



**UNIARTS
HELSINKI**

X SIBELIUS ACADEMY

NEXE

Exploring Interconnectedness

A multidisciplinary project composition of
immersion, interaction and voice

ESTHER CALDERON MORALES



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requirements for the degree of

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Picture by Debora Mendes

Abstract

This written component accompanies my artistic project, Nexe, a composition that integrates vocal ensemble, live electronics, acousmatic music, motion sensors, generative systems, and dance. It serves as a comprehensive reflection on the creative process and the themes explored within the project.

My initial artistic aim was to translate theoretical concepts about human nature into a live musical performance. These ideas revolved around the importance of human connection, interconnectivity, and the role of language. Utilizing case studies as foundational elements, I worked towards the piece, gaining valuable knowledge that influenced my decisions throughout the creative process. The thesis thoroughly delves into both the case studies and my creative processes, examining the journey from conceptualization to execution, including collaborative elements involving singers and choreographers.

It articulates and justifies my artistic decisions, particularly concerning the integration of technology and voice, as well as compositional choices that extend beyond sonic considerations, exemplified by the use of generative and real-time interactive composition tools, including data-driven score generation for singers.

Central to the elements of the piece and the thesis are themes of immersion and interaction, integral to human connection. While I didn't initially focus on these themes and their connections, their significance gradually became evident during the writing of this thesis. This process also generated additional questions for future exploration.

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1 Introduction

The aim of this thesis is to produce a reflective analysis of the compositional process, implementation, and result of my master's artistic component, *Nexe*. This composition integrates voice, live electronics, multichannel audio, and interactive elements, including dance. I aim to emphasize the role of immersion and interaction in my exploration of interconnectedness within the context of composition.

For this, I first delve into my artistic background and how this has laid the foundations for composing *Nexe*. I then present the different working methods as well as the connection between the different conceptual topics that guide my artistic exploration.

Following that, I transition to examine specific case studies derived from my preliminary work and further develop the theoretical framework concerning these case studies, with a clear trajectory toward composing *Nexe*.

In the next section, I present the process of composition of my master's artistic component, covering initial thoughts, topic exploration, structure, working sessions, and decisions on the spatial configuration. Subsequently, I proceed to analyze *Nexe* in-depth, going through each section and explaining its poetic, aesthetic, and technical features.

In the concluding chapter, my reflections encapsulate the impact of technology, interactive tools, and different compositional approaches employed during the creation of *Nexe*.

1.1 Background

My passion for the arts started at an early age. When I was three years old, my parents, recognizing my fascination with different forms of expression, enrolled me in music and ballet classes, later adding painting and rhythmic gymnastics to the mix. I remember my childhood being quite hectic but filled with excitement and creativity.

Music has consistently remained at the core of my interests. Growing up, I studied classical piano and participated in several choir experiences that I thoroughly enjoyed. Later, I pursued a degree in music composition, focusing primarily on instrumental composition across various styles, with limited exploration into the realm of sound art. During these studies, I had the opportunity to attend the Sibelius Academy, where I discovered the music technology department, in which I now study my master. This experience completely transformed my perspective on sound and ways of creating music.

Even though music technology entered my life relatively recently, the use of voice has been a constant and integral element. Beyond its musicality, it holds a significant place in my background as a composer and being part of a choir. Using voice as a performance instrument gives a textural depth and introduces the excitement and variability of human interpretation within a performance. This human presence is also intensified by the words, making language a central pillar of my artistic expression. Growing up bilingual at home and being able to communicate in three other languages has given me a deeper understanding of the nuances of languages, shaping my creative exploration.

Over the years, my engagement with dance became more intermittent, only enrolling sporadically in courses covering various types of dance forms. Nevertheless, I have been striving to interweave dance with my music creations.

For my bachelor's final project, I studied the relationship between music and dance, particularly in relation to the representation of feelings and bodily states. I thoroughly enjoyed learning about historical choreo-musical discourses and the different gestural parameters that can be found and discussed within them. I also relished the opportunity to participate in different improvisations with dancers and gained even more experience of this in my internship with the Copenhagen Contemporary Dance School.

The different elements that have been part of my life have been encapsulated in Nexé. A piece inspired by nature and the nature of our humanity. The components I used were chosen probably because in one way or another, they have been part of my life.

1.2 Purpose and working methods

The purpose of this paper is to uncover the theoretical foundations, rooted in human behavior, philosophy, sociology, etc., that have influenced the creative process and how these theories have been integrated into the composition. This exploration spans environmental impacts, social interactions, genetic factors, chance events, and language's power, all shaping human development and artistic expression. The thesis showcases how these theories serve as seeds for inspiration, guiding the compositional process and the choice of elements.

Moreover, the thesis aims to examine the intricate relationships among artistic elements like voice, live electronics, multichannel audio, interactive components, and dance within music composition. It delves into the connections and challenges arising from interdisciplinary collaboration, hoping to offer a comprehensive understanding of their complex dynamics within the context of the composition of *Nexe*.

