appealing manner. Mateu Malondra is the founder member and artistic director up to date.*
Placa Base Concrète *– Is a trio of laptops exploring concepts of co-creation within the frame of modular structural processes. The trio made its first public appearance at New York City Electroacoustic Music Festival in July 2018. The proposals of the trio are site-specific and non-replicable. The trio creations combine previously planned processes with free improvisation. Trio members Ángel Faraldo, Octavi Rumbau and Mateu Malondra.–*

Overlapping and Sequentialising

Overlapping and sequentialising, horizontally and vertically, are primary relational procedures to consider as contextual strategies.

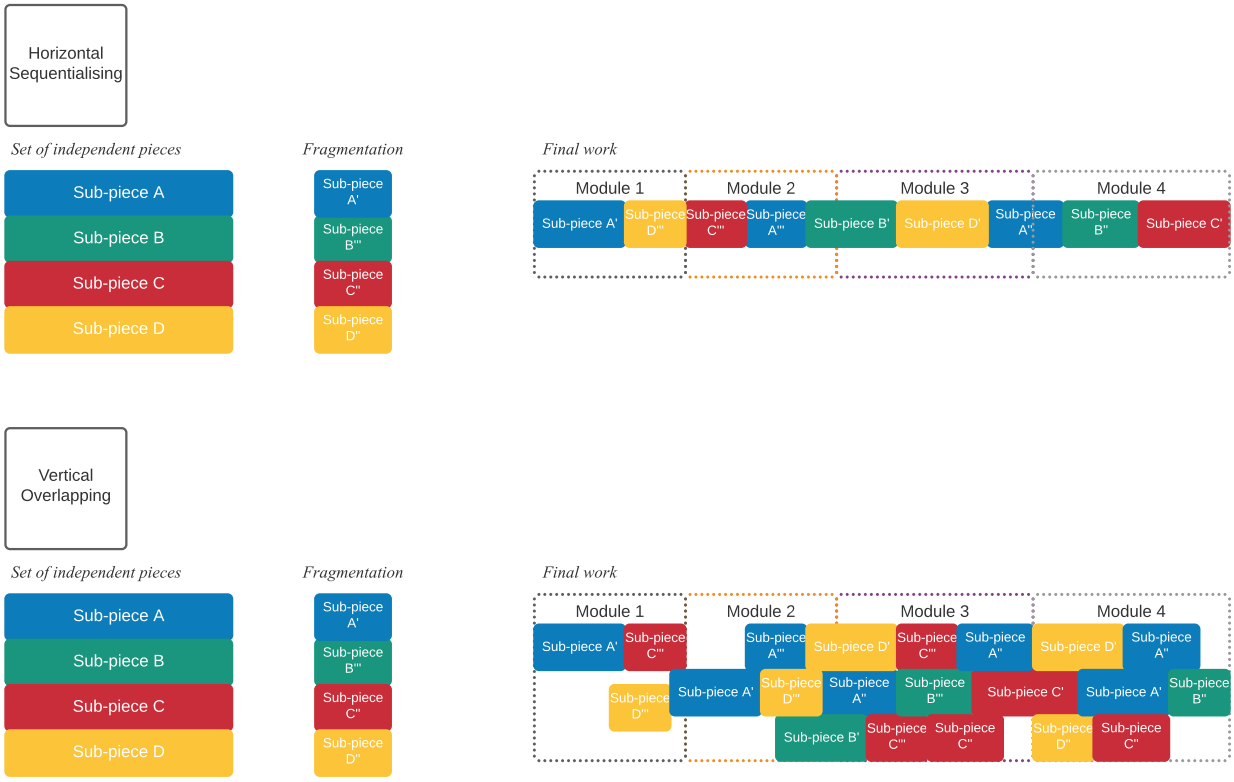

Fig.3.1: Schematic modular outline description

Sequentialising

Reusing musical encapsulated material in different contexts, is a concept that connects with the idea of a musical multiplicity. Within a sub-piece or a set of sub-pieces, multiplicity entails the development of musical modules as multiple referential elements dependant on contextual processes, crossroads and the position where they are inserted on each sub-piece. Sequentialisation is a strategy employed to define the combination and recombination of isolated sound units to develop new sonic interactions modifying the established linearity. However, modifying the linear relations does not necessarily mean modifying the contextual musical syntax. The research has taken into consideration the horizontal relationships between modular-cells, developments based on a linear directionality and the disruption of those relationships. The concatenation of these two musical syntaxes develops, to a greater or lesser extent, the perception of either a gradual transition or a sudden break, confronting syntax based on continuity and discontinuity.

These working processes affect the linearity and are based on inserting and assigning different positions to modular fragments. However, the relational intensity, considered as the amount of interactions, can be explored by common elements related to harmonic development, melodic lines, formalisation of the gestures, mixture of timbres, rhythmic patterns and instrumentation.

Nonetheless, the disruption of the sequential strategy has a direct linear bearing on the sound relations. Therefore, the sequential presentation of different modules is related to the narrative aspect of the musical discourse rather than to new textures or densities. When the horizontal relationships predominate over the vertical, it is evident that the energy or tension of the linear polyphonic development tends to create a stronger feeling of a goal-directed syntax. The disruption of the linear climax construction is achieved by inserting unrelated modules and by the sequentialisation of diverse dissociative modules. Ultimately, this can be applied in different lines and levels diluting the tension created by a linear formalisation of changes, implementing a parallel sequential process.

Overlapping

The vertical overlapping refers to the combination of various modules simultaneously in time. The use of vertical strategies leads the model to experiment with different levels of density. The superimposition of modules as sound startups creates new interrelations of the musical elements that also affects the horizontal syntax perception of the related elements. The plan to merge cells with diverse textures and materials is a constructivist idea that relates sound with a formal structure and compositional strategy. The conceptual analogy with techniques employed in concatenative synthesis and granular micro-montages inspires this procedure.

Sequentialising and overlapping modular-cells requires planning of different strategies to control the new harmonic relations. The work starts defining a set of sub-pieces by establishing a correlation of fundamental frequencies to which each sub-piece is related. It can be a straightforward pitch centre relation that stabilises a starting point for the interaction between harmonic modular-cells.

A delimited set – a set where the number of linked sub-pieces is locked – tends to develop the material towards linear structures with the final piece as destination, arrival or consequence. The multiplicity/rhizome concept is a framework that breaks the linear process of relations towards a climax. It represents a crucial subject in the overall structure, especially when a set of sub-pieces ends with a relational piece. Consequently, tempo, meter, rhythm, harmony, timbre and texture become a general issue concerning modularity, discontinuity and the instrumental relations.

Concerning instrumental relationships when recombining modules of various sets in a relational piece, the research focused on three domain areas:

- Comparing solo instrumental parts to the whole.
- Comparing flexible instrumentation to the whole.
- Treating the group of instruments as a whole.

Therefore, rhizome concept applies to horizontal and vertical processes through instrumental relationships. Furthermore, the reuse of relational segments, along with the referentiality and multiplicity, invite us to explore how quotes are perceived and how they transform the artistic discourse. Chapter 4.2.1 develops the general strategies to define the use and typologies of quotations.

3.1.2.General Strategies: Harmonic modular-cells

This chapter structures the harmonic modular-cells sieve as source set which is based on *harmonic series*[13] partials with the twelve pitches of the chromatic scale as fundamental. The harmonic modular-cells prime forms are collections of organised overtone sets formed by inharmonic frequencies, taking into consideration the first sixteen partials of the series. The material used to generate these prime forms are correlative notes discarding repeated pitches. The source sets or formulas are the primary forms that define the harmonic modular-cells and the related pitch-class sets[14] (Pc sets).

> A pitch-class set (Pc set), then, is a set of distinct integers (i.e, no duplicates) representing pitch classes.
> (Forte 1974, p.3)

In my works, the harmonic and pitch material is based on the harmonic series. Pitch-class set theory helped me to establish linkages, clarify parameters and tempered relations to the exact frequency.

The sources for the primary Pc set approximations are divided in three types of scales:

- Scales based on a 12-tone equal-tempered scale (chromatic)
- Scales based on a 24-tone equal-tempered scale (quarter-tone scale)
- Scales based on an exact frequency inflection (when using electronically generated waves)

Consequently, applying integer notation and pitch-class theory has been crucial to prepare the harmonic materials, pitch organisation modules and sketches. The integer notation concept gives a number to each note in the chromatic scale. I applied a personal approach to the theory designating the harmonic series as the primary scale and not the chromatic scale as would be usual. The numbering relation to define the primary harmonic modular-cell started on number 1 instead of 0 and went up to the 16th partial. Once the primary material was defined, I applied the regular pitch-class theory[15].

Integer notation of the partials of the harmonic series is based on the order of appearance as per the figure below:
[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16]

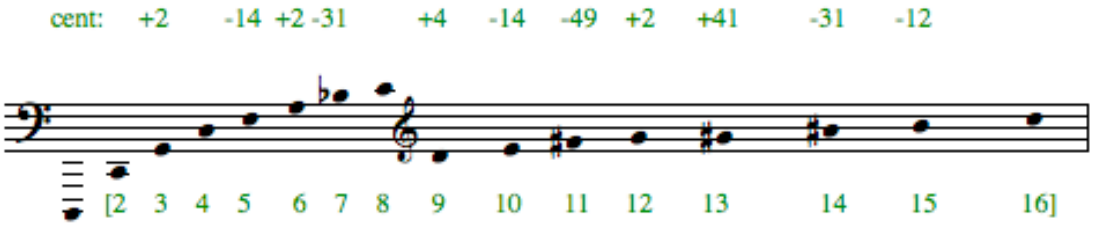

Fig.3.2: Harmonic series with cent derivation and integer notation. Fundamental: C

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[13] ***Harmonic series*** *– Sets of musical notes whose frequencies are related by simple whole number ratios. A harmonic series is a set of frequencies which are successive integer multiples of the fundamental (or first harmonic). For example, the set of frequencies 100, 200, 300, 400, 500 Hz ... is a harmonic series whose fundamental is 100 Hz and whose fifth harmonic is 500 Hz. In general, the nth harmonic of a series has a f frequency which is n times the fundamental frequency (Guy Oldham, Murray Campbell and Clive Greated 2001, Grove Music Online)*

[14] ***Pitch-class set*** *– Term and concept introduced by Milton Babbitt (1916-2011) in his musical set theory. The theory was developed further by Allen Forte (1974).*

[15] ***Pitch-class*** *– One of the 12 pitch-classes designated by the integers 0 through 11. Pitch-class 0 refers to all notated pitches C, B♯* and D𝄫. Pitch-class 1 refers to all notated pitches C♯, D♭, B𝄪, and so on. *(Forte, 1974 – The Structure of Atonal Music– New Haven and London, Yale University Press)*

Integer notation of the ordered harmonic cells:
[1,3,5,7,9,11,13,15]
[2,3,5,7,9,11,13,15]
[3,4,5,7,9,11,13,15]
[4,5,6,7,9,11,13,15]
[5,6,7,8,9,11,13,15]
[6,7,8,9,10,11,13,15]
[7,8,9,10,11,12,13,15]
[8,9,10,11,12,13,14,15]
[9,10,11,12,13,14,15,16]

Integer notation of the cent derivation of the harmonic partials:
[1,2,4,8,16] –fundamental–
[3,6,12]+2
[5,10]-14
[7,14]-31
[9]+4
[11]-49
[13]+41
[15]-12

12-tone equal tempered ± cent derivation:
[1,3(+2),5(-14),7(-31),9(+4),11(-49),13(+41),15(-12)]

Collection of categories of harmonic cells pitch-class:

fundamental	timbral	acoustic beats	quarter tone derivation
[1,2,4,8,16]	[3,6,12]+2	[5,10]-14	[11]-49
	[9]+4	[15]-12	[13]+41
		[13]+41	[7,14]-31
		[7,14]-31	

As mentioned above, the partials have a distinctive cent derivation. Using an approximate pitch generator, the harmonic series assigns a position to each pitch and the fundamental relates it to a defined partial region. Therefore the cent derivation of the inharmonic 12 or 24-tone equal-temperament pitch will vary depending on the related fundamental.

In parallel, I produced sets based on electronically generated exact frequencies. The register determines the Hz derivation of the exact frequencies in relation to the cent inflection. Therefore, there will always be a changeable relation between the approximate pitch generator process and the exact frequency.

The atomic particle to define harmonic modular-cells is the harmonic spectrum as well as the tempered and non-tempered harmonic series. Thus, it enables a way to navigate through several compositional strategies within the same principle.

As an example, the relation to the integer notation of the prime harmonic modular-cell set with fundamental C in comparison with the integer notation can be represented as below:

Harmonic cells	Integer Pcs
[1,3,5,7,9,11,13,15]⟷	[0,7,4,10,2,6,8,11]
[2,3,5,7,9,11,13,15]⟷	
[3,4,5,7,9,11,13,15]⟷	
[4,5,6,7,9,11,13,15]	
[5,6,7,8,9,11,13,15]	
[6,7,8,9,10,11,13,15]	
[7,8,9,10,11,12,13,15]	
[8,9,10,11,12,13,14,15]⟷	**[0,2,4,6,7,8,10,11]**
[9,10,11,12,13,14,15,16]	

The resulting ordered form of the Pc set in relation to prime harmonic cell will be:
[0,2,4,6,7,8,10,11]

The transpositional equivalent ordered Pcs:

t=1	t=2	t=3	t=4
[1,3,5,7,8,9,11,0]	[2,4,6,8,9,10,0,1]	[3,5,7,9,10,11,1,2]	[4,6,8,10,11,0,2,3]
t=5	**t=6**	t=7	t=8
[5,7,9,11,0,1,3,4]	**[6,8,10,0,1,2,4,5]**	[7,9,11,1,2,3,5,6]	[8,10,0,2,3,4,6,7]
t=9	t=10	t=11	
[4,11,1,3,4,5,7,8]	[10,0,2,45,6,8,9]	[11,1,3,5,6,7,9,10]	

The transpositional equivalent unordered Pcs:

t=1	t=2	t=3	t=4
[0,1,3,5,7,8,9,11]	[0,1,2,4,6,8,9,10]	[1,2,3,5,7,9,10,11]	[0,2,3,4,6,8,10,11]
t=5	**t=6**	t=7	t=8
[0,1,3,4,5,7,9,11]	**[0,1,2,4,5,6,8,10]**	[1,2,3,5,6,7,9,11]	[0,2,3,4,6,7,8,10]
t=9	t=10	t=11	
[1,3,4,5,7,8,9,11]	[0,2,4,5,6,8,9,10]	[1,3,5,6,7,9,10,11]	

The inverse ordered Pcs of harmonic cell nº8:
[0,10,8,6,5,4,2,1]

Prime form[16]:

Name	**Pcs**	Vector
8-24	**[0,1,2,4,5,6,8,10]**	464743

[16] ***Prime From*** *– (Forte, 1974 – The Structure of Atonal Music– New Haven and London, Yale University Press. p.179)*

12 and 24 tone equal-tempered sets

As 12-tone equal-tempered sets, the harmonic modular-cells can generate material as ordered, unordered and prime form Pc sets. The transpositional equivalent Pcs (**t=6**) and the inversionally equivalent Pcs results in 8-24 prime form. It permits the development of primary material as harmonic modular-cells based on Pcs theory.

This relation between harmonic series and integer notation on a 12-tone equal-tempered system provides the following primary structures: ordered harmonic cell, the ordered Pcs, unordered Pcs, inverse ordered Pcs. Accordingly, it is expanded by the permutations and transpositions of all the ordered and unordered sets. The Pcs primary material as a 12-tone equal-tempered sets, is extended by considering the Pcs generated from the 24-tone equal-tempered inharmonic partials. In this manner, the harmonic partials and the pitch representation can be implemented with fidelity or exactitude.

As mentioned above, when we take into consideration certain regions of the harmonic spectrum as a set of partials with similar cent derivation, these sets can be considered as a collection of categories. This prime harmonic modular-cells can behave as melodic generators – sequential material – or as harmonic generators – overlapped material. The compositional strategies developed in the previous chapters can be applied as a sound organisation system. The relations between the structural, formal and harmonic modular-cells, helped me to perceive the musical elements as transversal and a formalized modularity as a general strategy.

Thus, the main concern of the enquiry was the organisation of the harmonic material within the modular thinking, as any other element in the system. The permutations of the primary modular cells can develop a new set of relations with distinctive morphologies. The harmonic modular-cells can modulate from harmonic structures to cluster pitch or to noise sets – not meant to be linear, neither in this order. This transitions can follow different processes like feedback – acoustic, digital or musical – saturation, additive synthesis, massive acoustic beatings or ties to transit from one harmonic set to another.

Hereby, the harmonic modular-cells based on frequencies and pitch can be attached to an established function. The referential nodes are bridges between modules. These nodes can be defined by the interactions of the Pcs integrated into the harmonic modular-cells. Consequently, any partial region of the cell can be attached to a referentiality.

The following list is an illustration of the harmonic modular-cells sieve as source set:

If we get harmonic modular-cell prime form number 8, with C as fundamental, then harmonic Pc C [8,9,10,11,12,13,14,15] as a 12-tone equal tempered inharmonic disposition, would result in [C D E F♯ G A♭ B♭ B]

The same prime harmonic Pc as 24-tone equal-tempered inharmonic disposition, would be [C D E F𝄲 G A𝄳 B𝄬 B]. If we use it as a frequency based – with fidelity – harmonic Pc as approximate reference [C D𝄱 E𝄳 F𝄲 G𝄱 A𝄳 B𝄳𝄬 B𝄭].

Finally, the Pc harmonic ratios. Example:
Primary harmonic modular-cell of pc C:

Harmonic cell nº8: [8,9,10,11,12,13,14,15] Integer Pcs: [0,2,4,6,7,8,10,11]
Transposition ordered Pcs (t=6): [6,8,10,0,1,2,4,5] Inversion ordered Pcs: [0,10,8,6,5,4,2,1]
Prime form: [0,1,2,4,5,6,8,10] vector: 464743

Tuning reference = 440Hz
Fundamental C_1= 32.703Hz
All the Pc sets are based on C_4=261,63Hz and with the pitch-class in the spectrum of C_4:
All related frequencies in Hertz are exact references only used in computer generated parts.

12-tone equal tempered –chromatic– inharmonic disposition:
[C D E F♯ G A♭ B♭ B]= [(261,63), (293,66), (329,63), (369,99), (392), (415,30), (466,16), (493,88)]

[C D E F♮ G A♭ B♭ B]= [(261,63), (293,66), (329,63), (349,23), (392), (415,30), (466,16), (493,88)]

24-tone equal tempered –quarter-tone– inharmonic disposition:
[C D E F𝄲 G A𝄳 B𝄬 B]= [(261,63), (293,66), (329,63), (359,45), (392), (427,46), (452,8), (493,88)]

approximate reference:
[C D𝄲↑ E𝄳↑ F𝄲 G𝄲↑ A𝄳↑ B𝄬↑ B𝄲↓]
(used as an approximate instrumental notation which is based on inharmonious variable frequencies dependant on the instrument and register)

harmonic whole-notes:
[C D𝄲↑ E𝄳↑ F𝄲 G𝄲↑ A𝄳↑ B𝄬↑ B𝄲↓]= [(261,63), (294,33), (326,97), (359,67), (392,45), (425,25), (457,88), (490,46)]
(used only as exact frequencies in computer generated parts)

pc C related to the cent derivation of the harmonic series:
[C C𝄲↑ C𝄲↓ C𝄳↑ C𝄲↓♯ C𝄳↑ C𝄲↓]= [(261,63), (262,23), (259,52), (254,32), (261,93), (267,90), (256,98), (259,82)]
(used only as exact frequencies in computer generated parts)

During the development of the concept, the use of transitional references emerged as a way to create linkages between modular agents. In this manner, the referential harmonic modular-cells are dependant on the position of the pitch in the harmonic series of a given fundamental. This idea links the use of the referentiality, as a nodal point, to a particular harmonic sets. To sum up, it is a way to define a transitional process.

Ultimately, it links the referentiality with formal structural elements. Somehow, this idea expands the constructivist approach of independent, diverse and distinctive modular-cells with meso-structures. However, the idea of referential elements is not hierarchical; no modular-cell underlines another modular-cell. The node is a point of circulation, a transitional joint to link modules. It is not a hierarchical functional tonal theory; the nodal references are entryways through which to navigate from one harmonic modular-cell to another in a continuous chain of relations and transformations. Accordingly, the procedure can be defined as a parametric methodology to relate pitch-class sets. Thus, the transition between cells can reinforce the harmonic and sound tension. Furthermore, it relates the harmonic element to form. In my work, the harmonic formal tension, in a non-functional

compositional process. This is an issue that I found extremely compelling, especially when discontinuity is the referential musical syntax. However, it is difficult to somehow propose a general solution. Roads (2001, p.11), describes the perception of macro time scales as follows "… listeners perceive the macro time scale in retrospect, through recollection. It is common knowledge that the remembrance of things past is subject to strong discontinuities and distortions. We cannot recall time as a linearly measured flow…".

Roads advocates that the idea of referential points in classical tonal music is an essential element to navigate through the formal structure. The harmonic formal implications of non-established structures and linear developments, tend to be subjective approximations to the material. Hence, it is often a cumulative process of energy towards a climax. In this manner, modularity can provide a unity level where the formal structures can relate to distinctive and defined nodal references. This relates to the use of musical modular-cells as frames of self-contained musical information within a structural mapping, matrix or framework within which the referential nodes are the expansion joints of the structure. Transitions between modules are possible due to the harmonic materials and the recirrent fields between series. The harmonic modular-cells relate pitch-class sets and exact frequencies through the modules. The vertical and horizontal disposition of the modules will define the order and the relation of the modular-cells. A possible way to organise the sequentialisation of the Pc sets and the relation of the musical elements in a formal system is the location of the referential nodes. The planning and mapping of the referential nodes is a possible solution to define the structural transformation of concatenated modules. Chapter 6.3 expands the concept with detailed examples.

3.1.3.General Strategies: Sonic events, non-pitch modular cells and sound morphologies.

This chapter is an attempt to define the sonic event as pitch and non-pitch sonic events and its systemic referential characteristic in a polyphonic and polymorphic structure.
However, the use of the harmonic series as a main harmonic and sound generator has several implications. In my compositions, multiple sound morphologies are combined in interrelated heterogeneous constellations of harmonic and sonic masses – as a pitch/frequency generator and non-pitch event relations. Nonetheless, the referential behaviour of some harmonic modular-cells is more objective when it relates to harmonic series than when it relates to a non-pitched sound morphology. The strategy enables a form of referential transit that can potentially expand to material closer to noise. This concomitant concept associates each module with a particular referentiality. The established function of the referentiality is achieved without being a functional system in the sense tonality dose it.

> The emancipation of acoustically defined sound from its rather subordinate function in earlier music is among the achievements of the musical developments in our century. The immediate empiric-acoustic perception of sound has found a place – not in the central position but in a key position – of musical experience, a place that was kept by an old perception, defined by tonal contexts and by consonance and dissonance.
> (Lachenmann, 1970, p.1 Tr: Thomalla)

The research has been applying consistently the modularity theory to deconstruct complex structures, formal and sonic, into simpler smaller elements or particles.
If the sonic particle is spotlighted, the process developed is a bottom-up compositional strategy that has as a centripetal idea, the definition of the sonic event as the musical atom.
Nonetheless, this is an area in which I have been introduced due to my increasing interest into electronic music composition – see chapter 6 and 7. Anyhow, the development of parallelisms with electronic music techniques and the compositions included in the portfolio of works have been a conceptual analogy applied to instrumental writing. These ideas are implemented through the use of modular-cells such as *capsules* and *microcapsule* as sonic events in meso and sound object time scales (Roads 2001, p.3-4) – for an epistemological definition, see chapter 4.2.

The *microcapsules* – instrumental grains – are the smallest musical cells that can be conceptually related to the grain in granular synthesis. Microcapsules are the microsounds of granulation in the instrumental domain. The *capsule* and microcapsule that are formalized as signifying layers of musical material, can interrelate as pitch and non-pitch sonic events. Therefore, these relationships can be between capsules of pitch and non-pitch grains where all the microcapsules in a particular capsule develop a similar sound morphology. In this manner, the amalgamation of microcapsules with diverse sound morphologies expands the generative process. However, overlapping and sequentialising diverse microcapsules and/or capsules in an instrumental granulation strategy can develop sound masses, textures and clouds just as granular synthesis develops micromontage, clouds, sound objects and mixtures in electroacoustic music.

The development of classes of modular agents – for an epistemological definition, see chapter 4.2 – defined by time scales that transit from the sound object to the macro and supra scale and its relation with a traditional pitch generative device system defined by the harmonic modular-cells, has been expanded with the idea of the sound object as a non-pitch material. Hence, in my instrumental writing, the microcapsules and the capsules are relational particles within which the harmonic spectrum (pitch material) and non-pitch material can merge together as a unity in a non-hierarchical context.

As mentioned above, the processual element to define the harmonic modular-cells has as a generative element the harmonic series around a fundamental. Therefore, the equal judgment of all the sonic elements within a processual compositional context, incorporates the exploration of diverse non-pitch sonic events as a structural and relational parameter. Ultimately, this approach extended the compositional sound palette and the acceptances of a wider range of sonic elements. Likewise, it incardinates the modular-cell, as a self-contained morphological singularity, into Edgar Varèse's Organized Sound philosophy. In this context, rhizome has provided a framework strategy to develop a coherent use of sounds of multiple morphologies. Moreover, the integration of non-pitch material in a pitch based system has been possible through the conceptual definition of Schaeffer’s sound object (perceptual) and Roads’ sound object time scale (time defined). It will be discussed in detail in chapter 4.1.

4. Apposition [figures of disorder]

(Commissioned and recorded by Takao Hyakutome - Apposition I and II: Recoded under the label Champdaction)

Apposition [figures of disorder] is a set of pieces for solo violin. The term apposition is a concept related to figures of speech. It is a grammatical construction in which two elements are juxtaposed by confronting each other. In this case, one of the elements affects the definition of the other. The linear flow of the sentence is often altered by the disruptive action of the figure. The artistic background of the work is based on the communicative dilemma and investigates the essential element of universal grammar, creating a parallelism with apposition and a recursion. In this manner, the development of recursive[17] structures implies the relationship of clonic or similar elements but at different scales. Consequently, due to the inherent replicability of the model, recursion can directly affect the formal structure and the resulting aesthetics. However, the use and meaning of recursive elements can vary depending on the domain to which it is applied. In *Apposition [figures of disorder]*, the recursive procedures are linked to the proportions of the modular-cells and how these cells are concatenated. The planning of the set focuses on the development of a recursive modular strategy avoiding total dependence of the replication of the same cell within different time scales. It can relate to structural elements, formal issues, harmonic and sound parameter, referential elements or musical syntax within a recursive contextual idea. When the communication dilemma needs to be understood easily by the audience, I relate the mechanisms to referential musical elements to develop formal structures. Moreover, it has been an important topic to define how to perceive the possible connections when these elements are fragmented, dissociated and concatenated as vertical and horizontal vectors. The concept has been expanded with a systemic development of relations based on the idea of a structural rhizome. An important question for me has been to determine if there is a need to be engaged with a considerable number of sub-pieces or, on the contrary, if it is possible to perceive the idea of equal relations within a network of connections in a single structure – sub-piece – without knowing the contents of the entire set.

4.1.Creative exploration of sound objects in instrumental writing

The *Apposition* set relates non-pitch complex sound with pitch sonic events. The postulates of *musique concrète instrumental* developed by Lachenmann influenced my experimentation with the denaturalised instrumental sounds. The following figure 4.1 of *Apposition IV*, is an example of an heterogeneous sound.

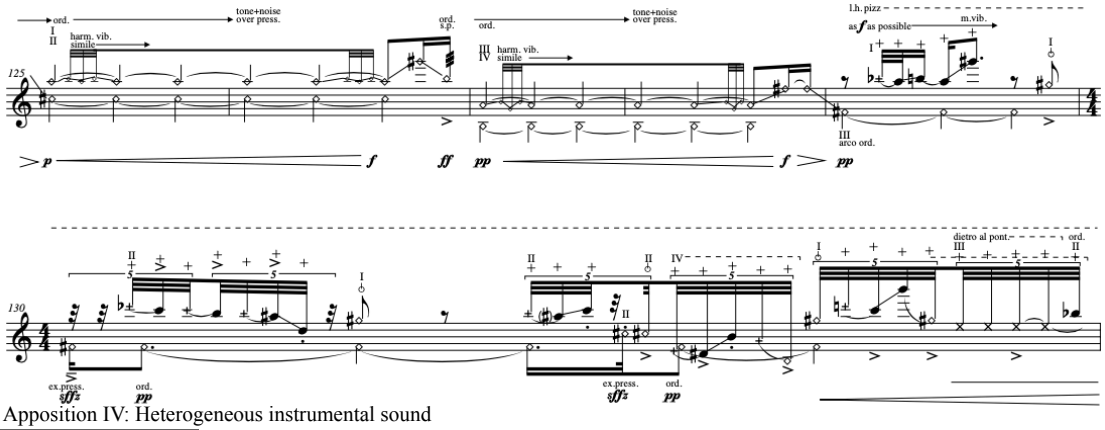


Fig.4.1: Apposition IV: Heterogeneous instrumental sound

17 ***Recursive*** *– Characterized by recurrence or repetition.*
Mathematics Linguistics: Relating to or involving the repeated application of a rule, definition, or procedure to successive results.
Computing: Relating to or involving a program or routine of which a part requires the application of the whole, so that its explicit interpretation requires in general many successive executions.(Oxford living Dictionary Online)

The idea of an "emancipated sound" as instrumental musical object, explored in Lachenmann's work, has generated new perceptual conditions which transformed the homogeneous instrumental pitch production into heterogeneous instrumental sounds. The compositional material conceived as a wide range of acoustic phenomena, could not be developed without the experimentation of complex sounds in electronic montages. My work and exploration of the electronic techniques lead me to introduce into my acoustic instrumental writing the possibility of pitch and non-pitch processes in multilayer dispositions. The "philosophy of organised sound" (Varèse) has been the appropriate framework to study a non-hierarchical relation between sound and pitch.

Similarly, the diverse morphologies developed by Schaeffer (1966) in *Traité des objets musicaus* and the ideology of musique conrète, acts as a case for non-pitch instrumental sounds. *Guide to Sound Objects* (Chion 2009, p.32) defines the sound object as "The sound object refers to every sound phenomenon and event perceived as a whole, a coherent entity, and heard by means of *reduced listening,* which targets it for itself, independently of its origin or its meaning". Chion's guide spotlights the sound object as an organised unit in parallelism with the theories of shape or figure developed by gestaltism in the psychology of form theory.

As described in Roads (2001) work, an important characteristic of Shaeffer's conceptual development was that from a precise sound material he developed "abstract musical values". Shaeffer took into consideration that "traditionally, music is formed on the concrete interpretation of sound entities based on abstract conceptualizations". Roads (2001, p.16) describes a sound object time scale defined by the duration of traditional notes: "from 100 ms to several seconds". His definition emphasises the different natures of the note and the sound object as homogeneous (note) and heterogeneous (sound object). The heterogeneity of the sound object and its applicability in the instrumental music domain, reveals the possibility to relate *musique concrète instrumental* postulates as structural referential singularities. This i assumption enables acoustic-instrumental music to introduce the idea of sounds that do not belong to homogeneous note production. In Roads (2001, p.19) opinion "there are two ways that the concept of a sound object generalises the note". He describes a first feature in which the sound object is understood and perceived as an element that overcomes the limitation derived from the set of properties related to a heterogeneous collection of singularities. In this manner, the second category relates the object to properties that vary in time but does not take into consideration the invariant. Then the objects can be classified in classes that are independently transformed. The mixture of non-related singularities (sound objects) and the independent transformations of the classes necessarily leads to a discontinuous syntax. My interpretation of the sound object has been analytical, as Roads defines it. However, the Scheffer-Chion's definition (perceptual) has been essential to understand the *reduced listening* as a contextual process in demands of an active listener.

Furthermore, the approximation to Lachenmann's work focused on the development of a wider palette of heterogeneous instrumental sounds. Lachenmann advocates that this development introduces, into compositional context, musical materials which were not previously considered within historical conventions. Lachenmann developed, in his compositions, a catalogue of new and unconventional complex instrumental sounds. This has been a constant parameter of his creative production. In his article, *Sound-Types of Music*, enumerated a catalogue of sound models that he called "*sonorous types*" (Lachenmann 1966). These sonorous singularities are related to instrumental extended techniques. Accordingly, these are indispensable actions to produces specific sounds. Consequently, they are considered as indivisible as any other musical parameter contained

in the modular-cell.

> …the possibility to abstract certain sonorous models…Pitch, timbre, volume and duration are without doubt indispensable for the definition of an acoustically presented sound – particularly timbre as the sum and result of natural or artificial partials consisting of different volume and frequency. Just as important as these four parameters, though, is the differentiation between sound as [fixed] state and sound as process, or, to put it differently: sound with undefined length (which is determined in its duration only from outside), and sound with a duration intrinsically defined by a characteristic shape [or development].
> (Lachenmann, 1970, p.1 Tr: Thomalla)

4.2.Apposition Set Structure: Fragmentation and Discontinuity

The set *Apposition [figures of disorder]* is formed by six sub-pieces. The sub-pieces have an inner interrelationship based on the invariant structure of programmatic elements such as the number of bars, meter changes and tempo changes. *Apposition [figures of disorder]* is my first attempt to establish a concise overall concept at the meso timescale. The ordered planning of the set investigates two perspectives of linear fragment sequencing. *Apposition I* and *V* develops a similar degree of fragmentation and discontinuity. Likewise, dissociation is progressively abandoned introducing longer modules and developments in *Apposition II*, *III* and *IV*.

Apposition VI develops a high degree of discontinuity, exploring extensively the concatenation of unrelated and unlinked musical elements. Finally, to consolidate a rhizome framework, I introduced freedom of structural choice regarding the number and order of the sub-pieces performed. Consequently, the idea evolves from a chain of fixed interlaced of an ordered set of sub-pieces, to an open multiple relational trusses dependant on the performers structural choice. Thus, it generates various perceptual situations when performed as isolated pieces or as a set. Likewise, when performed as a set there are four possible situations: entire set, partial set, ordered or unordered. Furthermore, it is possible to insert other pieces of other authors in between the sub-pieces. As mentioned before, the relational linkages will depend, to some extent, on the interpreter's decision. The overall concept, in the set *Apposition [figures of disorder]*, is based on the approximate tempo changes based on the classical ritardando and accelerando and the metric modulations are developed extensively. However, this skeleton is progressively morphed, transformed and moulded dependant of the musical context of each *moment*.

Apposition I

In the overall set, *Apposition I* acts as a formula – refer to figure 4.2 for a schematic structural flowchart diagram of *Apposition I* – introducing a vast heterogeneous material and is a compressed representation of the process developed in the whole set of sub-pieces. This implies that the musical ideas are reused and reworked throughout the set. As mentioned above, the disruption of linearity reduces progressively throughout *Apposition II*, *III* and *IV* and expands and intensifies again in *Apposition V* and *VI* generating a process of increasing discontinuity, *Apposition VI* being the sub-piece with a higher degree of disruption. The abstracted fragmented modules of the first sub-piece, are inserted into the upcoming sub-pieces. *Apposition I* is formed by six distinctive modules – refer to figure 4.2 for a schematic structural diagram example of the modular division. In this manner, these modules are defined by the level of fragmentation and discontinuity. Moreover, module 6 is fragmented in five nodal points positioned in between modular changes. Hereby, the

modules are formed by a concatenation and juxtaposition of microcapsules, capsules and blocks.

Block division: microcapsule, envelop and capsule

The modular strategy is applied throughout all structural elements in the composition.
Therefore, the module is a supra structure divided in blocks. Likewise, blocks are divided into capsules, envelopes and microcapsules. The examples included in this chapter, illustrate the bottom-up division of a block. Therefore, the typology starts defining the shortest particle, the microcapsule. However, the following figure is a flowchart illustration of the modular division.

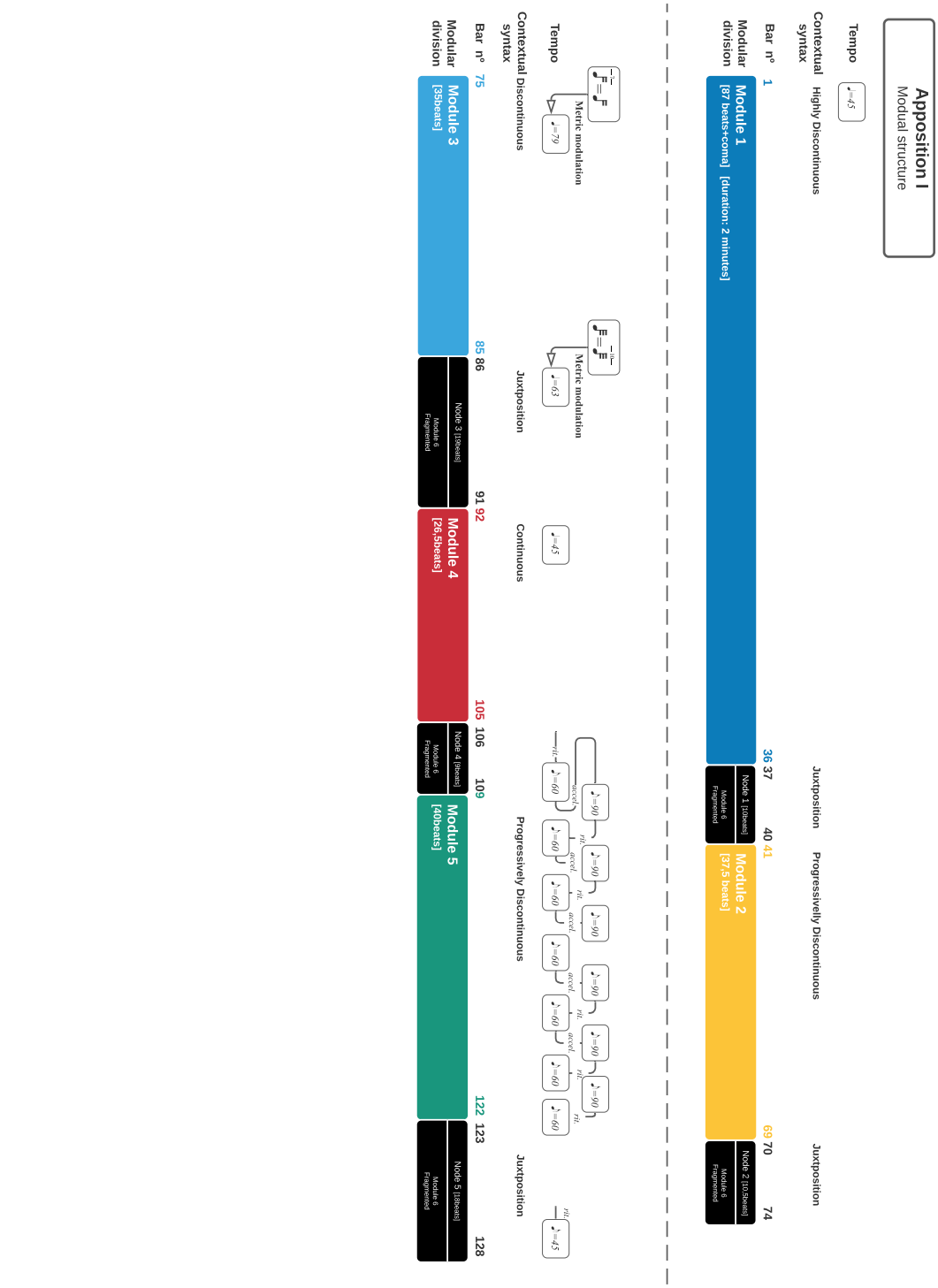


Fig.4.2.: Apposition I: Modular form flowchart.

Microcapsule

A *microcapsule* is the smallest modular-cell. It defines the shortest vertical relation between elements – pitch, rhythm, texture, density, timbre, articulation and dynamics. In a parallelism with electronic music composition, a microcapsule can be considered as a grain in an instrumental time scale. Microcapsules are elements of considerably short duration. These type of modular-cells can be considered as the atoms that define essential parameters of bigger structures.

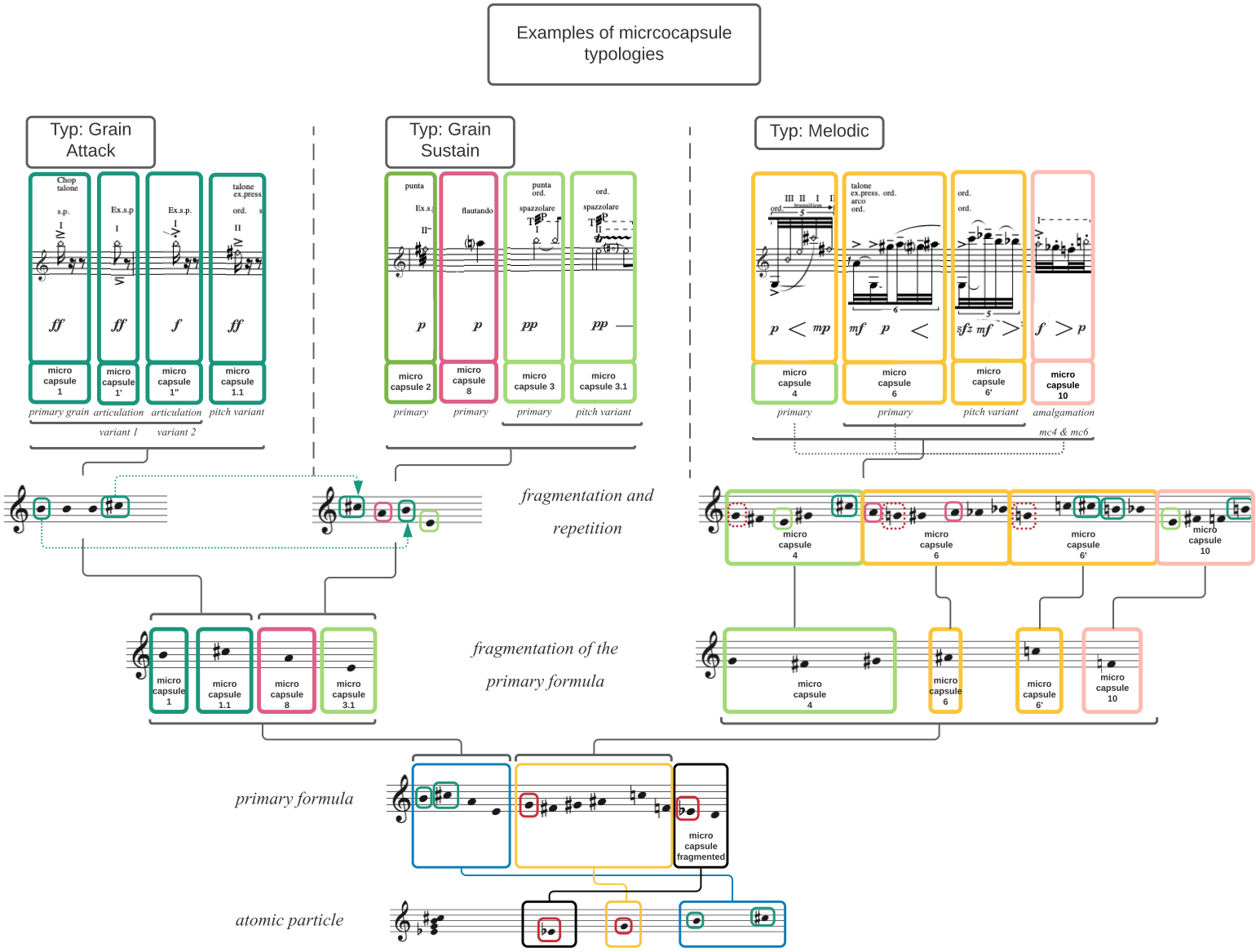


Fig.4.3: Microcapsule examples: typologies

Accordingly, the use of sound typologies influenced by the explorations and the techniques employed in electronic music defines clearly the working process. As and example the grains types have been employed to create sound textures that evolve gradually in an analogy to electronic music. In his review, Roads (2001) points out the importance of the linkage of the sound parameter in granular synthesis. My personal interpretation of the strategies explored to create linkages

between modular-cells as sound objects[18], musical elements, frequencies, pitch or sonic morphologies is influenced by the ideas of granular linkages parameters.
Obviously, through the use of small particles, defined by the time scale of the grain, makes it a strategy to develop the overall sonic result from the sonic atom. The grain technique is not directly extrapolated into instrumental writing. However, the microcapsules are an attempt to create a direct analogy with the concept. The microcapsule is understood as an instrumental grain.

Envelope

An *envelope* is formed by one or more independent microcapsules that are considered as a unity and they are not a consequence of a morphing or variation process. There are two types of procedure to generate and envelope:

- Horizontal overlapping
- Vertical sequential

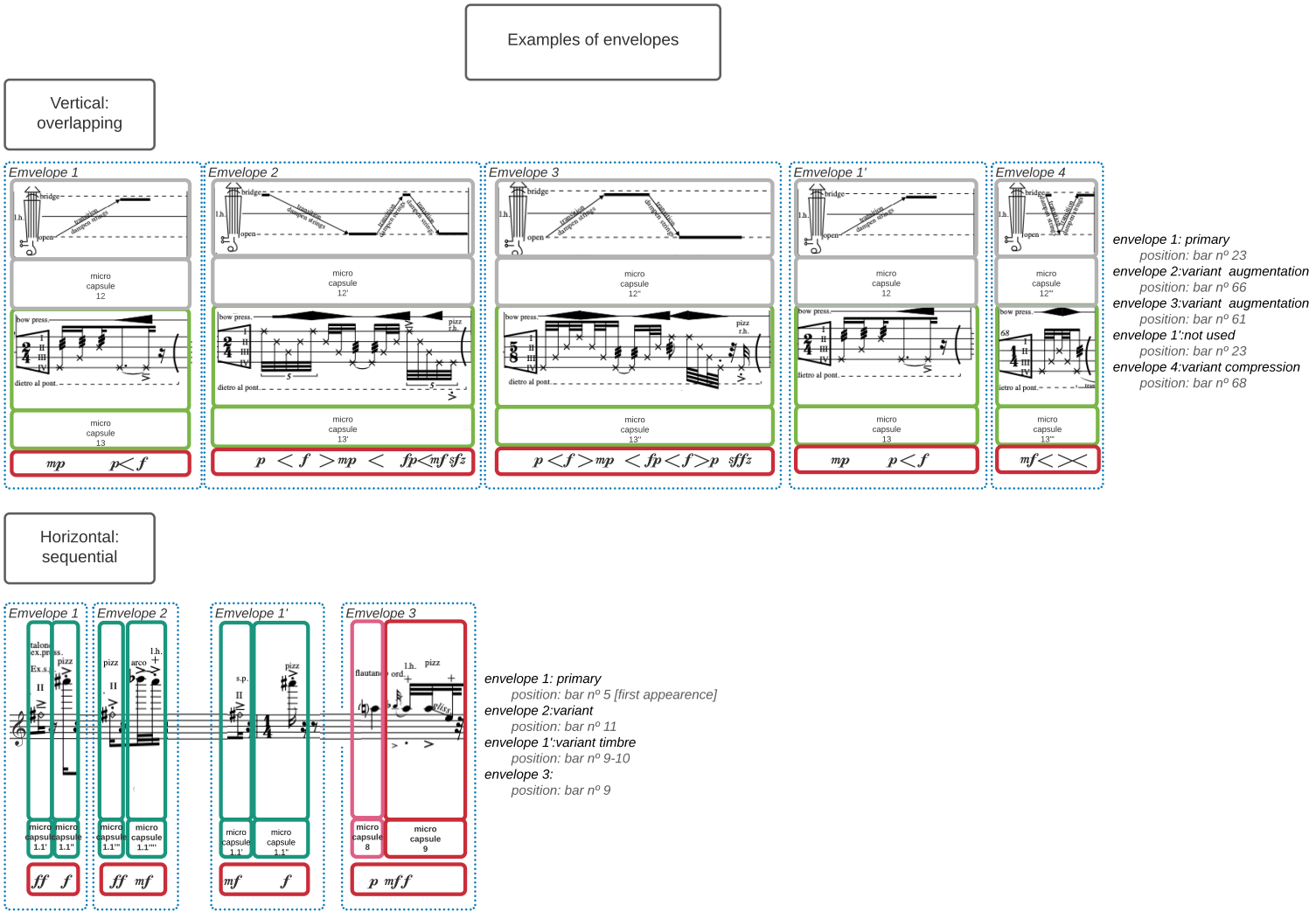


Fig.4.4: Envelope examples: typologies

[18] ***Sound Object*** – *The name sound object refers to every sound phenomenon and event perceived as a whole, a coherent entity, and heard by means of reduced listening, which targets it for itself, independently of its origin or its meaning. (Michel Chion, Guide to Sound Objects, Trans: John Dack and Christine North, London 2009)*

Capsule

A *capsule* is a modular-cell that can be related to a motive. When diverse capsules are combined they form a block. The capsule is my personal interpretation of Ferneyhough's gesture. It is formed by independent microcapsules that explore different musical parameters.

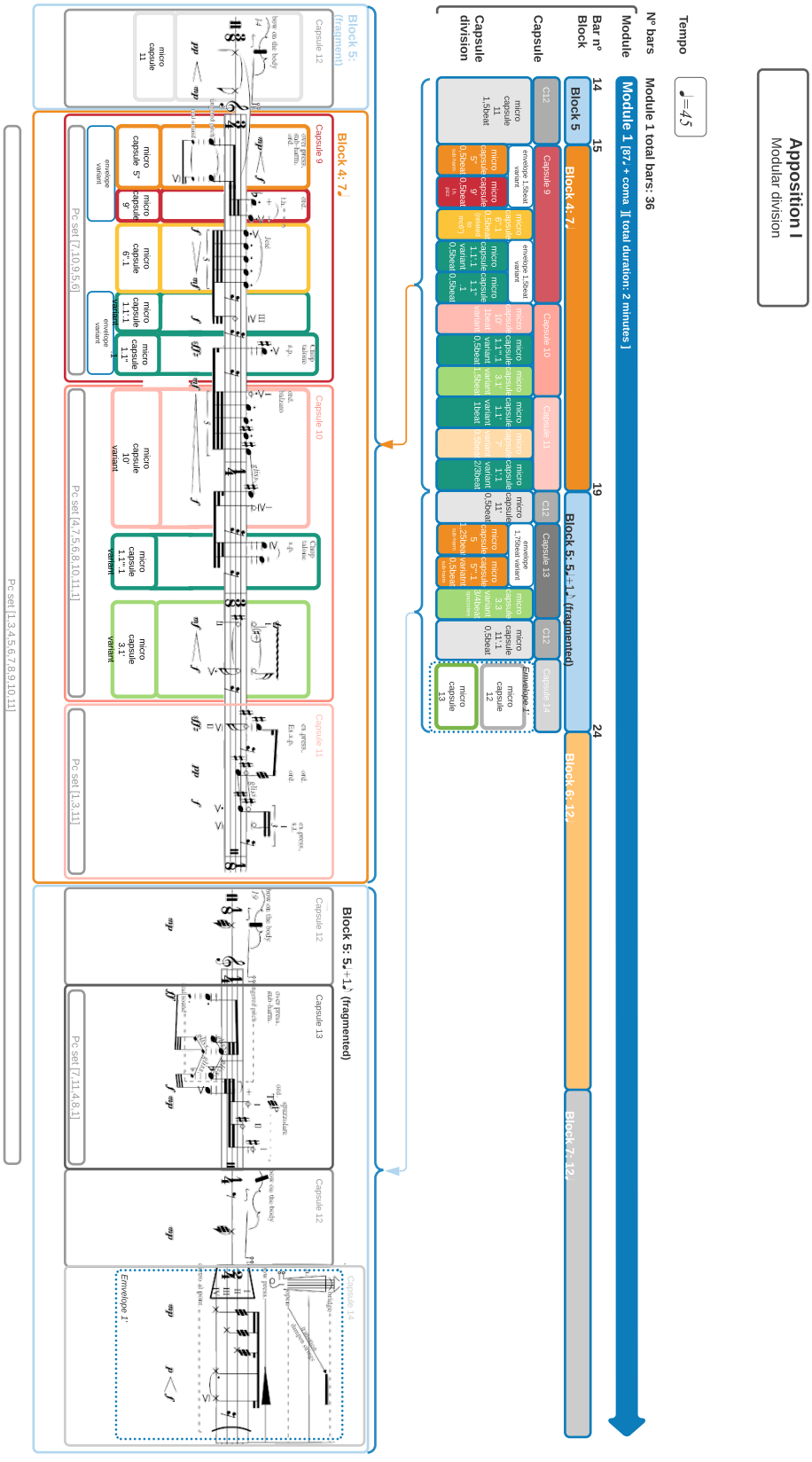


Fig.4.5: Microcapsule examples: typologies

Block

I explored the use of two types of Blocks:

- Primary Block: formula from where the material is extracted.
- Structural Block: modular agent of the final work.

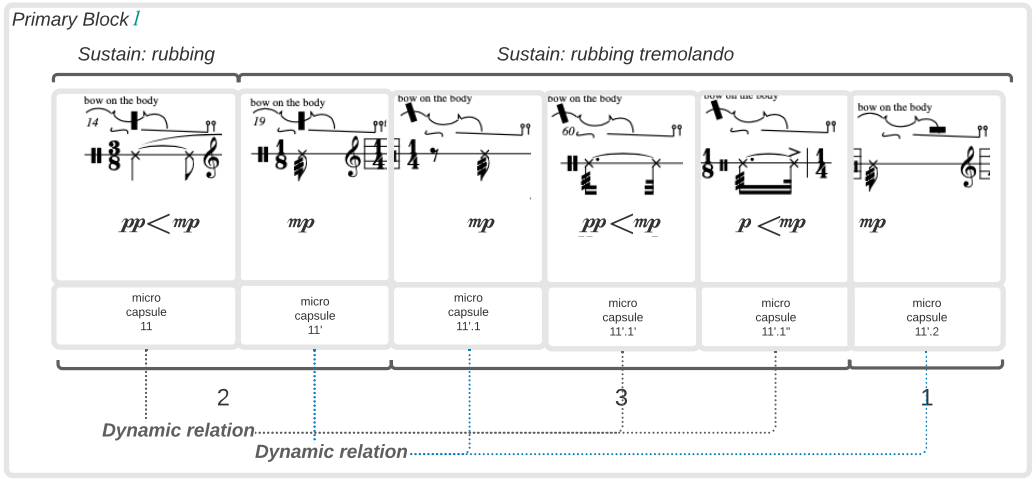
Primary Block

The *Primary Block* represents the formula from which the material is abstracted by fragmentation to be inserted in different positions at the final work.

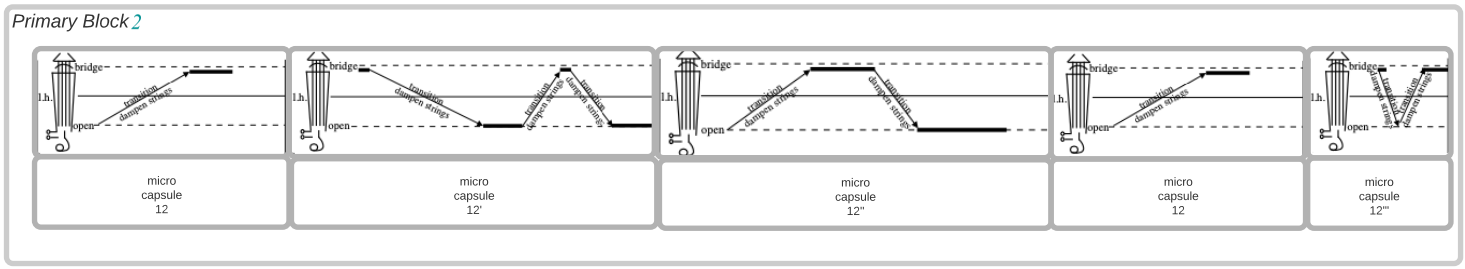
Refer to Figure 4.6: The *Primary Block 1* explores timbre modifications by changing the bowing area on the body of the instrument. In this sequence, at microcapsules 11 and 11' the sound is produced by bowing on the central area of the body of the instrument. At microcapsules 11'.1, 11'.1' and 11'.1" the bowing area changes to the bottom area of the violin's body. The sequence ends with microcapsule 11'.2 in which the bowing area is the upper side of the violin's body. The *Primary Block 1* is fragmented and inserted in different positions in *Apposition 1*. Furthermore, at the *Primary Block 2* the sequence includes a repetition of microcapsule 12 which is not repeated in any structural block. *Primary Block 2* explores the sound produced by rubbing the strings from the head of the violin's neck to the bridge. Moreover, the *Primary Block 2* explores two different sonic events, microcapsule 12 and 12"', to generate disrupted bilateral symmetry in different possible combinations. The resulting sound produced depends on the speed of the movement between the neck and the bridge and when staying at a certain position the speed of rubbing. *Primary Block 3* explores the sound produced when playing with the bow behind the bridge.

Examples of micrcocapsule typologies

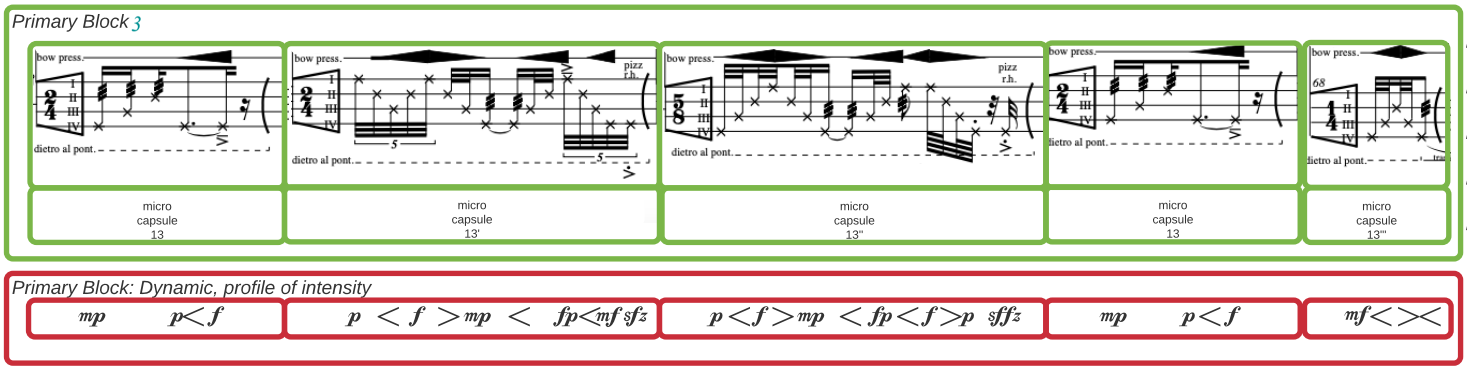
Typ: Mass harmonic timbre



microcapsule 11: primary
position: bar nº 14 [first appearence]
microcapsule 11':primary variant [tremolando]
position: bar nº 19
microcapsule 11.1:variant mc11' [change bowing area]
position: bar nº 22
microcapsule 11'.1':varinat mc11'
position: bar nº 60
microcapsule 11'.1":variant mc11'
position: bar nº 67
microcapsule 11'.2:variant mc11' [change bowing area]
position: bar nº 53



microcapsule 12: primary
position: bar nº 23 [first appearence]
microcapsule 12':variant augmentation
position: bar nº 66
microcapsule 12":variant augmentation
position: bar nº 61
microcapsule 12:not used
position: bar nº 23
microcapsule 12'":variant compression
position: bar nº 68



microcapsule 13: primary
position: bar nº 23 [first appearence]
microcapsule 13':variant augmentation
position: bar nº 66
microcapsule 13":variant augmentation
position: bar nº 61
microcapsule 13:not used
position: bar nº 23
microcapsule 13'":variant compression
position: bar nº 68

Fig.4.6: Microcapsule examples: typologies

Structural Block

The *Structural Block* is a modular-cell that can be related to the length and characteristics of a phrase or a theme. It is formed by variable number of *Capsules*. The following Figures 4.7 and 4.8, illustrates the structure and characteristics of a Block.

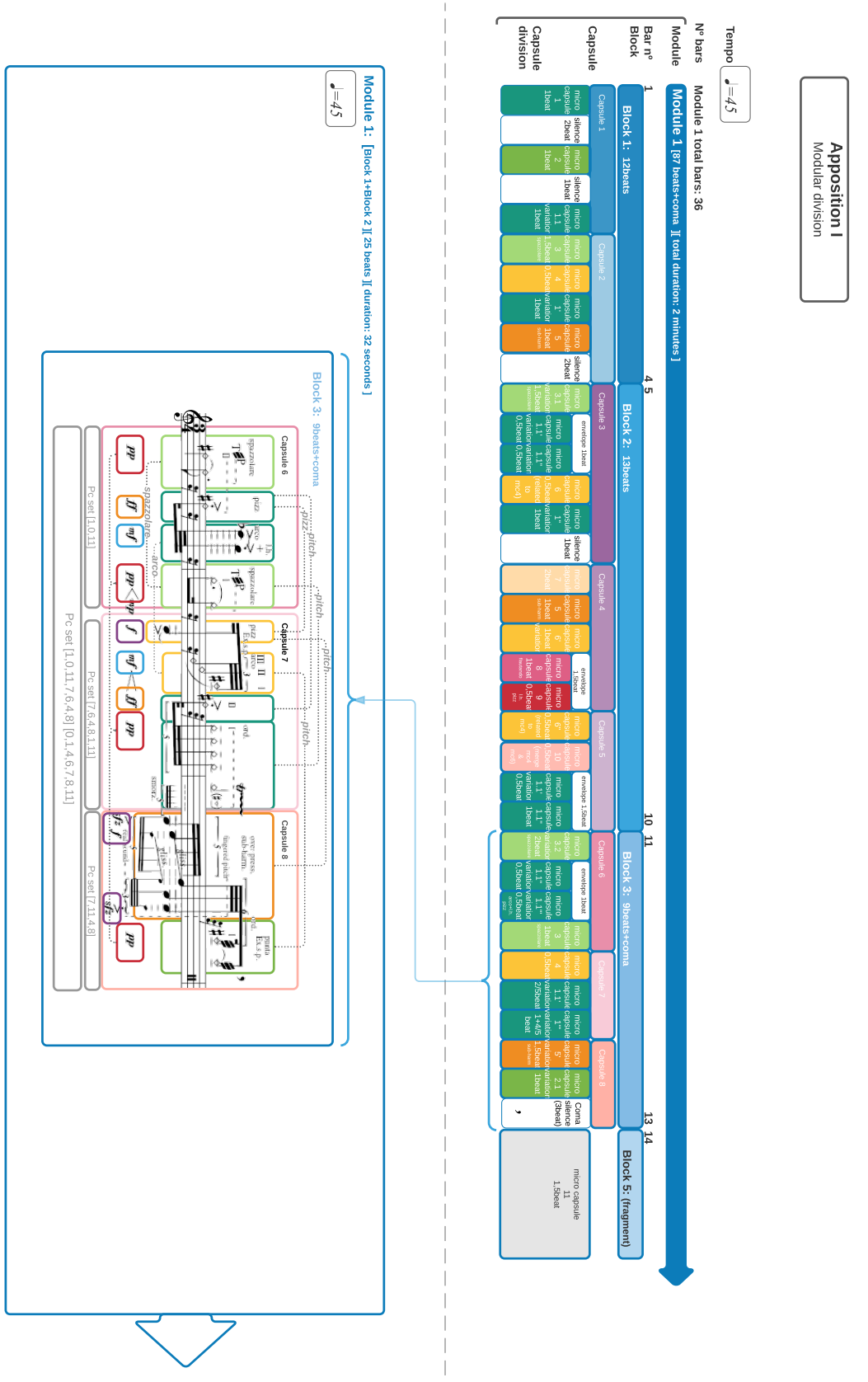


Fig.4.7: Microcapsule examples: typologies

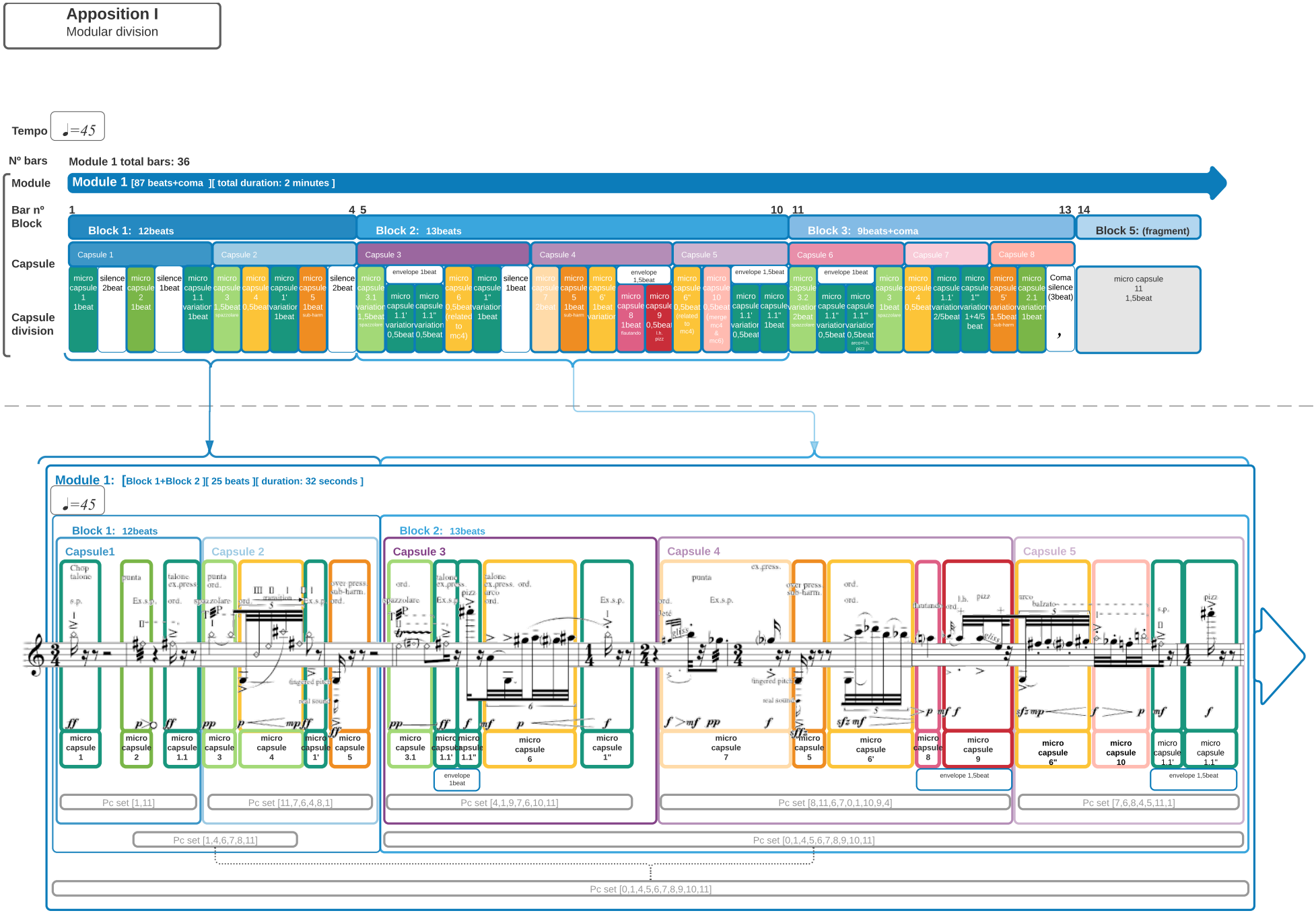


Fig.4.8: Microcapsule examples: typologies

Apposition IV

As mentioned above, the first three sub-pieces have a closer structural relation. *Apposition IV* for prepared violin, develops further some of the modular-cells and discards some others. The preparation consists of three intertwined rubber-bands placed on the first natural harmonic position at the neck of the violin. This type of preparation allows a fast transition from prepared to un-prepared and vice versa. Therefore, the modules involving prepared violin can be fragmented and inserted in other sub-pieces. However, it needs some time to be placed or removed. This is an extra reason which reinforced the linear programming of the sub-pieces and the transit from natural sound, denaturalisation to electroacoustic interaction. The preparation explores new textural sound elements but also elements of polyphony, impossible without it.

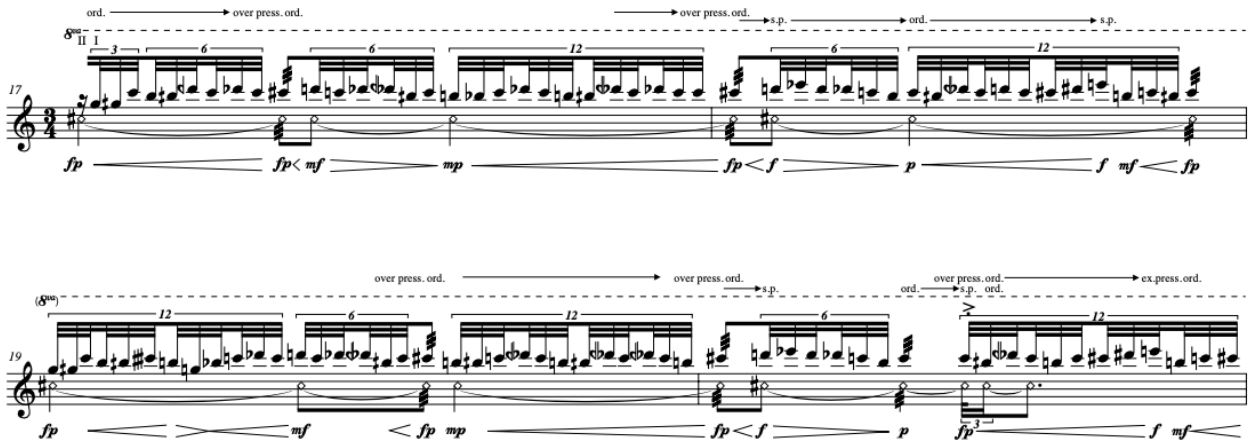


Fig.4.9: Apposition IV example: Polyphony derived from the preparation of the violin

Apposition IV develops larger modular sections than the previous sub-pieces and introduces a quarter-tone melodic lines that emulates the natural speech tonal inflection. In addition to a compelling timbre, the research for a way to prepare the violin focused on the material and placement of it on the violin's neck. The goal was to enable polyphonic lines which are physically impossible without the preparation reinforcement. The rubber-band preparation turned out to be perfect for what I was looking for. It lets the natural harmonics of the first position to act as pedal line together with a melodic line on the same register. Likewise, when over pressing the string it produces the characteristic sound of the sub-harmonic as well as semi-uncontrolled multiphonics, due to the non-regular oscillation of the violin's strings as a consequence of the rubber-band action.

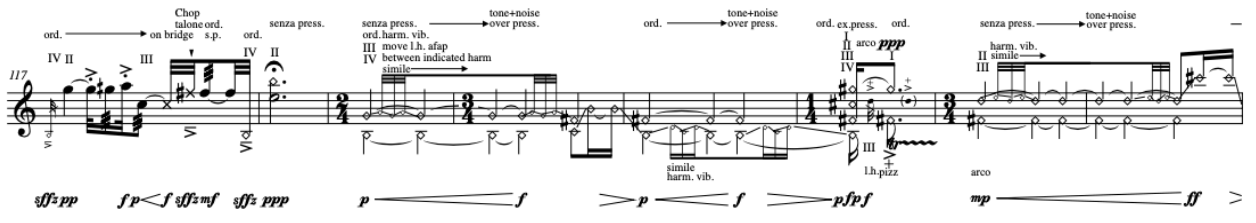


Fig.4.10: Apposition IV example: Over pressure and sound morphology derived from the preparation of the violin

Apposition IV acts as a central pivotal axis in the linear ordered structural plan. Therefore, it generates a symmetrical structure of three purely violin pieces and three prepared pieces; object preparation (rubber-band), analog-electroacoustic preparation (amplification and feedback) and

extensive use of digital sound morphing. However, if the performer decides to freely restructure the set order, the consequent structural decision made, will provide a variant which will generate a new relational linear order.

Apposition VI

Sub-piece five integrates electronic means with extensive use of amplification and feedback. *Apposition VI* expands the electroacoustic material by the use of sampling, granular synthesis, morphing and spacialization of the samplers and grains. Sequentialisation and concatenation are techniques extensively used and explored throughout the set due to the use of block fragmentation. This fragmentation dilutes through the sub-pieces ending on the sixth sub-piece where it transits from sequential to overlapping and from the violin to the electroacoustic environment. In sub-piece number six, the modular set class is an aggregate of the modular-cells employed in the previous sub-pieces. The samplers in *Apposition VI*, are recordings of blocks, capsules and microcapsules developed in the previous sub-pieces. The interaction between the violin and the electroacoustic element is based on the gesture, frequency and dynamical control of the synthetic elements. The electronic section of *Apposition VI* develops an audio-reactive response of the violin performance.

As mentioned above, the sub-pieces in the set are influenced by the macrostructure of a violin suite but also as independent entities. The sub-pieces explore extensively, from a distinctive perspective, instrumental grain, modularity, discontinuity, mutability and perceptual linkages of the various musical materials. Moreover, the introduction of structural free choice and the overall evolution of the concept, let me think about the possibility of working on a retrograded set, once the primary set is finished. The approach to the retrograde set would include the possibility of working on the material with the same principles and enabling the introduction of new inserts; primary, primary retrograde or any variation of the existing modular-cells.

Apposition set: work structure

The development of the musical elements started out being very technical and abstract. Nonetheless, the music exploration unwrapped in the *Apposition* set, was influenced by the ideas and work of Ferneyhough in the field of the instrumental physicality to produce, generate and materialise precise sounds. Throughout the compositional process, I carefully worked the materialisation of the musical ideas and the notation of the complex sound morphologies with the performer, Takao Hyakutome, who commissioned the set. The work with Hyakutome has been vital to defining the physical interaction with the instrument and facilitated the exploration of various techniques combinations. Likewise, for an optimal definition of precise sounds and in some case, even to establish a suitable tempo ratio so that the sound speaks adequately, the process of experimentation with Hyakutome was essential. Hyakutome intended to commission a work that emphasised the musical concepts developed in my previous pieces with palpable virtuosic and technically demanding performing elements. From the very beginning, my concern was to generate a musically compelling material and not just a mere catalogue of techniques. Therefore, due to the extensive palette of sound materials used in *Apposition I*, each modular-cell is related to a distinctive violin technique or articulation, to incorporate a characteristic timbre that accompanies the modular structure sequence. *Apposition I* explores the sequentialisation of dissociated fragments as a strategy to develop discontinuity. Accordingly, the extended techniques fulfil a double function. On the one hand, they define the physicality needed to generate a precise sound and on the other, they facilitate the perception and comprehension of the linkages between disconnected modular-

cells. Hence, conceiving the modular-cells as replicable singularities means that the musical elements' interrelations within the cell are indivisible units, rather than as independent musical elements. These units are a body of sound which is self-contained and not dependent on the structural development and the contextual musical syntax. Therefore, the set is an extensive exploration of the unidimensional relationship between pitch register, rhythm, performative gesture and extended technique.

> It is our duty as composers to make the text, the visual aspect of the text and its musical structure, so self-referential in an enriching sense that the performer can find some way of plugging it into his own sensibilities — so that he is not trying simply to give a generally tasteful rendering of some set of noises, or whatever, but that these noises are, in a semantically specific sense, interrelated among themselves in such a way that the performer himself can attempt to take an attitude towards the relationship.
> (Ferneyhough 1982, p.269)

As mentioned previously, the context of the set of sub-pieces, the discontinuity is progressively abandoned in sub-pieces *II* and *III* in order to develop larger modules. This strategy re-establishes the use of linear processes during *Apposition II* and *III* to progressively retake the syntactic discontinuity in *Apposition V*. It ends with an almost permanent degree of dissociation in *Apposition VI*. Later experimentation allowed me to understand the saturation of dissociated fragments defined by various durations, as a form of development of polymorphic structures in an instrumental context.

4.2.1.Quotations

As mentioned in various occasions, modular-cells are singularities delimited and defined as a collection of time-frames in different scales of duration. Conceiving the time-frame delimitation as a materialisation of the modular agent, a decontextualised replication of the singularity brings in the possibility of quoting non-related modules throughout the sub-pieces.
Thus the development of this concept brought into the creative framework two different typologies of the quote:

- Self-referential quotation: Quotes that belong to own production. In my work, the *Self-referential quotes* are modules with structural function. The quoted material provides a direct link between different sets, sub-pieces and modules.
- Appropriation quotes: Quotes that belong to the collective memory. It refers to the appropriation of external material and the use of material from other authors.

Self-referential quotation

Self-referential quotations are modular-cells that appear throughout a set of sub-pieces or works. These quotations are brief passages, hidden windows or generative material that can evolve in different directions. Moreover, they can be considered as a recurrent insert and relates the exploration with invariance –including the possibility of subtle morphing– as a structural referentiality.
Likewise, the self-referential quotation is a recurrent microcapsule or capsule. This idea relates the

concept to the *reminiscence motif*[19]. The use of reminiscence motif as an invariant element is an early stage or predecessor of the leitmotif. The reminiscent motif can be a simple musical element, and it can relate to formal structural parameters. In my compositions, I do not use leitmotif in the traditional sense, as an element of representation of a dramatic entity.

The use of self-referential quotes as a reminiscent motif, an isolated and non-contextual element– establishes long-term structural elements as a sort of nodal points. These points appear throughout diverse sets of sub-pieces. Therefore, when all the sub-pieces in a set are performed together, the nodes are perceived as a structural referentiality or tie, transcending the particularities of the individual structure in each of the sub-pieces. What appeared to be a disconnected cell, acquires a new function, interacting as a referential conjunction. Furthermore, when the microcapsule is concatenated or sequentialised to the same reminiscent microcapsule, an utterly diluted element starts being the centre of the discourse. Therefore, it can also be considered as a free particle that can be used at any time and moment as a generator of unexpected developments.

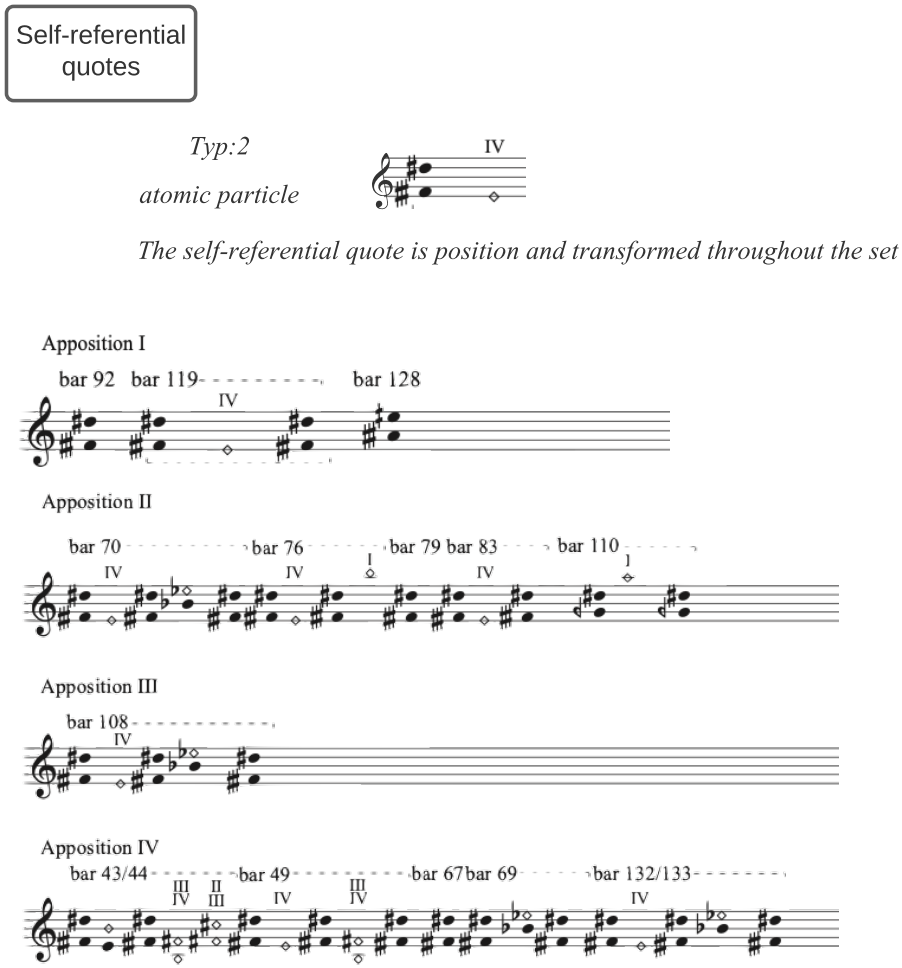


Fig.4.11: Microcapsule examples: quote-typology

This process enables an extended interrelation by developing remote and recurrent sonic relations throughout the compositions.
The reminiscent microcapsule is an essential relational element which can be identified as an

[19] ***Reminiscence motif*** *– A theme, or other coherent musical idea, which returns more or less unaltered, as identification for the audience or to signify recollection of the past by a dramatic character. It is an important ancestor of the Leitmotif . (Grove Music Online, 2002)*

unrelated insert in the short term interaction and as a structural element in the long-term structure. Moreover, repeating the element throughout diverse sets of sub-pieces transforms the material into a distinctive sing, an iconographic element that relates to the author.
As an example, in Antoni Tapies[20] work, the use of some very distinctive iconographic elements that are recurrent in his paintings do have a symbolic meaning. Nevertheless, I did not attach any symbolism, beyond the structural function.

The following diagram – Figure 4.11, 4.12, 4.13 and 4.14 – illustrates the relation of the microcapsule as self-referential quotes with a related primary block structure. Similarly, it maps the particles throughout the set in positions indicating the sub-piece and the bar number. The contrasting typology of the three different microcapsules – attack grain, sustain grain, melodic grain – adds a characteristic articulation to the distinctive timbre of the sub-harmonic. The process develops a clear linear construction ending with the fragmented primary block in *Apposition II*. However, the final perceptual linearity is conditioned by the performer's free choice.

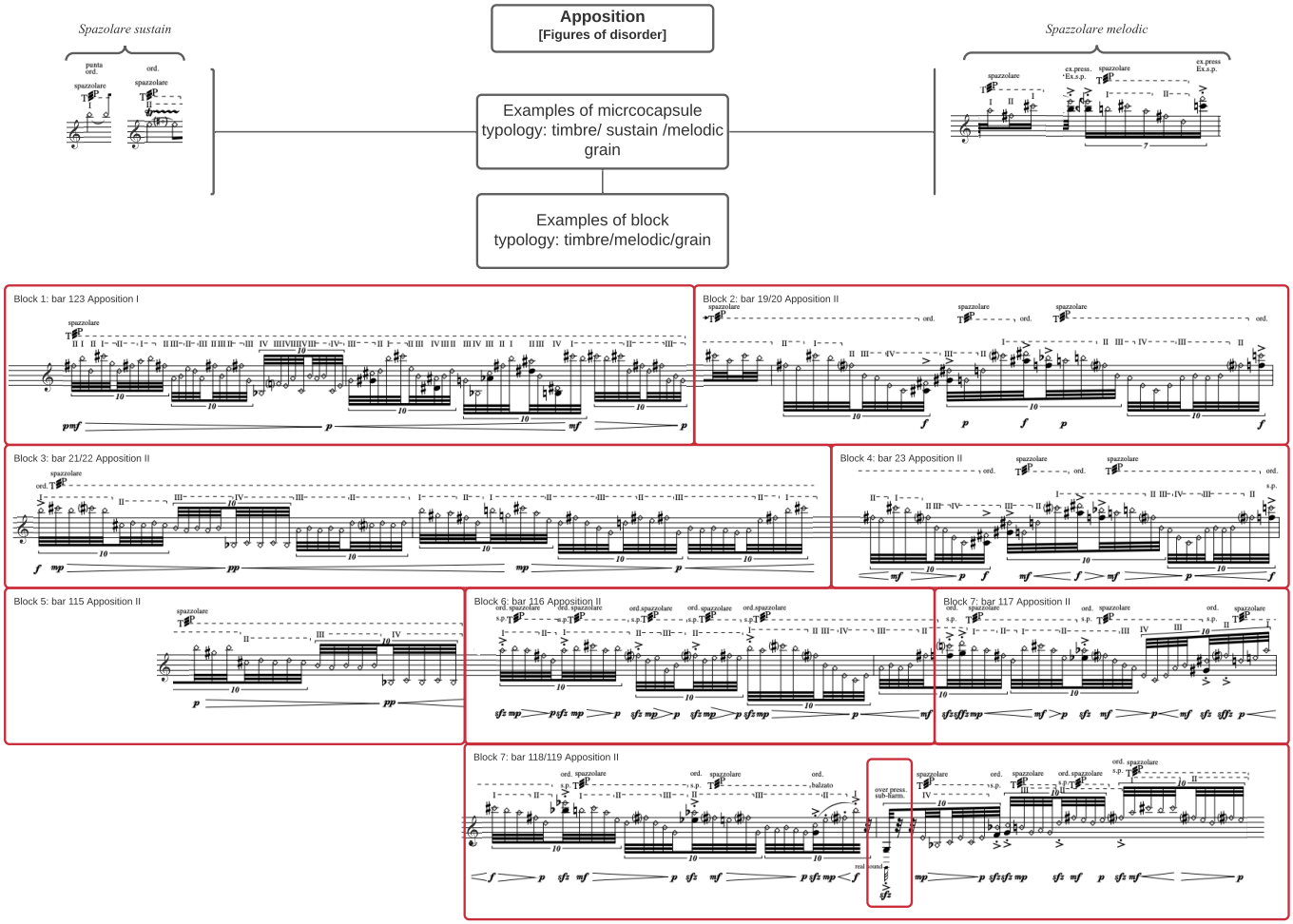


Fig.4.12: Microcapsule examples: typologies

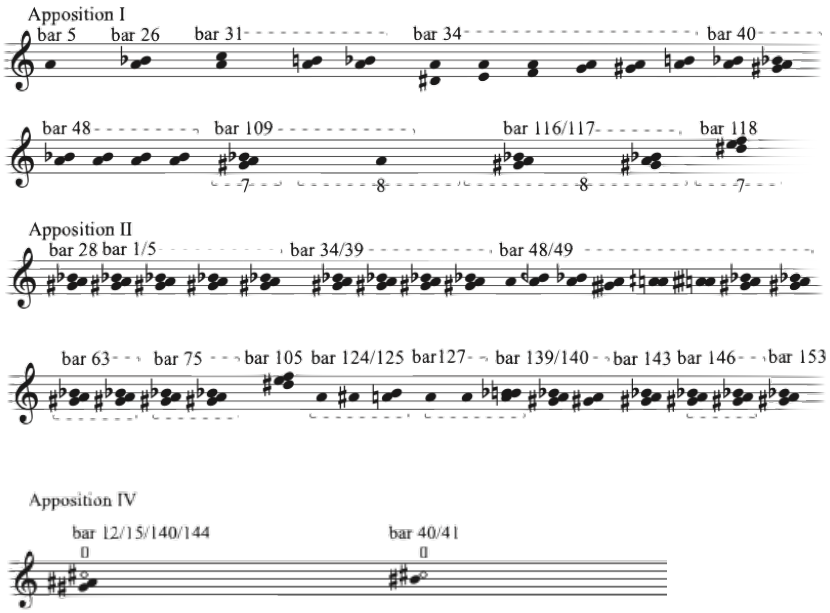
20 ***Antoni Tàpies*** *(1923-2012) – His first artistic attempts began during a long convalescence following a serious illness, after which his increasing dedication to painting and drawing led him to abandon his university education. By the 1940s, he was already exhibiting work that distinguished him among the artistic scene of the moment. Co-founder of the magazine Dau al Set in 1948, and influenced by Miró and Klee, he became increasingly interested in iconographic and magical subjects. He gradually began to incorporate geometrical elements and colour studies leading to an interest in matter through the use of heavily textured canvases of great expressive and communicative possibilities. With these works, Tàpies achieved international recognition by the mid-1950s. In the 1960s, he began incorporating new iconographic elements (writing, signs, anthropomorphic elements, footprints and references to the Catalan situation), and new technical methods (new surfaces, use of everyday objects and varnish). Tàpies' pictorial language has continued to develop ever since, resulting in a creative and productive body of work that is admired throughout the world. (Fundació Antoni Tàpies - Online)*

Self-referential quotes

Typ:1

atomic particle

The self-referential quote is position and transformed throughout the set



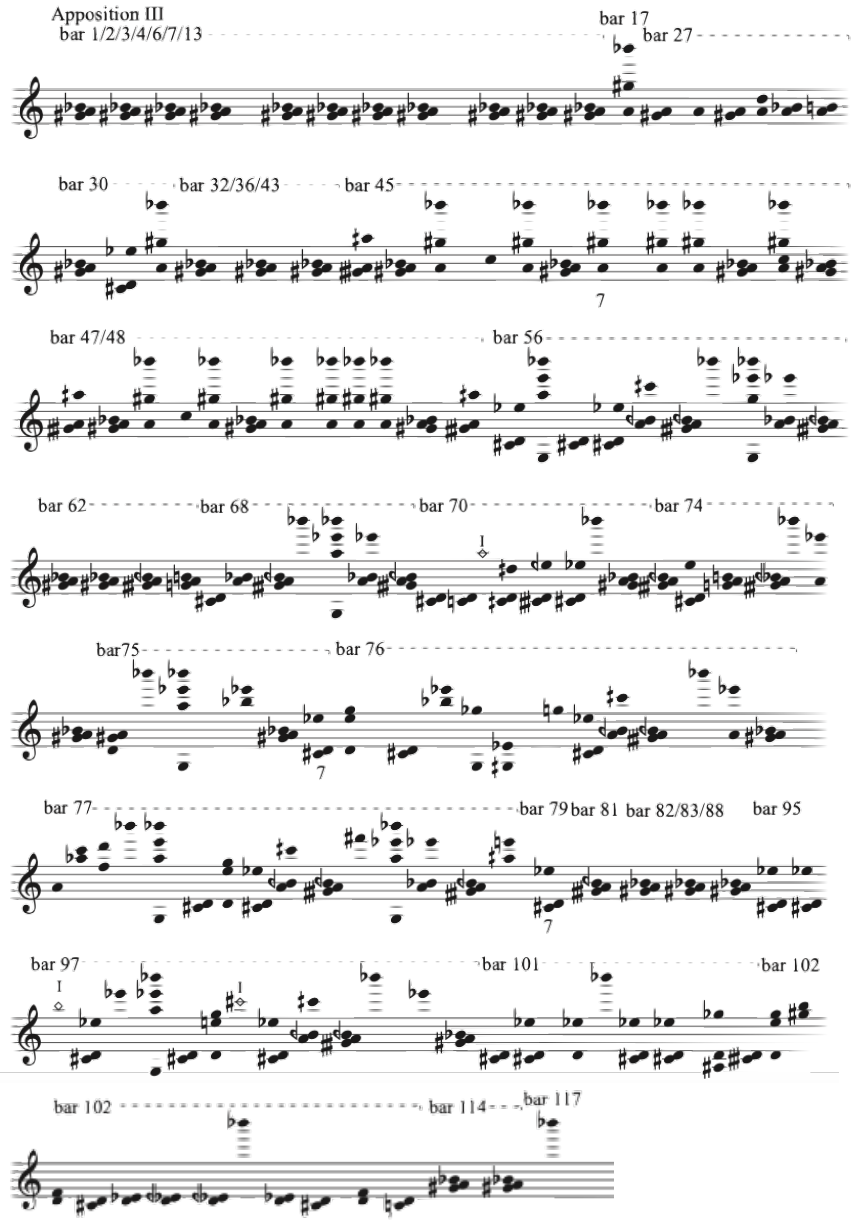


Fig.4.13: Microcapsule examples: typologies

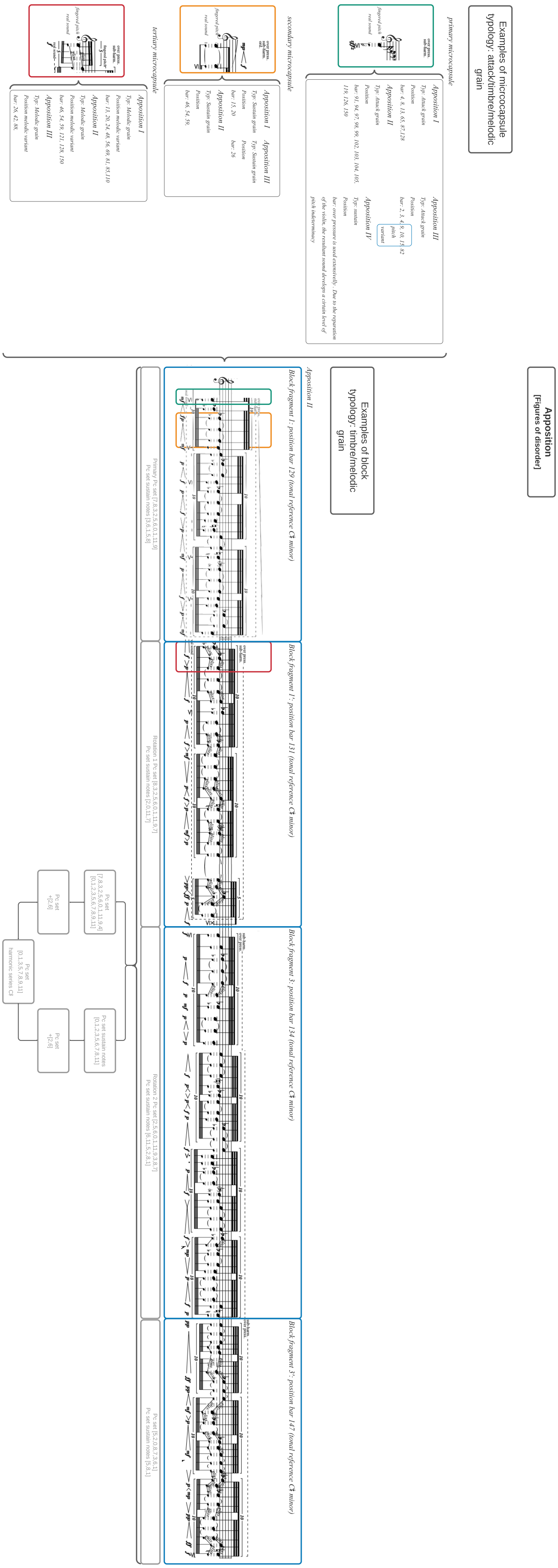


Fig.4.14: microcapsule examples

Appropriation quotes

Collage, montage and more recently, sampling, plunder-phonics and mashups in popular music, explore the role of *appropriation quotes*. This concept can also be related to the theme and variations form. Therefore, a central issue is how to define the relationship between the appropriation and my own material. The insertion of material from other authors must consider two possible perceptual and referential uses of the quote. When the intention is the linear transformation and the integration of the appropriation with my own material, the work must focus on the reinforcement of the linkages between the quote and my own material. On the contrary, when the intention is to generate discontinuity and an evident clash of musical elements, the work must focus on decontextualising and unlinking the quote from own material.

Considering the structural quote –the replication of the inner architecture of a particular piece– as a common typology to both types of quotations and as a much more analytical reference, we can conclude that to be effective, any quote needs to be distinctive and easily recognisable.
The following tables are an example of the pre-sketching material of the work *24 modular-cells*.
The work *24 modular-cells*, explores extensively the disruption and discontinuity of the linearity. The overall structure focuses on the mutability of the appropriation quote. The work is based on Paganini's *24 Caprices*. Thereby, the sub-piece are composed by 24 short sections to be performed in a single movement. Each section develops a completely different technical aspect of the violin and of the duo interaction. *24 modular-cells* is strongly related to *Apposition* set.

Module 1	**meter**	**tempo figure**	**tempo**	**number of beats**	**number of bars**	**Paganini Caprice**	**Funda mental**	**Pcs**	**Har. Pcs + Cent**
modular-cell 1	2/4 (Andante)	quarter	120	82	41	1	E	[4,6,8,10, 11,0,2,3]	[8,9(+4), 10(-14),11(-49),12(+2),13(+41),14(-31),15(-12)]
Module 2	**meter**	**tempo figure**	**tempo**	**number of beats**	**number of bars**	**Paganini Caprice**	**Funda mental**	**Pcs**	**Har. Pcs + Cent**
modular-cell 2	6/8 (Moderato)	dotted quarter	60	41	20,5	2	b	[11,1,2,5, 6,7,9,10]	[8,9(+4), 10(-14),11(-49),12(+2),13(+41),14(-31),15(-12)]

Table 4.1: structural table of 24 modular-cells 1

Module 3	meter	tempo figure	tempo	number of beats	number of bars	Paganini Caprice	Fundamental	Pcs	Har. Pcs + Cent
modular-cell 3	2/2 (Sostenuto)	quarter	70	47,83333	11,95833	3	e	[4,6,8,10,11,0,2,3]	[8,9(+4),10(-14),11(-49),12(+2),13(+41),14(-31),15(-12)]
Module 4	**meter**	**tempo figure**	**tempo**	**number of beats**	**number of bars**	**Paganini Caprice**	**Fundamental**	**Pcs**	**Har. Pcs + Cent**
modular-cell 4	3/8 (Presto)	dotted quarter	105	71,75	71,75	3	e	[4,6,8,10,11,0,2,3]	[8,9(+4),10(-14),11(-49),12(+2),13(+41),14(-31),15(-12)]
Module 5	**meter**	**tempo figure**	**tempo**	**number of beats**	**number of bars**	**Paganini Caprice**	**Fundamental**	**Pcs**	**Har. Pcs + Cent**
modular-cell 5	2/4 (Maestoso)	quarter	35	23,91666	11,95833	4	c	[0,2,4,6,7,8,10,11]	[8,9(+4),10(-14),11(-49),12(+2),13(+41),14(-31),15(-12)]

Table 4.2: structural table of 24 modular-cells 2

5. Archipiélago - String quartet nº2 - (Sub-piece 2)

(Selected piece for the Arditti international call for scores 2012: workshopped and recorded by the Arditti String Quartet on 23, 24 January 2012.)

Archipiélago is my second work for string quartet. The sub-piece is related to my first string quartet *Una Isla de Granito*. This second sub-piece develops further the ideas explored in the first string quartet but in a positive/negative relation. The inner formal structure is constructed around fragmented independent sections interrupting the linearity of the discourse. The unity is created through the development of these fragments establishing relations between disrupted elements and the introduction of new material with no previous development.

Artistically, the set formed by string quartet number 1, 2, 3 and 4, will be a representative work of the modular formalism that my compositions have experienced during the years. *String quartet nº1* was composed in 2010 and it was included as part of my portfolio of work for the PhD research application. String quartet nº2, *Archipiélago*, was composed in 2011. It was the first work composed with the idea of modularity. However, the modular-model was an incipient idea and neither developed or formalized as it is now. Due to the structural planning of the string quartet set, I thought that the processes needed some time to be developed. At the time, I did not have a full appreciation of the modular compositional strategy nor of the model.

5.1.First experiences in the use of modularity

The original structural form of the set, the interaction between the sub-pieces and approximate length of each sub-piece was planed with structural flowcharts – Figure 5.1 and 5.2.

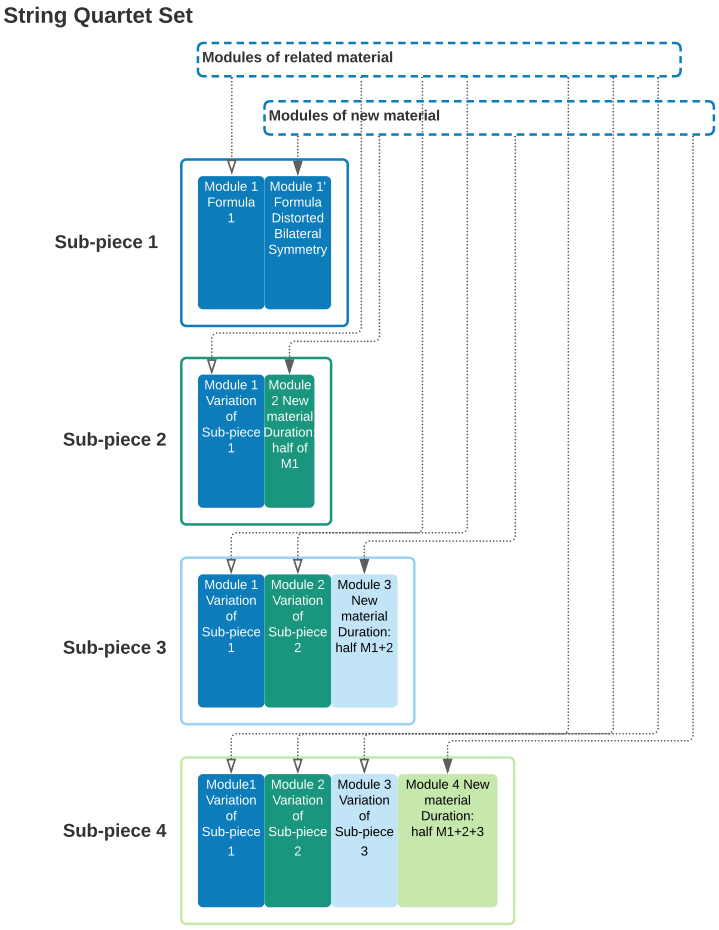


Fig.5.1: Modular form –String Quartet Series–

The module introducing new material is shorter than the modules included in the first section. In *String quartet nº1* the structure is a single section of material – Module 1 – which is re-exposed in a bilateral symmetry technique and with some of the instrumental blocks shifted away from its original position. This was one of my first attempts to compose a piece using defined blocks or the idea of modules. The *String quartet nº2* was a consequence of the prime idea to interrelate four movements – the idea of sub-piece came much later – using *String quartet nº1* as a generative model from which some of the material was derived. However, the technical applications of modularity in the first string quartet were early experimentations of the concept.

The sub-piece explores a process of continuous changes within the adhesion model. The plan is to compose four string quartets where each sub-piece in the series incorporates fragmented modular-cells of the preceding sub-pieces. Therefore string quartet number one, *Una Isla de Granito*, works as a formula and the fourth works as an adhesion model of the previous three sub-pieces.

To define a formal structure, I established a very simple outline that I forced myself to follow. The string quartet set develop sub-pieces that are subjugated linearly to the previous sub-pieces. Consequently, string quartet nº1 is the only one which is entirely composed with new material. The structural form of each sub-piece was planed in relation to the adhesion model. The architecture of each sub-piece is based on a structure divided into two sections. The first section is formed by one module of each of the previous sub-pieces – with equal duration – and second section is a single module of new material.

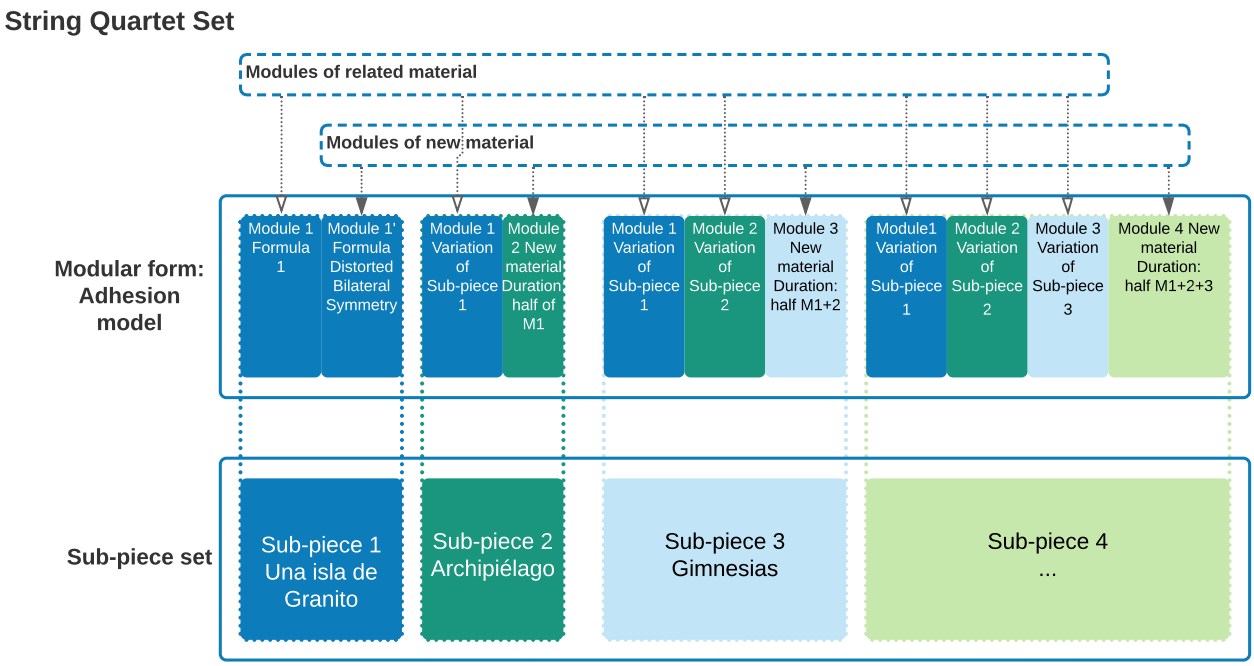


Fig.5.2: Modular form –String Quartet Set–

The set of sub-pieces is an increasing structure where the adhesion model makes a changeable modular relation through the sub-pieces. Thus, the formal structure in all the sub-pieces, can be compressed to a commune inner form of two modules – Illustrated at Figure 5.2/sub-piece 4 – . This strategy makes each sub-piece longer than the previous one, with the fourth being the longest.

The outline of modules has two possible interpretations.
Firstly when the sub-pieces are performed independently or continuously but with breaks.
Secondly when these are performed continuously, with no breaks, as a single piece. The formal structure is related but the perception of the modules changes.
If we consider the entire set as one unique module to be performed as a final piece –Figure 5.3.
Modular form: Adhesion model– the modules of related material, are disjointed by modules of non-related material. The modules in sub-pieces are perceived as literal repetitions of the formula with or without variations and not as referential material or quotations. I usually approach the repetition of a modular-cell, as a variation of the primary formula. However, in recent works, I have been exploring the invariance of unrepeated module.

Archipiélago: string quartet nº2

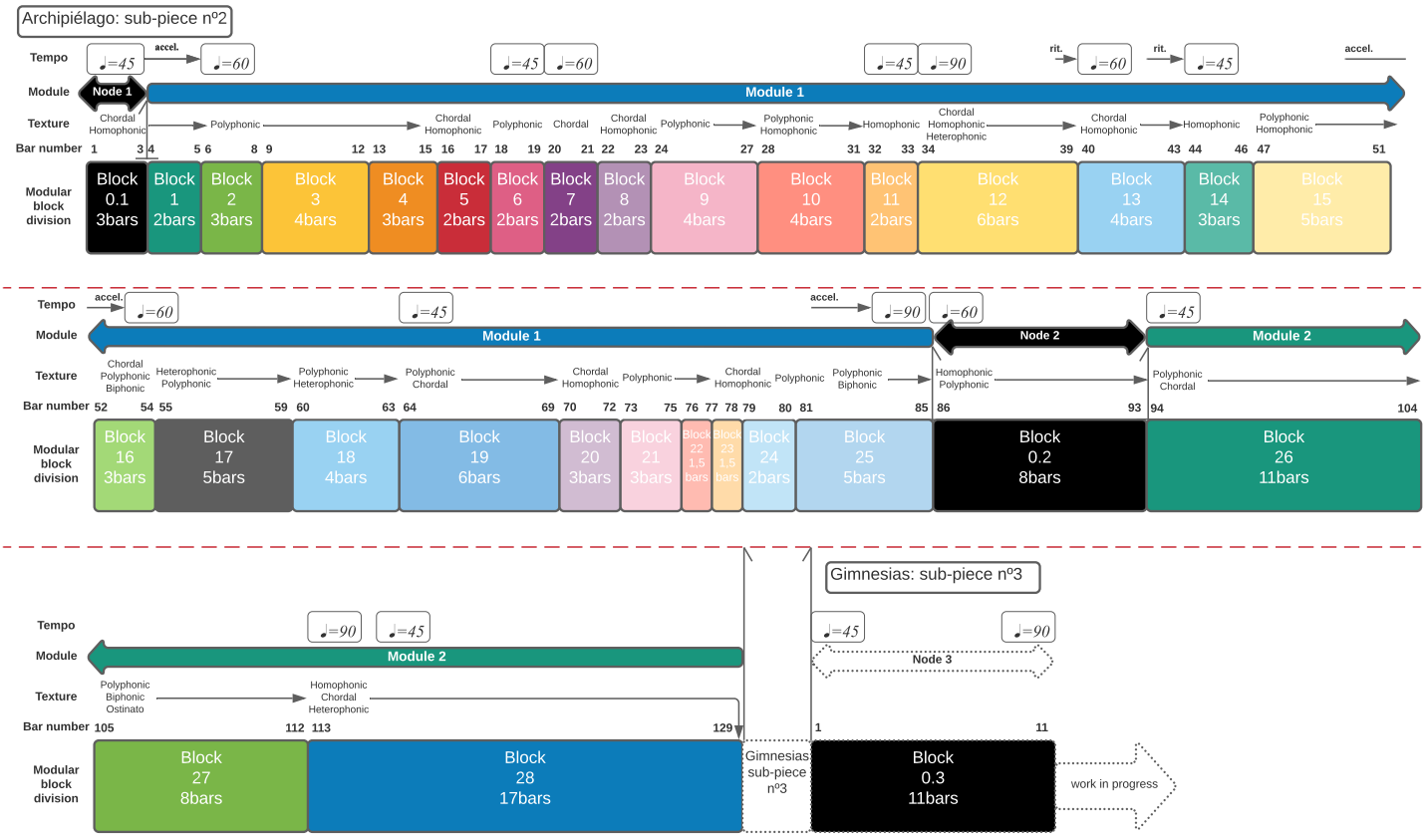


Fig.5.3: Archipiélago: modular form and block structure

Module

A *module* is the largest of the modular-cell. It can be related to the length of a section. However, the module differs from the idea of a classical section. The traditional definition of a section relates it to a bigger structure and it does not have the identity of an independent element.

Moreover, the module is considered a part of a sub-piece and a self-referential singularity. The module is a heterogeneous unit, a delimited structure containing diverse elements. Likewise, the elements forming the module are also independent and self-sufficient. Therefore, the final modular-structure develops within the momentform concept.
At the macro-structural level, the combination of several modules forms a sub-piece.
Archipiélago is divided into two modules Module 1 (bar 1 to 85) and Module 2 (bar 94 to 129). Module 1 is formed by twenty-five short blocks of different durations and usually grouped in contrasting pears. Module 2 is formed by three blocks of bigger dimensions than the blocks in Module 1.

Node point 0: is formed by 1 block divided into 3 bars. It functions as an insert-join between string quartet nº1 and 2.
Module 1: is formed by 25 little Blocks developing contrasted textures.
Node point 1: is formed by 1 block divided into 8 bars. It functions as an insert-join between module 1 and 2
Module 2: is formed by 3 Blocks of longer dimensions.

Figure 5.4 illustrates the comparison of the last three bars of the sub-piece 1, *Una Isla de Granito* with the first there bars of sub-piece 2 *Archipiélago.*

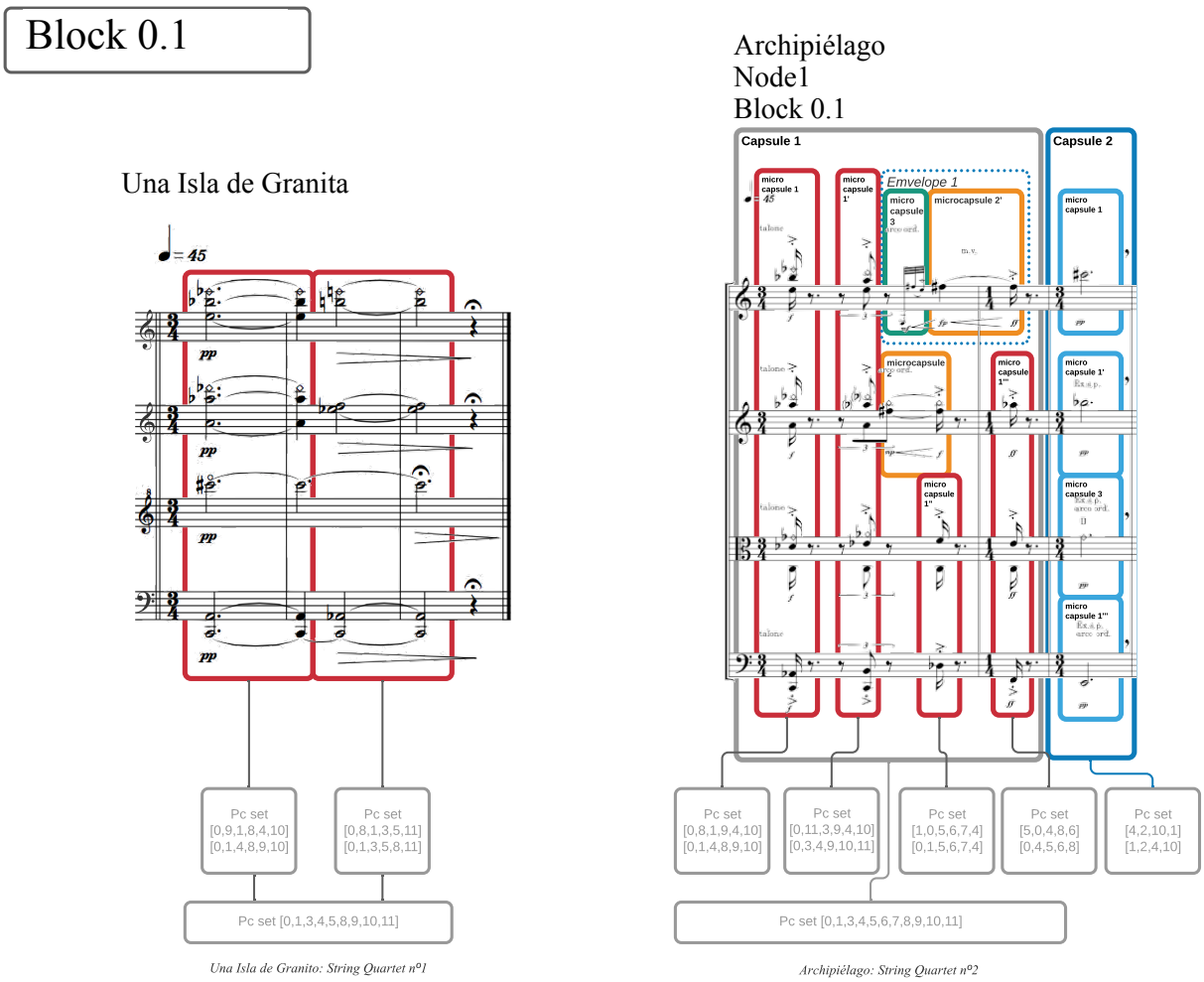


Fig.5.4: Relational ties of block 0.1: Sub-piece 1 and 2

There is an obvious harmonic material relation between the last three bars of sub-piece 1 and block 1 of sub-piece 2 – Figure 5.4. Tempo indication is the same in both examples ♩=45.

Block 1 starts with the same material as microcapsule 1, with a derivation of the cello line that combines the first chord with the second chord by substituting the primary pitch (A) with the second pitch, resolution, (A♭).

Node 1: Block 0.1 (bar 1-3)

Capsule 1 (bar 1-2)

microcapsule 1, 1', 1'', 1'''
microcapsule 2
microcapsule 3
envelope formed by microcapsule 3+2'

Capsule 2 (bar 3)

microcapsule 1
microcapsule 1'
microcapsule 3
microcapsule 1''

The harmonic material of the microcapsule 1 is based on the superimposition of chords; A minor (open strings) and A♯ minor-minor seventh, enharmonic of the written pitch. The minor third (C) on the A minor chord and the minor seventh (G♯) on the A♯7 minor chord are doubled.

The pc set is based on the harmonic modular-cell with fundamental D [D E F♯ G♯ A A♯ C C♯]

Block 0 is build by two bars with meter 3/4 and 1/4 on capsule 1, which is formed by three distinctive microcapsules, and on capsule 2 a 3/4 bar and a comma.

The example of sub-piece 1, Figure 5.4, is also formed by three bars with a particular difference that all three are 3/4 bars. It includes a fermata on the last beat of the piece which is related to the comma in block 1 of sub-piece 2 – Figure 5.4. The first of the two hexachords of sub-piece 1, as an integer Pcs, is [0,9,4,8,10,1]. The last hexachord of sub-piece 1, as an integer Pcs , is [0,8,3,5,11,1]. At sub-piece2, from the structural perspective, capsule 1 is formed by microcapsule 1 which is constructed under a unifying strategy as a vertical element. It is presented as the first beat of a 3/4 bar with the four instruments in a rhythmical unison. All performing elements through the instrumentation are unified as a single microcapsule. These parameter are morphologically similar. Both violins and the viola are performing double-stops consisting of a combination of an open string with an artificial harmonic. The violoncello is performing a double-stop with notes on adjacent strings including the open fourth string. The unity is extended to bowing technique, articulation and dynamics. In relation to structure of the block 1 – divided into two capsules of contrasting rhythmic activity – microcapsule 1 is a compressed derivation of the structural concept of block 1. It combines the same articulation – accent in staccato–, the same dynamics – forte –, as a first beat and a contrasting doted 8th note silence. There is a bow indication, "talone", to reinforce a timbral quality with some residual noise created by the bowing attack. The rhythmic unison is reinforced by placing the chord on the first beat as an isolated impulse delimited by the 8th note silence. The unified quality of the musical elements through the instrumentation is extended to the pitch material by the interval disposition and doubling octaves. However, the pitch unison is avoided presenting an amalgamation of both chords of sub-piece nº1.

Constructivism as a procedure is inherent to any modular proposed scheme. Therefore, the systematic structural approach – a process that can relate macro and microstructures as well as harmony, sound material, rhythm, tempo, dynamics and textures – is influenced by serial thinking. However, this has been a process of defining the compositional parameters employed to formalize a sound relational system and formal structure. As mentioned above, the constructivist framework evolved and grew up towards a development of a compositional strategy which organised the use of the modular agents. Therefore, in *Archipiélago-string quartet nº2* the basic hypothesis of using a collection of compositional concepts based on individual structural segments is much more intuitive and uncontrolled. From thereon, the decision making regarding the relation of modules in a set, evolved to be distinctive for each set of pieces.

In *Achipiélago* as in *Apposition*, the close work with the interpreters has been essential. The path to developing the final score has been a living process in which, thanks to Arditti's String Quartet contributions, I have been able to better develop some elements and their corresponding notation.

6. Free Module Study nº1

(Composition Commissioned by Festival Mixtur 2015, funded by the Ernst von Siemens Music Foundation)

In many aspects, the sub-piece *Free Module Study nº1* is rooted into classical tradition.
The sub-piece is structured and constructed around the transformation of a central block.
The mathematical definition of a *Free Module* acts as a contextual element of the compositional strategy. A free module in mathematics is a generative modular set that consists of linearly independent elements.
The set will be formed by three sub-pieces with the following instrumentation:
Free Module Study nº1:
Electroacoustic environment(Elctr), Electric guitar(E-guit), Saxophone(s)(Sax - Spr/Br), Piano(Pn), Accordion(Acc)
Free Module Study nº2:
Electroacoustic environment(Elctr), Electric guitar(E-guit), Saxophone(s)(Sax - Spr/Br), Piano(Pn), Percussion(Prc), Accordion(Acc)
Free Module Study nº3:
Electroacoustic environment(Elctr), Electric guitar(E-guit), Saxophone(s)(Sax - Spr/Br), Piano(Pn), Accordion(Acc)

Prior to my PhD research my interest in electronic music was considerable, but only a few of my works involved the use of electronic means. Since 2011, almost all my compositions deal, in one way or another, with the use of electronic means. As part of the instrumentation, I started to introduce physical or virtual electronic instruments such as electric guitar, amplification, oscillators, synthesisers and sampling, as well as different approaches to the relation of electronic means and acoustic instruments.

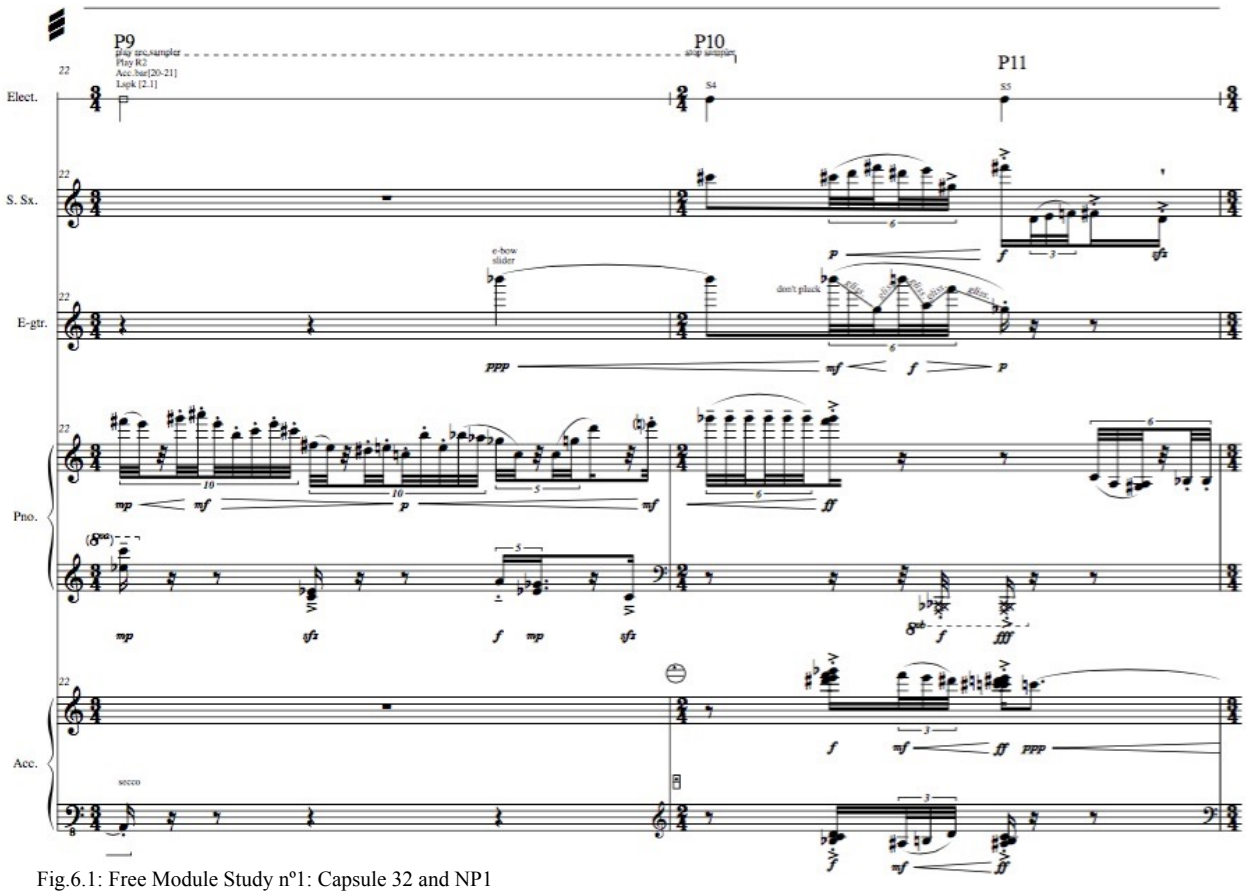


Fig.6.1: Free Module Study nº1: Capsule 32 and NP1

The central issues have been the timbral interaction between both environments – acoustic and electroacoustic – and defining the electronic instrument as a sound singularity. As an outcome of my growing interest in researching electroacoustic environments and techniques, the experimentation focused towards defining the electronic sound through material generated by electronic means as an instrumental singularity. Therefore the works did not develop processes of live transformation of the acoustic-instrumental signal morphing the real sound of the acoustic instrument. Consequently, the investigation led me to explore the work of Richard Barrett. The inquiry focused on multi-layer modularity, the relation with sampling different time scales and different parallel processes using a virtual instrument performed on a midi-keyboard. Thereby, the exploration focused on Barrett's series *Codex*. Therefore, the electroacoustic environment is conceived as a part of the instrumental set as a sonic singularity and not just as a morphing channel of the acoustic signal. Likewise, this approach to the electronic instrument enables an instrumental integration of the electronic environment with its own sonic identity and with chamber performing implications. Having these ideas in mind, I composed *Free Module Study N°1*.

Nonetheless, some of the concepts and sound qualities developed in fixed and mixed media electroacoustic compositions began to feed the compositional process of my acoustic instrumental compositions. The recreation of some of those principles within a purely acoustic instrumental environment led me to revisit the work of Lachenmann and his permanent search for new timbres and denaturalisation of instrumental sound. The strong relationship with a new musical paradigm imprinted in Lachenmann's works made me re-consider some critical aspects of my work. Therefore, the area of action was enlarged by the timbral-acoustic relations.

In *Free Module Study n°1* the modular-cells are treated independently, with a strong formal unity created by the instrumental transition of the cells. These transitions generate a relation linkage between the module and the instrument performing the blocks within that module.
The blocks do evolve from an almost naïve presentation of the material, in the piano part, to a much more complex instrumental group unit where the independent blocks converge into a single structure that behaves as a singular moment.

The instrumentation transits from an ensemble approximation to a sum of soloist in a permanent transformation. In addition, the ensemble interaction moves towards a sound amalgamation where all the instruments work together as a sonic object. Even though the idea of a vertical time is not evident when the sub-piece starts, it has been essential to developing a sense of sound space and sound strata. An influential description of vertical time is the one Jonathan D. Kramer (1978) did in his article *Moment Form in Twentieth-Century Music*. He describes the relationship with the concept of a time that is not linear but dimensional.

> Since Moment forms vertical time, render every moment a Now, avoid functional implications between moments, and avoid climaxes, they are not beginning-middle-end forms. Although the piece must start for simple practical reasons, it may not begin; it must stop, but it may not end.
> (Kramer 1978, p.180)

6.1.Linearity towards Moment: horizontal time and vertical time

In *Free Module Study n°1* time[21] is the element of delimitation, a unit of cohesion of the modularity. The sub-piece deliberately avoids tempo changes. The collection of horizontal independent modular-cells are defined by a constant immobile tempo. It is an attempt to reinforce the vertical moment defined by the time scale of the diverse modular-cells. The consequences of deposing the horizontal time is not obvious from the starting point. However, the sub-piece is not static. The first module starts being very polyphonic to evolve into a sound amalgamation that emerges over the contrapuntal technique followed until that moment. Consequently, it is a transit from a horizontal sequential block development to a vertical block overlapping. We can also find the concept of vertical and horizontal time in Shaeffer's definition of polyphony and polymorphy. In those terms, we can argue that the sub-piece navigates from a polyphonic model to a polymorphic model. Moreover, the sub-piece structure is formed by three modules. Two of the modules are based on relational material. The linearity of the blocks developed in the first module is a process of transformation. *Free Module Study n°1* evolves from a transparent melodic profile (module 1) to a dense amalgamation of parallel processes (module 2). The changing structural nodal point is the progressive transition of musical material in the new module. Modules 1 and 2 develop complementary musical material. This enabled a vertical overlapping of block 3 of module 1 and block 1 of module 2 in a concatenation of the materials.

It is good to denote that the change of saxophone, from soprano to baritone (bar 70), highlights the structural consolidation of the new material in the piece. As an extension of the instrumental change, the blocks developed by the saxophone abandon the rhythmical and highly articulated material with a strong melodic character of module 1, in favour of an extensive interrelation with the electroacoustic material. Therefore, this interaction emerges as an amalgamation of the sonic events defined by the microcapsules activity developing grains or clicks. The transition that occurs during the first and second module is an attempt to mislead the perception of a stratified and precisely delimited environment; as acoustic-instrumental, electronic instrument (e-guitar) and electroacoustic. In addition to the parametric development of the musical elements, the piano and saxophone(s) remark an acoustic sound element defined by the following morphological criteria: grain, melodic profile and mass profile. The accordion acts as a bridge between synthetic waveforms and acoustic instruments. Due to the contextual sonic material, in some moments, it is perceived as an additive synthesis generator. The electric guitar explores the hybridisation imprinted in the nature of the instrument developing morphological criteria related to harmonic timbre and crossroads between the electroacoustic material and the acoustic material. The electroacoustic environment is divided into two types of elements. Both elements are related to a fixed media resources, there is no live morphing or transformation of the signal. To sum up, there are live recordings of the instrumental performances for later playback and 10 different electroacoustic audio samples of diverse durations exploring granular montage techniques. In this manner, the live recording decontextualises the instrumental sound by redefining the sonic position of the instrument in the space and in time. When it is played-back the context relation with the musical material is redefined and the musical activity of the instrument clashes with the material recorded.

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[21] ***Time*** – *(1) A synonym or shorthand for musical metre, as in '6/8 time'.*
(2) A general term to designate the rhythmic acuity of a performer or ensemble, as in 'playing in time'.
(3) The essential medium for music and musical performance, a non-spatial continuum of past, present and future in which music exists and is understood. Music requires no material substance, nor can one circumscribe any set of sounds as inherently musical (and others as inherently non-musical), but all music must occur in time. (Justin London 2001, Oxford Music Online, Grove Music Online)

As a consequence of this, there is a clearly perceivable detachment of the live performed and playback material. This generates a physical discordance which favours the impression of an acoustic and electroacoustic sound amalgamation.

Consequently, the 10 audio samples are combined live to create montages with the defined sound objects. Each object is determined by its audio sample duration. The samples' sonic result is defined by the montage of diverse sonicevents. There is a use of filters that makes each sonic event defined. These objects are triggered one by one and recombined as aggregates during the sub-piece. The repetition of the same sample is not perceived as a periodical action since these are triggered in pairs, triads, groups of fours up to all 10 samples. As a result, the electroacoustic part ends in a combinatorial amalgamation of all the samples. The recombination of the audio samples and the live-recordings merge as contextual transitions between the instrumental activity and the invariant characteristics of a fixed audio sample. These audio samples are a type of short-term relational object recombined in a dynamic morphological variation. Consequently, the samples develop referential functions as reminiscent modular-cells. The concept of a structural referentiality as self-quotations and the precepts of an invariant reminiscent motive have been developed in sub-chapter 4.2.1.

Thus, the homogeneity created by the invariant audio samples and the live-recordings playback is diluted by stratifying the samples' adhesion model and the contextual activity of the recordings. The perception of what has been performed and the decontextualisation of the recurrence is not inserted exclusively as repetition of a musical element. The multi-layer stratification of module 2 embeds a polyphonic process towards a dense saturation of the material which materialises as a mass profile in module 3. This new context abandons progressively the polyphonic linearity in benefit of a dense polymorphic stratum.

The following table is a structural representation of the modular-form. The table gives basic information about the compositional technique (strategy), modular-model (modular-cells and nodal points) and positions (bars number and number of bars integrating the cells).

Strategy and Morphology	**Modular-cell**	**Structural Nodal Points**	**Bar n^{o}** (from-to)	**Number of Bars**
Hort.time/Seq Polyphonic	**Module 1**		**(1-53)**	**53**
Fragmentation/ harmonic timbre/ melodic profile/grain	Block 1		(1-22)	22
Sing:repetition/mass		NP1: Block 1 - Block 2	**(23)**	1
Linearity/repetition/ variation/melodic profile	Block 2		(24-44)	21
Sing:timbre/dynamic		NP2: Block 2 - Block 3	**(45-46)**	2
Linearity/repetition/ variation/density	Block 3		(47-52)	6
Sing:repetition/mass/ timbre/dynamic/		**NP3: Modul 1 - Module 2**	**(53-56)**	**4**

Hort.time/ Seq>Overl. Polyphonic to Polymorphic	**Module 2**		**(57-111)**	**55**
Fragmentation/mass profile/harmonic timbre/melodic profile/grain	Block 1		(57-65)	9
Sing:repetition/mass		NP1: Block 1 - Block 2	**(66-71)**	6
Linearity/repetition/ variation/melodic profile	Block 2		(72-88)	18
Sing:repetition/mass		NP2: Block 2 - Block 3	**(89-92)(93)**	5
Linearity/repetition/ variation/density	Block 3		(94-11)	18
Sing:repetition/mass/ timbre/dynamic/ melodic profile		**NP4: Var. of NP1 Module 2 - Module 3**	**(112)**	**1**
Vert.time/Overl. Polymorphic	**Module 3**		**(113-129)**	**17+1**
Saturation/mass profile/harmonic timbre/melodic profile/grain/allure	Block 1		(113-126)	14
Sing:grain/attack/ mass/harmonic timbre/ dynamic/allure		NP1: Block 1 - Block 2	(127-129)	3
Sing: fadeout		**Expansion joint: Sub-piece 1 to 2**	**(129/130)**	**1**

Table 6.1: formal structure

Module 1: Horizontality - Fully Polyphonic
Module 2: Transit from Polyphonic to Polymorphic
Module 3: Verticality - Fully Polymorphic

All modules will last around 50 bars with approximately the same duration. In *Free Module Study n°1* module 1 is 53 bars, module 2 is 55 bars and module 3 is 17+1 bars. Module 3 is fragmented in three parts (17x3= 51). The fragment defined as module 3 in sub-piece number 1 is the first 17 bars of the fragmented module that it is present in the whole set. There will be a disconnected fragment of 17 bars present in each of the 3 sub-piece in the set.
In module 1 there is an extensive use of polyphonic texture between the instruments. The modular-cells transit from one instrument to the other. In module 2 the linearity disintegrates progressively. However, the process is not a consequence of reducing and diluting the material, on the contrary, the disintegration of linearity is achieved by saturating the polyphonic texture. Module 2 is a moment of transition from a polyphonic to a polymorphic texture. Module 3 is a moment where the saturation of the sonic environment implies a rotation of the horizontality in favour of the verticality. The sound amalgamation created makes us perceive a single body of sound which together with the perceptive deception created by the instrumental playback in the electroacoustic part makes it difficult to define a clear sound transmitter, instrumental or electroacoustic.
It is clear that the structural mapping of the modules leads the energy linearly towards module 3. However, the climax – located in bar 127 – is aborted by the action of the audio samples as an anticlimax.

6.2.Modular-cells: instrumental interaction with sound objects and signs

The instrumental interaction, in *Free Module Study n°1* is defined by the density of the material which transits from the transparent module 1 to a saturated module 3. In between one and three, there is module 2 which acts as the bridge or node. In this transit, there are modular-cells developing criteria related to grain, melodic profile, harmonic profile and mass profile.

Instrumentation:
Electroacoustic environment(Elctr), Electric guitar(E-guit), Saxophone(s)(Sax - Spr/Br), Piano(Pn), Accordion(Acc)

Module 1: Horizontality - Fully Polyphonic

Block 1: linear construction of a capsule - microcapsule sequential disposition

Primary generative harmonic modular-cell: fundamental A♯

Secondary generative harmonic modular-cell: fundamental A♮

The first appearance of a combined fundamental A♯ / A♮ is located on bar 10-11.

Harmonic modular-cell –the generative process has been explained in sub-chapter 2.3.1:

Primary Fundamental	Secondary Fundamental
Pcs A♯: [10,0,2,4,5,6,8,9]	Pcs A: [9,11,1,3,4,5,7,8]

The following table is a collection of capsules and microcapsules of block 1. The table gives basic information about constructive elements (number of fragments), positions (bar number and instrumentation), sonic typology (sound morphology and the pitch class set) and name.

M1:
Block 1

Modular-cell type	Number of microcapsules	Bar number	Instruments	Sound morphology	pc set	name
capsule	3	(1)	Elctr, E-guit,Acc	Elctr (P1), E-guit,Acc attack/dynamic/mass profile/harmonic timber	[0 2 4 5 6 **10 9**]+ Audio sample (S1)	c1
microcapsule	1	(1)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	m1
capsule	2	(1-7)	Sax,Acc	Sax,Acc allure/harmonic timber	[6 **10**]	c2
microcapsule	1	(2)	Pn	Pn grain/dynamic	[6]	m2
microcapsule	1	(3)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	m3
capsule	2	(3-4)	Pn	Pn grain/dynamic	[6 4]	c3
capsule	3	(4-6)	Sax,E-guit,Acc	Sax/E-guti harmonic timbre	[6 **10**]	c4

M1:
Block 1

capsule	2	(4-5)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c5
capsule	2	(5)	Pn	Pn grain/melodic profile	[6 4 **9 10**]	c6
capsule	2	(6)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c7
microcapsule	1	(6)	Pn	Pn (ostinato) grain/dynamic	[0]	m4
capsule	3	(7)	Pn	Pn grain/melodic profile	[6 4 8 **10** 0]	c8
capsule	2	(7-9)	E-guit,Acc	E-guit, Acc harmonic timbre	[6]	c9
microcapsule	1	(7)	Pn	Pn (ostinato) grain/dynamic	[0]	m5
capsule	3	(8)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c10
microcapsule	1	(8)	Pn	Pn (ostinato) grain/dynamic	[0]	m6
capsule	3	(8)	Pn	Pn grain/melodic profile	[6 4 8 **10**]	c11
microcapsule	1	(9)	Pn	Pn (ostinato) grain/dynamic	[0]	m7
capsule	3	(9-10)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c12
capsule	1	(10)	Elctr/Acc playback	elctr. (P4) harmonic timbre (A♯)	[10]	c13 pb1
microcapsule	1	(10)	Pn	Pn (ostinato) grain/dynamic	[0]	m8
capsule fundamental note: A♯ and A♮ mixtur	3	(10-11)	Pn	Pn grain/melodic profile	[6 4 8 **10** 0]+ [3 1 11]	c14
microcapsule	1	(11)	Pn	Pn (ostinato) grain/dynamic	[0]	m9
capsule	3	(11-12)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c15
microcapsule	1	(12)	Acc	Acc grain/dynamic/mass	[0 2 4 5 6 8 **10**]	
capsule	2	(12-14)	Acc	Acc grain/dynamic/mass	[5]	c16
microcapsule	1	(12)	Pn	Pn (ostinato) grain/dynamic	[0]	m10

M1:
Block 1

capsule fundamental note: A♯ and A♮ combo	5	(12-13)	Pn	Pn grain/dynamic/ melodic profile	[6 8 **10** 0]+ [**9** 7 8]	c17
microcapsule	1	(13)	Pn	Pn (ostinato) grain/dynamic	[0]	m11
capsule	3	(13-14)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c18
microcapsule	1	(13)	Pn	Pn (ostinato) grain/dynamic	[0]	m12
capsule	3	(14)	Elctr, Sax, E-guit,	Elctr (P5), Sax, E-guit attack/grain/ dynamic/mass	[4 0 6 7 8]+ Audio sample (S2)	c19
capsule	1	(14)	Sax	Sax harmonic timbre	[8]	c20
capsule fundamental note: A♯ and A♮ mixtur	6	(14-15)	Pn	Pn grain/dynamic/ melodic profile	[6 8 **10** 0]+ [11 8 7 **9** 4 5 8 3]	c21
microcapsule	1	(14)	Pn	Pn (ostinato) grain/dynamic	[0]	m13
capsule	5	(15)	Tutti	Elctr (P6), Sax, E-guit, Pn, Acc attack/mass/dynamic	[**10** 11 0 6 5 4 **9**]+ Audio sample (S3)	c22
capsule	1	(15-22)	Acc	Acc pitch/dynamic/ harmonic timbre	[10]	c23
capsule	3	(15-16)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c24
microcapsule	1	(16)	Pn	Pn (ostinato) grain/dynamic	[0]	m14
capsule	4	(16-17)	Pn	Pn grain/melodic profile	[6 8 **10** 0 3]	c25
microcapsule	1	(17)	Pn	Pn (ostinato) grain/dynamic	[0]	m15
capsule	4	(17-18)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	c26
microcapsule	1	(18)	Pn	Pn (ostinato) grain/dynamic	[0]	m16
capsule	7	(18-19)	Pn	Pn grain/melodic profile/harmonic timbre	[0 **10 9** 5 8 6 4 3]	c27
microcapsule	1	(19)	Pn	Pn (ostinato) grain/dynamic	[0]	m17
microcapsule	1	(19)	Pn	Pn grain/dynamic/mass	[**9** 6 8 **10** 1]	m18
capsule	2	(19)	Pn	Pn grain/melodic profile/harmonic timbre	[**9** 8 4]	c28

M1: Block 1						
microcapsule	1	(19)	Pn	Pn (ostinato) grain/dynamic	[0]	m10
microcapsule	1	(20)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	m20
capsule	2	(20)	Pn	Pn grain/melodic profile/harmonic timbre	[8 6 4 7] [8 4]	c29
capsule	4	(20-21)	Pn	Pn grain/melodic profile/harmonic timbre	[**9** 6 8 **10** 1 3 4 0 11]	c30
microcapsule	1	(21)	Pn	Pn (nute) grain/dynamic/ attack	[5 6 8]	m21
microcapsule	1	(21)	Pn	Pn (ostinato) grain/dynamic	[0]	m22
capsule	1	(22)	Elctr/Acc playback	elctr. (P4) harmonic timbre (A♯)	[10]	c31 pb2
capsule fundamental note: A♯ and A♭ mixtur	8	(22)	Pn	Pn grain/melodic profile/harmonic timbre	[*3* 0 6 4 8 **10** *11 1 7* 2]	c32
microcapsule	1	(22)	Pn	Pn grain/dynamic/ attack	[0 3]	m23
capsule	1	(22)	Pn	Pn grain/dynamic/ attack/harmonic timbre	[9 3 6]	c33
capsule	1	(22)	E-guit	E-guit dynamic/allure/ harmonic profile	[10]	c34
microcapsule	1	(22)	Pn	Pn (ostinato) grain/dynamic	[0]	m24
NP1	24	(23)	Elctr, Sax, E-guit, Pn, Acc	Tutti grain/dynamic/ allure/harmonic timbre/melodic profile/mass profile/ attack		NP1

Table 6.2.: M1 Block 1

The polyphonic relation of the modular-cells is influenced by their sequential disposition. Therefore, the adhesion model – the model has been described in sub-chapter 3.1.1 – relates the modular-cell with the instrument which performs the cell. The transit of the modular-cells from one instrument to another starts at NP1 (bar 23). Block 1 explores the relationship between two contrasting textures. These two textures are both fragmented but within particular and distinctive processes. Instrumentally speaking, block 1 is divided into two groups; ensemble+soloist. The relationship between the piano (soloist) and the ensemble is defined by the musical texture developed by each group. The piano texture is defined by the rhythmic activity: including clicks,

rhythmic patterns and percussive sound. Moreover, it performs a repeated note as an impulse to generate a pulsar train in the domain of instrumental music – ostinato – and a melodic construction. The ensemble texture – including electronics – is defined by two elements: the rhythmical unison and several pedal points in different registers and instruments. These two contrasting textures define the instrumental context as biphonic.

Soloist texture: the piano develops three types of modular-cells, two capsules (c26 and c32) and one microcapsule (m4). The capsules are defined by a contrasting material. The microcapsule acts as a structural bridge between the capsule's morphologies. The two capsules are deconstructed by abstraction – the model has been described in sub-chapter 3.1.1. The resultant fragments are referential and distinctive microcapsules (m1/m2) first performed in bars 1 and 2.

1- Capsule c26 is a retrogradable rhythm from which the microcapsules have been abstracted. The pitch class set is [5 6 8] in the lower register of the piano.
The piano strings have been previously muted with rubber mutes. The mutes have to be placed in such a way that the resulting sound does sustain the minimum possible number of harmonics, materialising in a hollow timbre.

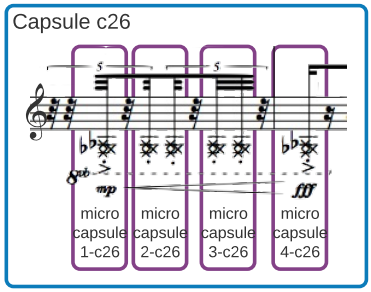

Fig.6.2: Capsule c26 and its microcapsule structure

2- Capsule c32 is developed under harmonic and melodic criteria. The capsule acts as a formula generating all the harmonic information developed in the whole block.

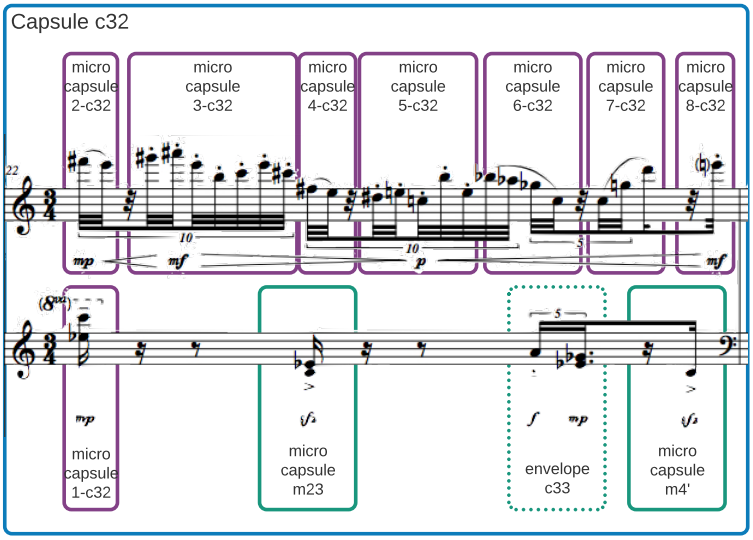

Fig.6.3: Capsule c32 and its microcapsule structure

The capsule c32 is formed by a collection of 8 melodic microcapsules, 3 grain and 1 envelope. It is divided into two typologies with three types of articulation.
Grain:1-c32 (tenuto), m23 (sforzato), m4'(sforzato)
Melodic:2-c32(legato), 3-c32(staccato), 4c32(legato), 5-c32(staccato), 6-c32(legato), 7-c32(legato), 8-c32(staccato)

3- Microcapsule m4: It is an instrumental grain type and is conceived as a repeated note in a perceptual parallelism with a pulsar train –which establishes a rhythmic ostinato on one note.

First appearance of the primary microcapsule (m4) in bar 6 (***ppp*** dynamics).

There are variations of the dynamic criteria, one variation of pitch addition – microcapsule m23 (bar 22) – and one variation by decontextualisation – the microcapsule m2-c22 as part of the cluster on bar 15.

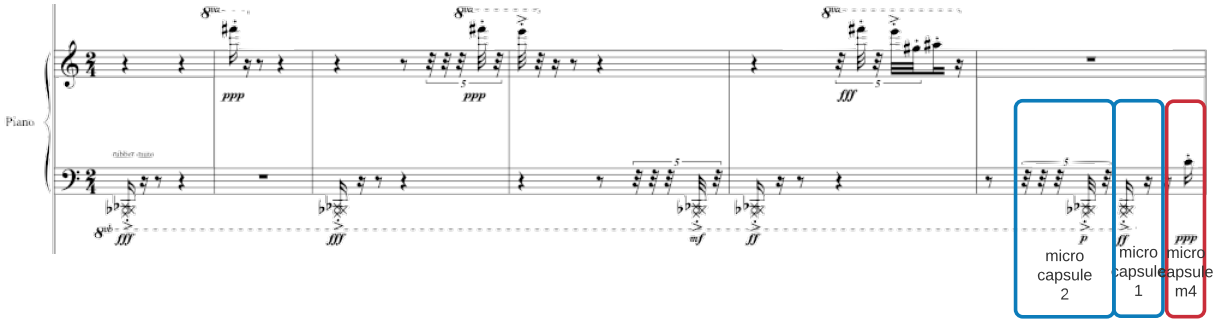

Fig.6.4: bar 6 –microcapsule m4–

Ensemble texture: the group of instruments implement two types of capsules. Both capsules are performed in the first bar. Contrary to the development of the piano texture, the ensemble develops variations on the same type of capsules during the course the work. These two primary capsules are defined by opposite types of texture, grain type and melodic type. Both types are combined to generate ensemble clouds defined by the a single type or an amalgamation of both types in a cloud.

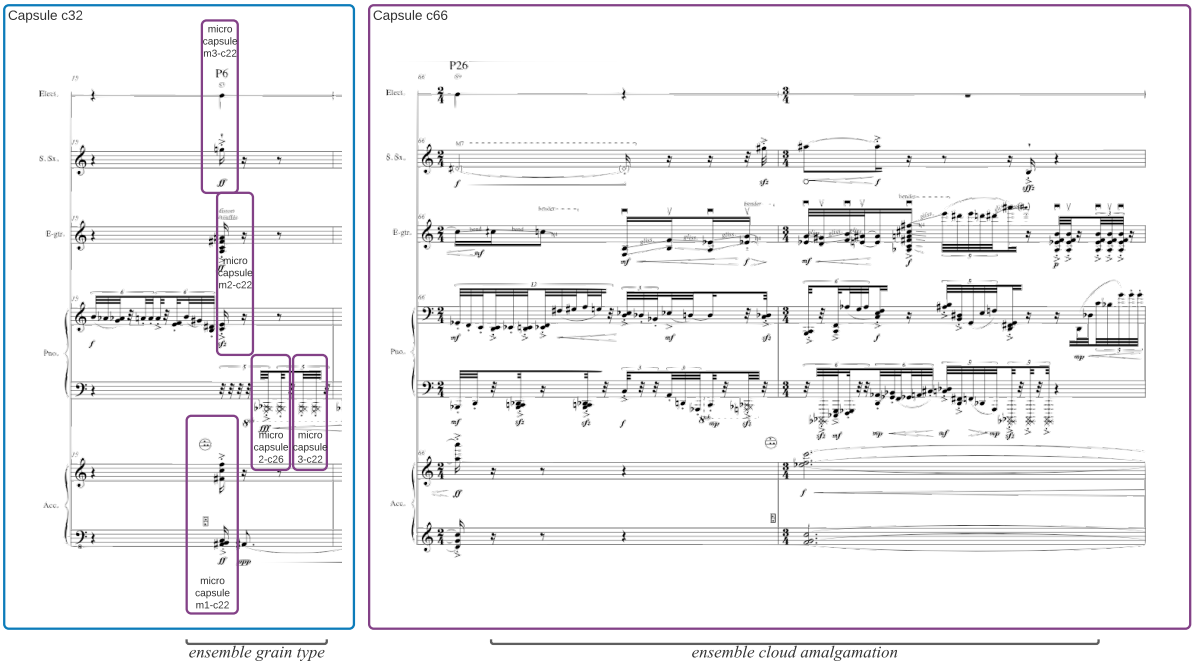

Fig.6.5: –microcapsule m4–

Ensemble Typology and Ensemble Cloud

Capsule c32: Ensemble grain type. Rhythmic unison on an eight-note with a ***ff*** dynamic attack.

Capsule c66: Ensemble cloud amalgamation.

The following table is a collection of capsules and microcapsules of the nodal point 1 (block 1/ module 1). The table gives basic information on constructive elements (number of fragments), positions (bar number and instrumentation) and sonic typology (sound morphology and the pitch class set).

M1: Block 1 NP1						
Modular-cell	**Number of microcapsules**	**Bar number**	**Instruments**	**Sound morphology**	**pc set**	**name**
capsule	1	(23)	Elctr (P10)	Elctr grain/attack/dynamic/ allure	Audio sample (S4)	c35
capsule	2	(23)	Sax	Sax grain/attack/dynamic/ allure/melodic profile	[11 0 4 1 2 6]	c36
capsule	2	(23)	E-guit	E-guit allure/dynamic/ melodic profile/mass	[10 7 11 9 6]	c37
capsule	2	(23)	Pn	Pn dynamic/attack/ melodic profile/ harmonic timber	[6 5]	c38
capsule	3	(23)	Acc	Acc attack/mass/melodic profile/harmonic timber	[10 0 2 3 4 5 6]+ [10 5 11 4 2 3]+ [10 11 0 1 2 3 4]	c39
capsule	2	(23)	Pn	Pn (nute) grain/dynamic/attack	[5 6 8]	c40
capsule	1	(23)	Elctr (P11)	Elctr grain/attack/dynamic/ allure	Audio sample (S5)	c41
capsule	4	(23)	Sax	Sax grain/attack/dynamic/ melodic profile	[4 0 2 3]	c42
capsule	1	(23-24)	Acc	Acc allure/melodic profile/harmonic timber/attack	[0]	c43
capsule	2	(23)	Pn	Pn grain/dynamic/attack/ melodic profile/ harmonic timber	[0 9 8 10]	c44

Table 6.3: Free Modules Study nº1 –formal structure

As mentioned above, the capsules are generated in relation to the instrument that is performing the material. Therefore, different extended techniques related to the characteristics and possibilities of

each instrument, have been applied to link the capsules. The heterogeneity of the instrumentation is related to the transformation of the material. The possibility of using capsules as singularities gives the possibility of attaching the capsule to a formal referentiality, reinforcing the structure. As an example the use of multiphonics in the saxophone that can be understood as harmonic element and as a referential object. Considering the multiphonic as an object gives the possibility to think in signals within the overall structure. Therefore can indicate structural changes in blocks (bar 24, 46/47, 73/74,), nodal points (bar 66) or modules (bar 57, 115). These signs are sometimes on the precise junction of modular changes but due to the parallel process and the overlapping of the instrumental independent units, the structural referentiality can be offset.

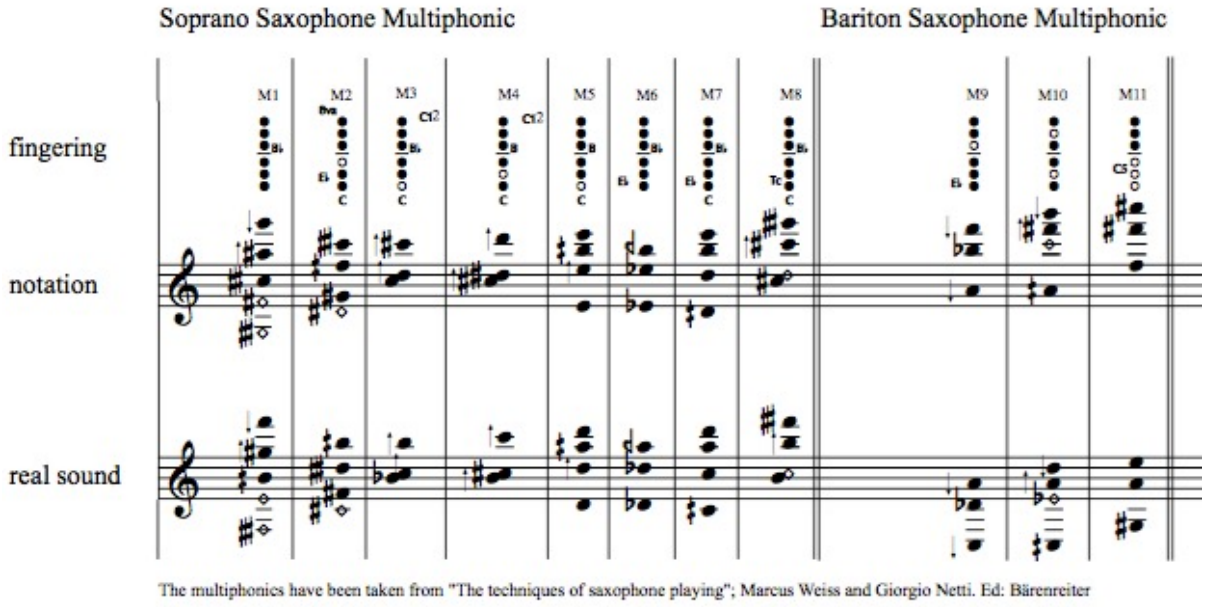

Fig.6.6: Free Module Strudy nº1 –saxophone multiphonics

Electroacoustic elements

The following table is a collection of electroacoustic samples conceived as blocks, capsules and microcapsules. The table gives basic information on constructive elements (sample number and pedal number), positions (bar number), duration and sonic typology (sound morphology).

Sampler name	Pedal number	Bar number	Duration in seconds	Type
S1	1	1	12	attack
S2	5	14	14	attack
S3	6	15	5	attack
S4	10	23	2	attack
S5	11	23	6	attack
S6 (prime)	12	24	30	allure
S7 (variation S6)	16	45	30	allure

S8 (variation S6)	18	54	30	allure
S9 (variation S6)	26	66	30	allure
Sdrone	52	124	74	drone allure/attack

Table 6.4: Free Module Study nº1 –Electroacoustic elements 1

Electroacoustic elements:

Combinations and its locations

Sampler name	Pedal number	Bar number	Duration in seconds	Fundamental morphology
S1/S8	28	70	30	attack/allure
S2/S7	29	73	30	attack/allure
S3/S6	31	75	30	attack/allure
S4/S5	32	79	6	attack/attack
S1/S3	33	83	12	attack/attack
S2/S3	35	87	14	attack/attack
S1/S3 (first repetition)	36	92	12	attack/attack
S1/S2	37	97	14	attack/attack
S5/S6	38	98	30	attack/allure
S6/S7	39	99	30	allure/allure
S7/S8	40	101	30	allure/allure
S8/S9	41	102	30	allure/allure
S7/S8/S9	42	103	30	allure
S5/S6/S9	46	113	30	attack/allure
S3/S4/S9	47	115	30	attack/allure
S1/S2/S9	48	115	30	attack/allure
S1/S2/S4	49	117	14	attack
S1/S2/S3/S5	50	119	14	attack
S1/S2/S4/S6	51	123	30	attack/allure
S1/S3/S5/S7/ Sdrone	52	124	74	attack/allure/drone
S2/S3/S4/S5/S6/ S8	53	127	30	attack/allure
S1/S2/S3/S4/S5/ S6/S7/S8/S9	54	129	35	attack/allure

Table 6.5: Free Module Study nº1 –Electroacoustic elements 2

Electroacoustic elements:

Collection of playback

Sampler name	Pedal number (Rec)[Play]	Bar number recording (from-to)	Bar number playback	Instrument
R1	(2)[4][13][39]	(3-7)	10/29/85	Acc
R2	(7)[9]	(20-21)	22	Acc
R3	(14)[17][19][30]	(39-41)	46/56/74	Sax
R4	(20)[22]	(57-58)	57	Acc
R5	(23)[25][27]	(61-67)	64/68	Pn
R6	(43)[45]	(111)	112	Sax

Table 6.6: Free Module Study nº1 –Electroacoustic elements 3

6.3.Harmonic modular-cells as referentiality

This chapter pursuits the definition of the harmonic modular-cells as a referentiality. It can be divided into two typologies.

- when it relates to an harmonic series
- when it relates to a non-pitched sound morphologies.

Accordingly, this plan allows that some musical elements act as referential signs to transit from one organisation system to another throughout pitch and frequency linkages and as morphological timbre and sonic events. The use of the harmonic series as a main harmonic sieve concatenates the generative process with the sonic spectrum and the harmonic partial deviation. It can potentially relate and expand linkages between materials that are based on noise morphologies or complex sounds. Likewise, the concept relates each module with a particular referentiality. Important to notice that they are not hierarchical.

As discussed at chapter 3.1.2, I considered various possible harmonic modular-cells; 12-tone, 24-tone equal tempered sets and non-tempered sets. Therefore, modular-cell can relate to partials[22], harmonics[23] and inharmonic frequencies[24]. Consequently, this strategy enables the possibility of working with musical material that are derived from both the chromatic intervals and the microintervals[25].

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[22] ***Partial*** *– One of the component vibrations at a particular frequency in a complex mixture. It need not be harmonic. The fundamental and all overtones may be described as partials; in this case, the fundamental is the first partial, the first overtone the second partial, and so on. (Murray Campbell 2001, Grove Music Online)*

[23] ***Harmonic*** *– An isolated frequency of the harmonic series. Definition of harmonic series, footnote 13.*

[24] ***Inharmonicity*** *– The deviation of a set of frequencies from an exact harmonic series. The most common musical application of the term is in discussion of the natural mode frequencies (or partials) of a stretched string. For a uniform, completely flexible string, the mode frequencies (or resonance frequencies) are members of the harmonic series represented by the following formula, in which n is the harmonic number (counting the fundamental as the first harmonic) and F is the fundamental frequency: frequency of nth harmonic = nF The stiffness always present in a real string increases the frequency of each mode by an amount which depends on the mode number. The resulting inharmonic series of mode frequencies is given, to a good approximation, by the following formula: frequency of nth mode = $nF(1 + bn^2)$ (Murray Campbell 2001, Grove Music Online)*

[25] ***Microinterval*** *– Is an interval narrower than 100 cent (one semitone)*

If we consider the multiplicity of the 11th partial; [*f* x 11]-51, [*f* x 11], [*f* x 11]+49, the harmonic material can be expanded with a transition to the region of the 11th overtone of any given fundamental. In this manner, this enables a transition in a net of related material. As a harmonic device, this sieve of the 12 and 24 equal temperament tone sets produces three alternative frequencies around the 11th partial: the harmonic, and two inharmonic – one 49 cent up and one 51 cent down from the harmonic frequency. This simple harmonic generator can be replicated to any overtone with any fundamental. As a general plan of action, I transit from one modular-cell based on a defined fundamental to a modular-cell based on a different fundamental through the use of the overtones relations. Therefore, the note or frequency position in the harmonic series determines the cent fluctuation of the frequency and it is an entryway to transit from one fundamental to another. As is well known, this fluctuation befalls in the field of the microintervallic derivation. As a consequence, this replicable strategy becomes a referential tie in the structural form as well as an intervalic generator. Therefore, each partial can develop its own referential role in the framework, allowing different types of transition between harmonic modular-cells.

If we take middle C as a fundamental and tuning reference A=440hz, the resulting frequencies would be:
[(261,63 x 11)-51c=2794,38hz], [(261,63 x 11)= 2877,93hz], [(261,63 x 11)+49c=2960,54hz]
Pitch reference: [F♮], [F𝄲], [F♯]

When considering the inharmonic 3rd , 6th , 12th overtone; the exact frequency has a deviation of a 2 cent inflection from the 12-tone equal tempered scale pitch. This is non-perceivable in sequential disposition. The cent inflection of the frequencies creates acoustic beats starting to be clearly perceivable to me at 1Hz deviation. Of course the physical beating produced from smaller derivations of 1Hz will result in a slower beating rate, but in general I use beatings from 1Hz on. The cents needed to produce 1Hz derivation depends on the register of the frequency. In some registers, a 2 cent inflection produces a derivation smaller than 1Hz. In the cases when the frequencies are performed simultaneously in a stereo system and with each frequency assigned to a different output, I personally perceived it as a left-right movement of the sin wave.

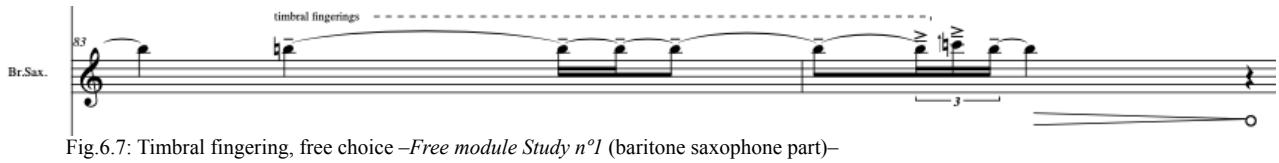

Fig.6.7: Timbral fingering, free choice –*Free module Study n°1* (baritone saxophone part)–

When I use this idea, in instrumental writing, the obvious impossibility of controlling an inflection of 2 cents, made the related approximation a graphical representation of the fluctuation. I describe these partials as timbral inflections. My approach was to assign a type of gesture which is approximate and relates to a microtonal fluctuation, timbral fingerings, glissando fluctuations, vibrato and phonetic changes. The pallet of related instrumental extended techniques is not fixed since it can be expanded with distinctive particularities related to each instrument, including brands or models.

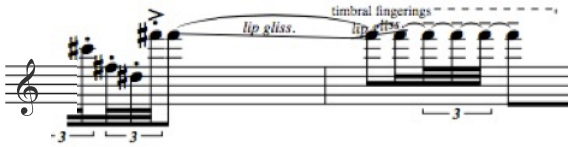

Fig.6.8: lip glissando and timbral fingering, free choice –
Free module Study n°1 (baritone saxophone part)

Applying the same principle of the previous example, the material can relate to the region – 3td , 6th and 12th partial – of different fundamentals. In this case, the semiotic implication between notation and the resulting sound is approximate since it will depend on the instrumentation and the performers' decision. Likewise, I consider the dominant 7th chord, present in the harmonic series, as a harmonic modular-cell. In a 12-tone equal tempered inharmonic disposition, the harmonic set integer notation will be [4,5,6,7]. Obviously, the Pc set definition of this particular harmonic modular-cell is an abstraction. When the fundamental is defined, the harmonic modular-cell can be superimposed and overlapped with different modular cells based on other fundamentals.

With a C as fundamental, it will result in [4,5,6,7]=[C,E,G,B♭] and as Pc set integer notation [0,4,7,10]. It can also be expanded with an approximation in a quarter-tone disposition [4,5,6,7(-31c)]=[C,E,G,B𝄬] and considering approximations of smaller cent derivations [4,5(-14c),6(+2c),7(-31c)]=[C,E𝄲 ,G𝄳,B𝄲𝄬]

Accordingly, this sieve of frequencies creates acoustic beats with different intensities on the major third and the minor seventh and significant intervallic friction combining the pitch in a 12-tone equal tempered approximate disposition, quarter-tone approximate disposition and exact harmonic frequencies.
The possible strategies to transit or modulate between different harmonic modular-cells are considerable. The following example illustrates a simple process based on a possible voice-leading resolution and focuses on one of the variables to define a transition.
If it is decided to resolve the minor seventh in a scholastic traditional downwards resolution, it leads to the major sixth. The major sixth is not a ratio of the series. Therefore, the resolution could be used to transit to another harmonic modular-cell with the related major sixth as a fundamental or as an overtone.

Nonetheless, the overall concept – the work in relation to the harmonic series – evolves from the use of the approximation based on the 12 and 24 tone equal tempered scale, to assign a distinctive characteristic to each partial. Moreover, it considers the referential pitch as different nodal points. However, the referential microtonal oscillations linked to the transit and translation between fundamentals depend on the partial position of the tone in relation to the fundamental with which it is related. The relation with its position in the series based on a fundamental is not as an exact frequency, but as pitch. This thinking, enables a distinctive consideration of the partials, individually, as isolated notes and as a set of transitional regions between the harmonic series. Consequently, each note has a changeable function that is fixed or defined by its position in the harmonic series in relation to a fundamental.

7. Systematic Double Bind (work in progress)

This chapter is an attempt to shed some light on my personal approach to modularity as a hybrid framework in which to work with fixed notation and guided improvisation instructions. The modular strategy clarifies remote relations when dealing with dissociated elements. *Systematic Double Bind* is a work in progress. It includes works for a flexible number of groups of instruments with electronics. The work is influenced by Gregory Bateson's *Double bind theory.* It characterises by placing the individual in a situation where he receives more than one contradictory message.

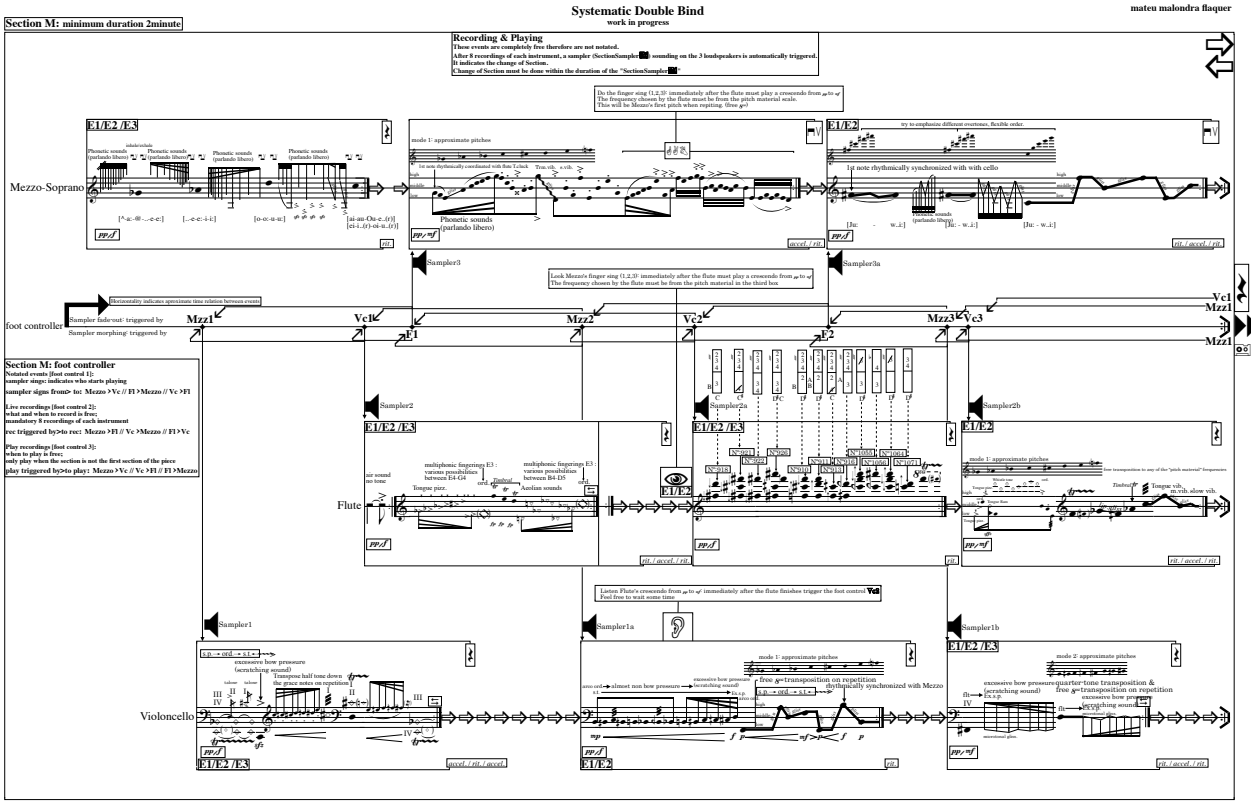

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Fig.7.1: Modular structures –approximate notation– in *Systematic Double Bind*

Fitch[26] (2014, p.83) proposes the following scheme of relations:
"1.Composer⟷2.'Score'/Instruction⟷3.Preparation⟷4.Performance⟷5.Reception"

The exploration of these different levels of communication, as a self-referential analytical method (2), with the audience (5), with the performer (3/4) and contextual concept (1/2/3/4/5), is the starting point for the study of a methodology that could be applied to the entire spectrum of relations. The following chapter advocates a musical context, terminology and methodology applicable throughout the whole parametric development of the composition. In this manner, the key issue in *Systematic Double Bind* is the concise study of several levels of reciprocity. However, the sonic relation and the rhythmical and physical interaction between the players and with the electroacoustic environment, is the main area of research.

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26 ***Lois Fitch*** *– A musicologist, Dr Fitch pursues research interests in New Music, and the interdisciplinary relationships between music and other performing arts, focusing in particular on issues of notation/text interpretation and the performer's creative process. (Royal Conservatory of Scotland online) Text from: Brian Ferneyhough (Intellect, 2014)*

In *Systematic Double Bind*[27] I explore the encapsulation of tempo and different parallel tempi. It is a set that develops an approximation to different layers of notations. I explore the role of musical elements as performing instructions to indicate changes of modular-cells and the level of interaction between instruments. Moreover, it develops the idea of a notation as a two-way linkage of relations between composer, performance and the reception of the piece.
Various and unexpected ways of exchanging information create an alogical non-linear development. The set of modules can be freely organised or combined by the performers. *Systematic Double Bind* is a work in progress that develops a modular free-form in a fixed notation modular system. Due to the work on *Systematic Double Bind,* the research started to focus on the work of free improvisers. As a consequence, I introduced changes and new parameters in the set. The existing relations between guided improvisation and fixed notation were expanded by adding more instrumental flexibility and in between modular linkages.

Defining *time*[28] as a notated element has been an issue explored since the 16th century. During the 20th century, the development of compositional techniques exploring the perception of time through tempo, meter and rhythm, has been a prominent topic for many composers. Oliver Messiaen (1956) describes a glossary of strategies based on contrapuntal rhythms in his compositional treatise *The Technique of my Musical Language*. The procedures employed and defined by Messiaen in his treatise – added values, augmented or diminished and the retrogradable and non-retrogradable rhythms – apply to the modular interaction. It is evident that these are suitable to be applied to the parameters imbricated within the modular-cell, but they can be applied in the structural layer as well.

More precisely if the modular fragment is related to a time duration in parallel to rhythmic figures and accordingly to the mathematical regular/irregular proportions. Therefore, the research of polyphonic structures necessarily has to study processes to define notational parameters related to the use of traditional polyphonic elements – be these pitch, rhythm or modular structures. However, in relation to the approximation to polyphonic time perception, I focused on the study of two very different proposals. These have been Ferneyhough's work with a direct relation between tempo, bar and metre and Grisey's conceptual *Skeleton time*[29]*, Flesh of time*[30] and *Skin of time*[31]. Likewise, the concern regarding the role of tempo in relation to modular-cells led the investigation to consider

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[27] *The tempo suggested in the score can be modified from a list of possible relations, even a multiple parallel tempos is a possibility of free choice. The piece is accompanied by a series of independent click tracks.*

[28] ***Time*** *– (1) A synonym or shorthand for musical metre, as in '6/8 time'.*
(2) A general term to designate the rhythmic acuity of a performer or ensemble, as in 'playing in time'.
(3) The essential medium for music and musical performance, a non-spatial continuum of past, present and future in which music exists and is understood. Music requires no material substance, nor can one circumscribe any set of sounds as inherently musical (and others as inherently non-musical), but all music must occur in time. (Justin London, Oxford Music Online, Grove Music Online– 2001)

[29] ***Skeleton time*** *– refers to the basic quantitative, temporal infrastructure of a work as measured in chronometric time. Grysey maintained that the temporal division of the skeleton are not immediately discernible. (Jeffrey J.Hennessy, Alternative Temporalities in Grisey's "Prologue for Solo Viola", Perspectives of New Music Vol. 47, No. 2 (SUMMER 2009), p.36-58, p.38)*

[30] ***Flesh of time*** *– represents the more qualitative, phenomenological, and psychological aspects of musical time. Grisey believed that composer have control over this qualitative time by considering the differences perceived between sounds and the degree of "preaudibility" of a future sound. (Jeffrey J.Hennessy, Alternative Temporalities in Grisey's "Prologue for Solo Viola", Perspectives of New Music Vol. 47, No. 2 (SUMMER 2009), p.36-58, p.38)*

[31] *Skin* ***of time*** *– is that elusive, subjective time of the individual listener, the field where the composer "notices more than he acts". Grysey believed that contemporary psychoacoustics and sociological investigation might one day illuminate more about the relationship between musical time and listener time. (Jeffrey J.Hennessy, Alternative Temporalities in Grisey's "Prologue for Solo Viola", Perspectives of New Music Vol. 47, No. 2 (SUMMER 2009), p.36-58, p.38)*

issues related to time perception in momentform. The ideas explored incorporated ideas used in electroacoustic drones as an element to define vertical time.

Therefore, in *Systematic Double Bind,* I abandoned the use of tempo changes to preserve contextual statism, sound masses, clouds and drone techniques. The process of transformation, concerning harmony and sound texture, in electroacoustic-drones is gradual and progressive. The study of progressive minimum changes was influenced by the work of Eliane Radigue. During these experimentation, I developed several sub-pieces included into my electroacoustic set, *Sound Block*.

However, in *Systematic Double Bind* the experimentation with statism expands by introducing parameters related to fixed notation and guided improvisation. I developed a personal approach to the idea of controlled and uncontrolled notation on a smaller time scale within modularity concept. Nonetheless, the ideas developed in *musique saturée*[32] regarding the use of uncontrolled complex sounds and the use of graphic notation, is an attempt to interrelate the following dichotomies: fixed/ improvised and controlled/uncontrolled. Accordingly, the work explores uncontrolled complex sounds which relate to approximative instruction. Consequently, fixed notation, which is imbricated with an analytical tradition, is combined with approximative instructions. Within this context, overlapping started to be a natural strategy to combine elements to expand and enrich the instrumental sound. Once the formal system and inner architecture of *Systematic Double Bind,* was defined, the investigation started to focus on a diversity of models to materialise the symbol and relation of the approximative instructions. The more obvious process would have been to encapsulate tempo related to bars and metre changes – however, the research process developed in the opposite direction. Therefore, I decided to encapsulate tempo, as a free choice module. Therefore, the final result is equally dependant on the notated indications in the score, the electronic samplers provided to the performer and the choices made by the quartet.

The interaction with the electroacoustic environment was a key issue in *Free Modules Study Nº1*.
In the work in progress *Systematic Double Bind*, there are two basic and distinctive types of modules:

- Guided improvisation modules: [F,M, and so on]
- Fixed notation modules: [€, and so on]

Figure 7.1, represents one of the modules of *Systematic Double Bind*. The particularities of the score in relation to modular-cells and the chamber references/characteristics of the sub-piece are developed as a net of guided interaction between the instrumentalist. In the following lines, I provide a brief overview of some of the parameters that define the use of modularity as a process of contingency to approximate musical and physical instructions.

In *Systematic Double Bind*, each page represents a different and distinctive module. The score is notated on independent A3 pages. There is only one structural text instruction where the fixed and guided improvisation modules need to alternate. It is important to note that the elements within the modules are self-contained modular-cells of delimited referential material.
The work explores performance fidelity in the context of graphic/text instructions and in fixed

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[32] ***De l'excès du son*** *– The concept was first exposed by Franck Bedrossian and Raphaël Cendo (2008). Cité de la Musique de París: Centre de Documentation de la Musique Contemporaine in collaboration with Ensemble 2e2m*

notation. The musical material –in the graphic/instructions format– is approximate within the musical elements of each modular-cell. Consequently, in the guided modules, the sonic result can vary enormously from performance to performance.

Within the module, each modular-cell works as a trigger device of distinctive musical elements and actions. These elements are contained as modular agents that can be modified or transformed within the defined parameters. The vertical coordination between distinctive instrumental modular-cells is opened. This parameter changed the perspective of a linear notation format. The left/right reading direction relates to the traditional timeline but the duration of each modular-agent depends entirely on the performer's decision. That only happens in the guided improvisation modules. On the contrary, the fixed notated modules are a traditional staff system within a linear graphic development of time. The interstice between different notations evokes changes of context and performance situation. These variations of the notation environment are consistent with the overall concept of the work. It communicates with the performer in a transforming musical situation that navigates from a highly approximate context to a fidelity context and back.

There are, certainly, other possible outcomes but modularity transmits a sense of unity within the set and across sets. However, the compositional model has an inherent heterogeneity caused by the implementation of parallel processes and indeterminacy. This idea together with the consideration of the micro-fragments led me to investigate analogies with the techniques employed in electronic music composition. Thereupon, the study of Xenakis theory of grains of sounds and Horacio Vaggione's micro-montages are my first attempts to explore *granular synthesis*. However, my primary explorations in the field of electronic music are related to the subject-matter developed mainly in *musique concrète*, *micromontage*, *additive synthesis* and *subtractive synthesis*. These investigations became my laboratory for electroacoustic works and later also for acoustic instrumental writing. Further research led me to explore the multilayered grain technique and *concatenative synthesis* to parametrically create sonic and structural relations to define and construct linkages within the frame of *harmonic modular-cells*[33] and the *non-pitch modular cells*[34].

Accordingly, it also helped me to develop strategies to overlap processes of transformation. Therefore, in *Systematic Double Bind* is crucial the palette of samples developed. It is also vital, prior to the performance, the close work with the instrumentalist. Moreover, to clarify its role, it is convenient the narrow work with the electronic performer. This is even more important when the electronic environment dominates over the acoustic instruments. However, due to the co-creative nature of the proposal, prior contact to clarify the relationship between sound systems or the instrumental instructions is not mandatory.

Nonetheless, in an open formal framework, the constructivist process of sequential and overlapped modular-cells, led me to explore possible relations with speech grammar agents in a musical context. This idea evolved in parallel with *Generative grammar*[35] principles. There are two

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[33] ***Harmonic modular-cells*** *– It is a term that I use to define the harmonic source sets. Explanation expanded on sub-chapter 2.3*

[34] ***Non-pitch modular cells*** *– It is a term that I use to define non-pitch source sets. Explanation expanded on sub-chapter 2.3*

[35] ***Generative grammar*** *– is a formal system which is built from a finite number of ingredients, but provides an explicit way of constructing (generating) a potentially infinite set of strings of atomic symbols and possibly associates each of these strings with a constituent structure. If we view a language L as a specific set of strings, a generative grammar G is a grammar for L just in case the set of strings generated by G coincides exactly with L. For example, the grammar G1 in (1) is a grammar for the infinite language L1 = {anbn: n ≥ 1}: (Knut Tarald Taraldsen, Oxford Research Encyclopaedia of Linguistics Online, 2016)*

interesting general relations defined by Noam Chomsky (1953, p.242-256) which can be easily transmuted to music. He advocates the desire to enquire into "the formalisation of the linguistic method and to examine the applicability to a wider range of problems". The paper focuses on the formalisation of certain parts of the linguist's generalised syntax language.

My work, *Systematic Double Bind,* is an attempt to develop an adequate notion of syntactic and relational categories within an inscriptional nominalistic framework to channel the musical material in a free choice system and thus embody a semi controlled co-creative environment. The work aims to emulate an open musical conversation within a precise framework of defined material but with an unpredictable final result.

8. Conclusion and further research

This dissertation seeks to prove the possibility to interlacing the concepts of momentform and modularity. Therefore, the inquiry has become an impulse, a renewal of ideas and a tool to continue building up a creative environment. Momentform as a self-contained mobile structure has been the inception seed of the research. However, the development of new entryways into the topic evolved towards unexpected areas of development. The investigation created conceptual, musical and structural linkages between modular theory, fragmentation, multiplicity, replicability and discontinuity.

The philosophical background development is a consequence of the study of Russell's logic atomism and Deleuze's multiplicity/rhizome theory. Nevertheless, both concepts have been explored within the awareness that there is a profound contradiction of conceptual applicability of two opposed ideas in parallel. On the one hand, the *logical atomism* relates generative processes. On the other hand rhizome attempts to establish a non-generative model. However, the dissertation is entirely devoted to defining a personal creative musical framework. I do not attempt to pursue or formulate any amalgamation of both theories or produce a conclusion within a philosophical hypothesis.

Likewise, the research has developed broadly diverse relational hypothesis, proposed referential functionalities and related the ideas to current relevant figures. Moreover, the dissertation attempts to provide common strategies to define the compositional procedures included in the portfolio of works. These works explore significantly and progressively the use of modularity. In this manner, the work *Within Modular Objects* extensively exploits the various issues investigated in the research.

The premises involved in the first stage of the investigation, the development and definition of an atomic musical particle, became a strategy to define the formal elements as modular agents. Accordingly, a vital terrain to establish the musical syntax and the linkages between modules has been the exploration of a structural constructivist method based on a rhizome framework. Therefore, the musical and sound relations, by themselves, are the central element of the dissertation. Likewise, the research determines a methodology to settle: supra-structures, macro-structures, meso-structures, frequency/pitch system, non-pitch sounds relations, referential pitch and sound objects. The fundamental concept has been to approach the interrelation of the modular agents as units – One as subject or object (Deleuze and Guattari 1987, p.8) – and not as diverse unrelated sound dimensions. Furthermore, the experimentation with self-quotations and appropriation quotes highlighted the importance of the contextual relation with the inserts.

I developed a collection of categories which defines the analytical framework to map multiple elements. This hypothesis is an attempt to establish a structural unity within the modularity theory. Thus, the final composition is strongly related to the preparation stage of the material. This idea made it necessary to formalize the structure of the modular agents during the sketching process. It has been a study to define modularity as an analytical method and as a framework to channel creative thinking.

Moreover, the idea of multiplicity and rhizome has confronted linear strategies based on generative developments in a cause-effect action with singularities not dependant on the contextual development. Accordingly, the momentform concept applies in supra and macro structures and

meso and micro-events. The singularities are self-contained modular-cells mapped as positions in the formal skeleton. Thus, the final contextual continuity is dependant on the primary musical material fragmentation. Moreover, a rhizome framework entails parametric relations or linkages between these modular agents (*the matrix*) and the reuse of the fragmented modules in position (mapping).

> A multiplicity has neither subject nor object, only determinations, magnitudes, and dimensions that cannot increase in number without the multiplicity changing in nature.
> **(**Deleuze and Guattari 1987, p.8)

> All multiplicities are flat, in the sense that they fill or occupy all of their dimensions: we will therefore speak of a plane of consistency of multiplicities, even though the dimensions of this "plane" increase with the number of connections that are made on it. Multiplicities are defined by the outside: by the abstract line, the line of flight or deterritorialization according to which they change in nature and connect with other multiplicities.
> **(**Ibid, p.9)

The interrelations between sets of pieces as a whole body of work have been described with consistently unified criteria. The modularity theory has been used as an intersect model to define diverse modular forms in the system. Consequently, modularity has been applied to the momentform concept. The enforcement of these ideas in the instrumental domain enabled a time scale definition of the sonic event as a self-contained modular-cell. Modularity is a model of *content information* which clarifies the relationship between materials and delimits each sonic event as a singularity. Defining the modular-cells by time scales and not by other parameters, enables the free application of multiple compositional techniques within the cells. The implementation of musical time scales (Roads 2001, p.3-4), has led me to focus on the smallest sonic event.

The definition of the different musical elements is divided into capsules as gesture and the microcapsule as instrumental grain or as a sound object. In this musical environment, the gesture (capsule) and grain (microcapsule) are considered self-contained elements. These sonic events of meso and sound objects time scale became atomic particles of great importance. The inquiry for the atomic sonic element inevitably directed my learning process into the domain of electroacoustic music. Accordingly, this is an area of knowledge that the investigation process itself has made crucial. Nonetheless, it had an impact on how I should move forward in future research. The strategy of a bottom-up compositional approach made it necessary for further research in electroacoustic music composition. However, the development of related procedures in my actual compositional work has been mainly a conceptual analogy applied to instrumental writing.

The reader can trace the initial thoughts regarding the area of interest as linked concepts of a fragmentary process, together forming complex musical structures. This idea of modularity theory is reinforced during the dissertation by a methodological top-down contextualisation – from the macro-level to micro detail. Consequently, I started fragmenting the structure into smaller time scale modules. Therefore, the supra and macro formal structural interest redirected to the meso, sound object and micro time scale. Thereby, the initial compositional hypothesis shifts from the top-

down to the bottom-up process. Accordingly, my interests migrated towards the micro. The experimentation with the micro-particles led me to work on textures and masses that can evolve polyphonically from the smallest musical event to the macrostructures. Therefore, parametrically and textually speaking, the micro-processes are better controlled and the macro-level richer. The change in perspective is a direct consequence of the inquiry itself. In particular, the consideration of the atomic particle (microcapsule) is as a singular unit.

However, it does not mean that top-down development is not consistent with the established criteria and the main research area (polyphonic structures). Likewise, considering the fragmentary procedure applied and the microcapsule as a distinctive unit, discontinuity has been investigated in detail. If the structure combines modular-cells developing discontinuous and continuous syntax, the formal structure develops a bias towards a systematic dichotomy. Therefore, when the architecture of the entire piece or sub-piece relates to continuity, how and when to break the juxtaposition of confronted musical materials is one of the critical issues. The juxtaposition of fragments, which can be grouped in blocks by typologies, can be perceived as a structural confrontation of an [A-B-C and so on] situation. Consequently, using concatenated chains of related and unrelated modular-cells implementing distinctive principles and processes, is a recurrent compositional strategy. Nonetheless, the development of both vertical and horizontal strategies breaks down the cause-effect binary thinking. Likewise, the rhizomatic framework has an inherent capability of exchanging information on a platform of interactions between equals. This enabling of the application of referential musical elements creates a model that unifies reactive procedures. Moreover, it is an entryway to transitionally and mutability.

> If it is true that it is of the essence of the map or rhizome to have multiple entryways, then it is plausible that one could even enter them through tracings or the root-tree, assuming the necessary precautions are taken (once again, one must avoid any Manichaean dualism). (Deleuze and Guattari 1987, p.14)

Considering a net where the functions are not hierarchic but regions of similarities and aggregates of modular class sets, the basis of the transformations are the exchange of musical material. The model maps the positions of singularities and generates a matrix of relational linkages. This approach materialises as modular class sets and as relational parameters in the cross sets. Thereby, the use of self-referential and appropriation quotes relates the research to montage and collage. However, the compositions included in the portfolio deliberately avoid pastiche, or a clash of aesthetics by confrontation.

Thus, a very obvious strategy is the replication of the same outline to define a structural liaison. As mentioned before, the modular-agents allow subdivisions of the material into smaller layers of defined duration recombined with other modular-agents.

To conclude, a system based on modularity helps to work independently with a significant number of strategies – musical and sound information – and control the parameters in an isolated manner. Moreover, it creates a correlation between macro and microstructures, developing replicable structures throughout the entire formal stratum. Therefore, the implications of applying the momentform concept when considering the structure as a self-contained sonic event in the meso or sound object time scale, made me understand the event itself as a unit of sound, emancipated from

the contextual supra or macro structure. Moreover, discontinuity is highlighted and developed within a framework of dissociated linkages and positions. Therefore, the modular model is applied in all the working stages of the creative process: it defines the material by typologies of self-contained elements and clarifies the position of linked modules in cross sets. The consequence is a contained and defined framework to map and create musical unity within the independent sub-pieces. In this manner, this conceptualisation of the musical environment emerges as a new creative perspective with personal compositional implications that made me rethink my work as a composer: the musical and non-musical time scales, the procedures applied and the nature of the musical sound object. These elements form the body of action in what Deleuze and Guattari (1987, p.4) would call "the plane of consistency".

As a result of this, this concept – the plane of consistency – had enormous implications on my compositional approach in organising the musical elements parametrically and structurally. Therefore, the initial defining model of the polyphonic structures as horizontal/sequential and vertical/overlapped structures changed into understanding fragmentation not as an end but as an opportunity for new connections within an endless chain. This principle framed the sonic event within the idea of a "*gestalt*" where the whole is more than to the sum of the fragments. Moreover, when the fragment becomes an independent unit not dependant on a specific context, it germinates as a signifying referentiality. Consequently, the research provides a unified musical ecosystem where multiplicity and modularity theory can be understood as a possible milieu within which the conceptual contradiction inherent in parametrical processual context (linear) and momentform (dimensional) are brought together as a whole.

Thus, the contribution of this dissertation is a constructivist framework development within a cross-linkage system and with no end. However, it is also a framework to relate form, structure, context, narrative and sonic events in a bottom-up process. To sum up, the initial idea of momentform as a polyphonic structure continues being vital to the general development and to my system of composing. However, I can assert that the interrelation of non-linear sequential traces is what opened the window for parametric relations in different time scales and moments as polymorphic and polyphonic structures, and it is which has so inspired my compositions.

> You always have to start any kind of argument from something which appears to you to be true; if it appears to you to be true, there is no more to be done. You cannot go outside yourself and consider abstractly whether the things that appear to you to be true are true. (Russell 2010, p.3)

In accordance with Russell, even in philosophical argument, there is a degree of personal conviction on what is true. Undoubtably, it also happens in composition. Although the subject-matter explored in this dissertation is vividly true to me, may not be immediately apparent to others. Yet, despite that, I am convinced that the reader has found inspiration in the ideas presented above. I have pursued a rigorous process to materialise the concepts explored into compositions, as presented in the portfolio of works. This dissertation, therefore, is both a personal artistic statement as well as a documentary evidence of the research process.

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Appendix 1: Pc set Harmonic-cell

Pcs Harmonic modular-cell nº8

Pcs A: [9,11,1,3,4,5,7,8] Pcs A♯: [10,0,2,4,5,66,8,9]

Pcs B: [11,1,2,5,6,7,9,10]

Pcs C: [0,2,4,6,7,8,10,11] Pcs C♯: [1,3,5,7,8,9,11,0]

Pcs D: [2,4,6,8,9,10,0,1] Pcs D♯: [3,5,7,9,10,11,1,2]

Pcs E: [4,6,8,10,11,0,2,3]

Pcs F: [5,7,9,11,0,1,3,4] Pcs F♯: [6,8,10,0,1,2,4,5]

Pcs G: [7,9,11,1,2,3,5,6] Pcs G♯: [8,10,0,2,3,4,6,7]

Primary harmonic modular-cell of pc A:

Harmonic cell nº8: [8,9,10,11,12,13,14,15] Integer Pcs: [9,11,1,3,4,5,7,8]

Transposition ordered Pcs(t=3): [0,2,4,6,7,8,10,1] Inversion ordered Pcs: [0,10,8,7,6,4,2,1]

Prime form: [0,1,2,4,6,7,8,10] vector: 464644 name: 8-25

Tuning reference = 440Hz

Fundamental A_0 = 27,5Hz

All the pc sets are based on A_3=220Hz and the pitch class within the spectrum of A_3/A_4:

All related frequencies in Hertz are exact references only used in computer generated parts.

12-tone equal temperate –chromatic– inharmonic disposition:

[A B C♯ D♯ E F G G♯]= [(220), (246,94), (277,18), (311,13), (329,63), (349,23), (392), (415,30)]

[A B C♯ D♭ E F G G♯]= [(220), (246,94), (277,18), (293,66), (329,63), (349,23), (392), (415,30)]

24-tone equal temperate –quarter-tone– inharmonic disposition:

[A B C♯ D𝄲 E F𝄲 G𝄳 G♯]= [(220), (246,94), (277,18), (302.27), (329,63), (359,46), (380,8), (415,30)]

approximate reference:

[A B𝄱 C↓♯ D𝄲 E𝄱 F↓𝄲 G↑𝄳 G↓♯]

(used as an approximate instrumental notation which is based on inharmonious variable frequencies dependant on the instrument and register)

harmonic whole-notes:

[A B𝄱 C↓♯ D𝄲 E𝄱 F↓𝄲 G↑𝄳 G↓♯] = [(220), (247,51), (274,94), (302.27), (330), (357,59), (385,04), (412,43)]

(used only as exact frequencies in computer generated parts)

pc A:

[A A𝄱 A↓ A𝄳 A𝄱 A↓𝄲 A↑𝄳 A↓] = [(220), (220,5), (218,22), (213,73), (220,25), (225,27), (216,09), (218,48)]

(used only as exact frequencies in computer generated parts)

Primary harmonic modular-cell of pc B:

Harmonic cell nº8: [8,9,10,11,12,13,14,15] Integer Pcs: [11,1,2,5,6,7,9,10]
Transposition ordered Pcs(t=7): [6,8,9,0,1,2,4,5] Inversion ordered Pcs: [0,9,8,6,5,4,2,1]
Prime form: [0,1,2,4,5,6,8,9] vector: 545752 name: 8-19

Tuning reference = 440Hz
Fundamental B_0= 30,86Hz
All the pc sets are based on B_3=246,94Hz and the pitch class within the spectrum of B_3/B_4:
All related frequencies in Hertz are exact references only used in computer generated parts.

12-tone equal temperate –chromatic– inharmonic disposition:
[B C♯ D♯ F F♯ G A A♯]= [(246,94), (277,18), (311,13), (349,23), (369,99), (392), (440), (466,16)]

[B C♯ D♯ E F♯ G A A♯]= [(246,94), (277,18), (311,13), (329,63), (369,99), (392), (440), (466,16)]

24-tone equal temperate –quarter-tone– inharmonic disposition:
[B C♯ D♯ F𝄲 F♯ G𝄳 A𝄲 A♯]= [(246,94), (277,18), (311,13), (339,28), (369,99), (403,48), (427,47), (466,16)]

approximate reference:
[B C↑♯ D↓♯ F𝄲 F↑♯ G↓𝄳 A↑𝄲 A↓♯]
(used as an approximate instrumental notation which is based on inharmonious variable frequencies dependant on the instrument and register)

harmonic whole-notes:
[B C↑♯ D↓♯ F𝄲 F↑♯ G↓𝄳 A↑𝄲 A↓♯]= [(246,94), (277,82), (308,62), (339,48), (370,41), (401,39), (432,19), (462,93)]
(used only as exact frequencies in computer generated parts)

pc B:
[B B↑ B↓ B𝄲 B↑ B↓𝄳 B↑𝄲 B↓]= [(261,63), (262,23), (259,52), (254,32), (261,93), (267,90), (256,98), (259,82)]
(used only as exact frequencies in computer generated parts)

Primary harmonic modular-cell of pc C:

Harmonic cell nº8: [8,9,10,11,12,13,14,15] Integer Pcs: [0,2,4,6,7,8,10,11]
Transposition ordered Pcs(t=6): [6,8,10,0,1,2,4,5] Inversion ordered Pcs: [0,10,8,6,5,4,2,1]
Prime form: [0,1,2,4,5,6,8,10] vector: 464743

Tuning reference = 440Hz
Fundamental C_1= 32.703Hz
All the pc sets are based on C_4=261,63Hz and the pitch class within the spectrum of C_4/C_5:
All related frequencies in Hertz are exact references only used in computer generated parts.

12-tone equal temperate –chromatic– inharmonic disposition:
[C D E F♯ G A♭ B♭ B]= [(261,63), (293,66), (329,63), (369,99), (392), (415,30), (466,16), (493,88)]

[C D E F𝄲 G A𝄭 B𝄭 B]= [(261,63), (293,66), (329,63), (349,23), (392), (415,30), (466,16), (493,88)]

24-tone equal temperate –quarter-tone– inharmonic disposition:
[C D E F𝄰 G A𝄳 B𝄬 B]= [(261,63), (293,66), (329,63), (359,45), (392), (427,46), (452,8), (493,88)]

approximate reference:
[C D𝄲↑ E𝄲𝄳 F𝄰 G𝄲↑ A𝄲𝄳 B𝄲𝄬 B𝄲↓𝄲]
(used as an approximate instrumental notation which is based on inharmonious variable frequencies dependant on the instrument and register)

harmonic whole-notes:
[C D𝄲↑ E𝄲𝄳 F𝄰 G𝄲↑ A𝄲𝄳 B𝄲𝄬 B𝄲↓𝄲]= [(261,63), (294,33), (326,97), (359,67), (392,45), (425,25), (457,88), (490,46)]
(used only as exact frequencies in computer generated parts)

pc C related to the cent derivation of the harmonic series:
[C C𝄲↑ C𝄲↓ C𝄳 C𝄲↑ C𝄲↓𝄰 C𝄲𝄳 C𝄲↓]= [(261,63), (262,23), (259,52), (254,32), (261,93), (267,90), (256,98), (259,82)]
(used only as exact frequencies in computer generated parts)

Appendix 2:

Band: List of Performances

e.g. titles in Bold

2019
2017/2019: Teaching at Conservatori Superior de Música de les Illes Balears; Mixed Media [associated professor] (Palma de Mallorca)
21 Feb: Sicut; for Voice and rec [UMS'n JIP, IV Encuentro Revueltas Sonoras, Sala Ponce, Cuernavaca, Mx]
16 May: Placa Base Concrète: Can Balaguer; (Collective work) 3-elctr [Ángel Faraldo, Octavi Rumbau, Mateu Malondra, Festival ME_MMIX, Can Balaguer, Palma]
23 Jul: Appointed Director of Institut d'Estudis Baleàrics
8 Oct: **24 Modular-cells** (1), Violin duo [Tatsuki Narita, Takao Hyakutome, Tokyo Opera City Recital Hall](WP)

2018
2017Oct/2018Oct: Mòdul i Trànsit; sound installation; Mixed media [Placa Base, Es Baluard, Palma]
26 Jan: Café Noir at Graves…;Guit [Svanur Vilbergsson, Dark Music Days, Reykjavík, IS]
18 Mar: G-Waves; Spr. Sax and elect.; [Placa Base Col.lectiu Instrumental, International Mallorca Saxophone Festival, Palma]
6 Apr: **Apposition IV**; for prepared Vl [Placa Base Col·lectiu Instrumental, Takao Hyakutome, Phonos, Barcelona]
20 May: G-Waves; Spr. Sax and elect.; [Placa Base Col.lectiu Instrumental, Forum Wallis, Leuk]
30 May: Sound Block Module II, elctr [Placa Base Col·lectiu Instrumental, Octavi Rumbau, Mateu Malondra, Festival ME_MMIX, Teatre Principal, Palma]
2 Jun: **Apposition IV**; for prepared Vl [Placa Base Col·lectiu Instrumental, Takao Hyakutome, Festival ME_MMIX, Es Baluard, Palma]
2 Jun: Pulse Interpolation; for Pn and elctr [Mark Knoop, Festival ME_MMIX, Es Baluard, Palma]
3 Jun: Sicut; for Voice and rec [Placa Base Col·lectiu Instrumental, UMS'n JIP, Festival ME_MMIX, La Misericòrdia, Palma]
19 Jun: Placa Base Concrète: Lewin-Righter; (Collective work) 3-elctr [Placa Base Col·lectiu Instrumental, Ángel Faraldo, Octavi Rumbau, Mateu Malondra, NYCEMF, Abrons Art Center, New York] (WP)
9 Oct: Placa Base Concrète: Présence; (Collective work) 3-elctr [Placa Base Col·lectiu Instrumental, Ángel Faraldo, Octavi Rumbau, Mateu Malondra, Festival After Cage, Teatro Gayarre, Pamplona]
20 Oct: Pulse Interpolation 1; for Pn and elctr [Jan Gerdes, Festival Sirga, Flix]
25 Nov: **Apposition IV**; for prepared Vl [Placa Base Col·lectiu instrumental, Takao Hyakutome, Turbulences Sonores, Motpellier] (FP)

2017
29 Apr: ESPAI project: G-Waves; Spr. Sax and elect.; [Pb Col.lectiu Instrumental, CAC ses Voltes, Plama de Mallorca](WP) [Light: Edu Biurrun]
29 Apr: ESPAI project: sicut ædificationem; recorder, voice and elect.; [Pb Col.lectiu Instrumental, CAC ses Voltes, Plama de Mallorca][Video artist: Belén Iniesta]
29 Apr: ESPAI project: **Apposition IV**; Vl; [Pb Col.lectiu Instrumental, CAC ses Voltes, Plama de Mallorca][Visuals-desing and programming: Pedro Trotz]
Jun: **Apposition IV**; Vl; [Takao Hyakutome, Champd'Action, Belgium]
14 Jun: sicut ædificationem constructa vocale sonum; recorder, voice and elect.; [UMS'n JIP, Kunstraum Walcheturm, Zürich-Switzerland]
18 Jun: sicut ædificationem constructa vocale sonum; recorder, voice and elect.; [UMS'n JIP, Zeughaus Kultur Brig-Glis, Switzerland]
19 Jun: sicut ædificationem constructa vocale sonum; recorder, voice and elect.; [UMS'n JIP, Ackermannshof Basel, Switzerland]
22 Jun: sicut ædificationem constructa vocale sonum; recorder, voice and elect.; [UMS'n JIP, ONO Bem, Switzerland]
22 Jun: Sound Block_Module II; fixed media; [Pb Col.lectiu Instrumental. Video: Belén Iniesta. New York City Electroacoustic Music Festival, New York](WP)
25 Jun: sicut ædificationem; recorder, voice and elect.; [Pb Col.lectiu Instrumental , Jack Theatre, New York, USA] (USAP)
15 Jul: Sound Block_Module II; fixed media; Video by Belén Iniesta [SIRGA Festival]
03 Sep: G-Waves; Spr. Sax and elect.; [Pb Col.lectiu Instrumental, Lo Pati, Terres del Ebre]
Nov: Pulse Interpolation 1; prepared Pn.; [Jan Gerdes; TBC](WP)

2016
09 Jan: **Systematic Double Baind**; Voice, fl, Vc and elctr.; [ClapTON Esnemble and Morphosis ensemble, London, UK](WP)
12 Feb: Geomatría del Amor; fl(pcc), Clr(BClr), Pn, V, Vc; [Palomar ensemble; Access Contemporary Music- International House at the University of Chicago- Chicago, USA] (USA-P)
10 Mar-25 Apr: 1231 (vocal work); Rehearsals [Ensemble NOVA, Colin Mason-Musikprotokoll]
25 Apr-28 Apr: 1231 (vocal work); Recording [Ensemble NOVA, Colin Mason-Musikprotokoll-ORF-Studio-Vienna, Austria]
21 May: 1231 (vocal work); [Ensemble NOVA, Colin Mason-Musikprotokoll 2016-Linz, Austria]
10 Jul: **Apposition IV**; Vl [Takao Hyakutome, Sirga 2016-Flix] (WP)
1 Oct: SydusIIIb; Pn and elect.; [Piano: Tomeu Moll, FiraB! 2016-Palma de Mallorca]
1 Oct: G-Waves; Sp.Sax and elect.; [Sopr.Sax: Beatriz Tirado, Conferencia didáctico- FiraB! 2016-Palma de Mallorca]
6 Oct: 1231 (vocal work); [Ensemble NOVA, Colin Mason-Musikprotokoll 2016-Graz, Austria] (WP)
9 Oct: 1231 (vocal work); [Ensemble NOVA, Colin Mason-Musikprotokoll 2016-Graz, Austria]
29 Oct: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Perc, electr [Vertixe Sonora; Oldenburg, Alemania]
24 Dec: **Apposition IV**; Vl [Takao Hyakutome, Japan](JP)

2015
20 Jan: Pulse Interpolation 1; Pn; [Jan Gerdes, Theater BKA: weekly series Berlin, Germany]
24 Apr: **Free Module Study nº1** (Commissioned by Festival Mixtur with the funding support of Ernst von Siemens Musikstiftung); [Vertixe Sonora Ensemble, Festival Mixtur- Fabra i Costa, Barcelona] (WP)
4 Ju: Geometría del amor; [Musica QuLacoza Ensemble; Studio Noru-Nagoya, Japan] (JP)
08 Oct: SOUND BLOCK; sound installation version [Musikprotokoll- Graz, Austria] (WP)
15 Oct: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; Festival SINTESE-Castelo Branco, Portugal] (PTP)
16 Oct: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; Festival SINTESE-Guarda, Portugal]
17 Oct: Pulse Interpolation 1; Pn [Jan Gerdes; Projecterafel-Rafel Bunyol, València]
04 Nov: **Apposition II, III**; Vl [Takao Hyakutome; MISE-EN Place- Brooklyn, New York] (WP Apposition III, USAP Apposition II)
08 Nov: **Apposition III**; V [Takao Hyakutome; NUNC2!- Northwestern University-Evanston, Illinois]
09 Nov: **Apposition I, II, III**; V [Takao Hyakutome; SPECTRUM- concert series, New York City, New York] (USAP Apposition I]
09 Nov: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; Ciclo de Conciertos del Colegio Nacional- México DF, México] (MxP)
12 Nov: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; XII Festival Música Nueva Monterrey- Monterrey, México]
14 Nov: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; CSUF New Music Series- Fullerton, California] (USAP)
14 Nov: Sydus IIIb; Pn+electr. [Tomeu Moll Mas; SIRGA Festival- Flix, Catalunya]
15 Nov: **Free Module Study nº1**; Sax (Spr, Br), E-guit, Pn, Acc, electr [Vertixe Sonora; USD Music Series- San Diego, California]
22 Nov: Pulse Interpolation 1; Pn [Jan Gerdes; maison franco-britannique, Paris] (FP)
27-29 Nov: Guest composer at IMMERSION Festival. Reijkiavik, Iceland.
10 Dec: **Apposition I, II, III** ::: Sydus IIIb ::: SOUND BLOCK; V ::: Pn ::: elctr.; [Takao Hyakutome ::: Tomeu Moll Mas; Encontre de Compositors-Palma de Mallorca, Illes Balears]

2014
11 Apr: **Apposition I** (figures of disorder); Vl; [Takao Hyakutome, Clothworkers Centenary Concert Hall-Leeds, UK] (UKP)
13 Apr: **Apposition I&II** (figures of disorder); Vl; [Takao Hyakutome, Cairo Contemporary Music Days-Cairo, Egypt] (WP Apposition II)
Apr: **Apposition I&II** (figures of disorder); Vl; [Takao Hyakutome, CD recording release Lecture and workshop, EECMS-CCMDFestival-Cairo, Egypt]
22 May: **Apposition I&II** (figures of disorder); Vl; [Takao Hyakutome, ChampdAction-Studio-Antwerp, Belgium] (EUP Apposition II)
25 May: **Apposition I&II** (figures of disorder); Vl; [Violin: Takao Hyakutome, Conservatorium-Maastricht-Maastricht, The Netherlands] (NP)
5 Jun: **Apposition I&II** (figures of disorder); Vl; [Takao Hyakutome, Forum Wallis-Wallis, Switzerland] (SWP)
11 Jul: Café noir at Grave's; guit.; [Avelina Vidal, Curso de Guitarras Cuarteto Ex Corde-Molina de Aragón, Guadalajara]

16 Jul: Roads to Nooteboom; elctr.; [(New version) Acusmonium, Alcõme, Festival SIRGA-Flix, Tarragona] (WP)
4 Sep: Pulse interpolation 1; Pn; [Jan Gerdes, musik21 eV at Jazzschmiede-Düsseldorf, Germany] (WP)
Oct: Sydus IIIb; Pn; [Tomeu Moll-CD recording]
4 Nov: Roads to Nooteboom; elctr.; [Encontre Internacional de Compositors-Palma de Mallorca, Illes Balears]
4 Nov: **Apposition I&II** (figures of disorder); Vl; [Takao Hyakutome, Encontre de Compositors-Palma de Mallorca, Illes Balears] (SP Apposition II)

2013
16 Jul: Geometría del Amor; [Ecce+Riot Ensemble, Dr.:Aaron Holloway-Nahum, Transatlantic Collaborations, The Forge-London, UK] (UKP)
17 Jul: Geometría del Amor; [Ecce+Riot Ensemble, Dr.:Aaron Holloway-Nahum, The Meetinghouse-Brighton, UK]
10 Aug: **Apposition I** (figures of disorder); Vl; [Takao Hyakutome, Baluard, Fundación Pilar i Joan Miró, ME_MMIX 2013-Palma de Mallorca, Illes Balears] (EUP)
23 Oct: **Apposition I** (figures of disorder); Vl; [Takao Hyakutome-Tokyo, Japan] (WP)

2012
9 Mar: Aankomst; [E88, Festival Nou Sons-L'Auditori-Barcelona] (SP)
4 May: **Systematic Double Bind II**; fl, Vc, Voice; [Trio Atem, IDAF Festival- Kingston University; Workshop- Kingston, London]
8 Sep: Aankomst; [Insomnio, Dr.: Ulrich Pöhl, Gaudeamus Muziek Week-Verdenburg Leeuwenbergh, Utrecht]
11 Nov: Geometría del Amor; [PluralEnsemble, Dr.: Fabián Panisello, Festival de Ensembles III, Perspectivas XXI-Auditorio Caja Sol, Sevilla] (WP)
12 Nov: Geometría del Amor; [PluralEnsemble, Dr.: Fabián Panisello, Festival de Ensembles III, Perspectivas XXI-Auditorio de Zaragoza, Spain)
1 Dec: Geometría del Amor; [PluralEnsemble, Dr.: Fabián Panisello, Festival de Ensembles III, Perspectivas XXI-L'Auditori de Barcelona]

2011
23-24 Jan: **Archipiélago**; [Arditti Quartet , Composition Workshop, Institute of Musical Research Senate House- London]
19 Oct: Capsule; [Conjunt Instrumental BCN 216, Dr.:Yasuaki Itakura, L'Auditori-Barcelona] (SP)

Recordings available at:
https://soundcloud.com/mateu-malondra