In the process of developing *Nexe*, I have used a diverse set of working methods that have facilitated the composition and collaboration processes and the documentation of the artistic journey.

Annotations, mind maps, and tables have been valuable tools for capturing sudden ideas, reflective processes, and decisions. This helps in organizing not only thoughts but also in understanding the reasoning behind my decisions. Tracing back to them has been crucial, enhancing the depth of the project elements and enriching my creative process.

Another approach I have used involves translating theoretical concepts into musical imagery using metaphors (Gibbs, Jr. 2008, 4, 12) as a bridge, extracting symbolic representations from the philosophical and sociological theories. This method has been crucial in shaping my compositional approaches, tools, and sounds.

To help me during the composition process, I created a creative questionnaire for the singers, asking about their vocal range, preferred registers, comfort with sight reading,

and their ability to sing through larger intervallic distances. Additionally, I asked about their comfort with answering personal questions verbally, as well as the languages they could speak. Revisiting some of these questions and engaging in conversations was important to ensure that I would understand their perspectives and help them through the performance.

The connections between these working methods are diverse, often forming circular patterns. Much of the process involved extensive contemplation, repeatedly revisiting my notes, and building upon them over several months. Most of my working process was spent reading, doodling, and reheating cold cups of coffee and tea.

1.3 Conceptual ecosystem

Within the conceptual framework of Nexe, I envision an ecosystem (see Figure 1) where the elements of body and voice, reside at the center. Surrounding this core are vital components of the piece such as algorithms, sensors, metaphors, live electronics, spatial audio, and the score.

Each element is intricately intertwined and integrated into the ecosystem. Further out, we have immersion and interaction, enveloping the different exchanges within the performance.

The relationship between the different elements within this ecosystem, mirrors the underlying philosophy of Nexe, emphasizing the unified integration and coexistence of diverse components.

The topics and relationships will be explained in detail later (see 2.2 Towards Nexe and 3.2 Inside Nexe).

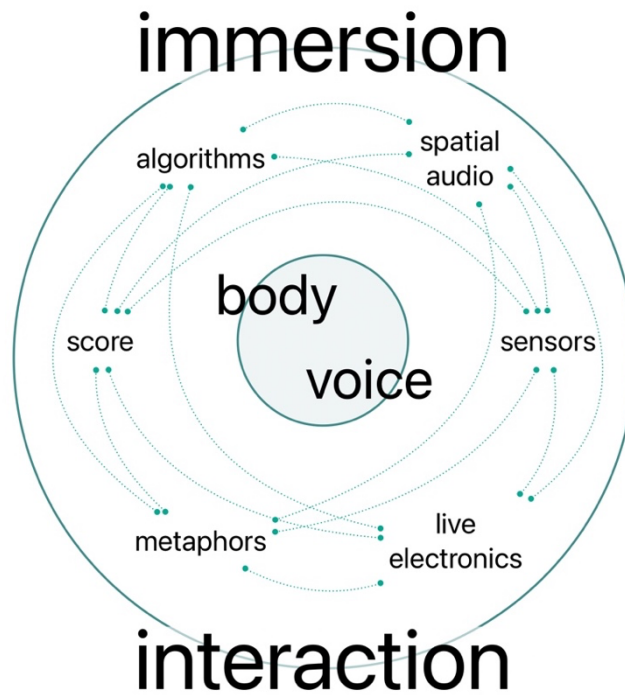


Figure 1: Ecosystem of elements and interactions in Nexe

2 Case studies - Portfolio

In this chapter, I will explore a series of works I have developed and participated in throughout my studies. These works have been crucial in shaping the foundation of my master's concert, *Nexe*. Following this overview, I will briefly introduce the piece and delve deeper into specific topics that have influenced my ideas, discussing how these concepts were initially introduced in these case studies.

2.1 Preliminary work

During my studies, I actively engaged in numerous projects, each serving as an arena where I could refine my skills and determine the tools for my master's concert. These projects provided invaluable hands-on experience, allowing me to experiment with various techniques, sounds, and creative approaches.

The pieces are now presented in chronological order. The underlying themes and concepts present in each piece will be explored in depth in the following section.

2.1.1 Tilan Kudelmia

Tilan Kudelmia is a collaboration with dance student, Rinja Sartolahti. In this piece the intention was to allow movement and sound to intertwine and interlace through each other and towards each other, creating a unique kind of weave in the space.

This performance was based on an improvisational score for which I performed the piano and a modular synthesizer. The sounds of the piano were treated looped and played through a quadraphonic system.



Video 1: Tilan Kudelmia teaser

The audience seated almost in line with the speakers, leaving the center free for the dancer's performance. In this setup, the "sweet spot" for optimal music appreciation was only occupied, at times, by the dancer. Despite this seating alignment, the performance still allowed for certain immersivity.

I relied on v-bap technology for spatializing the sound. I was able to control the amount of spread in the sound and its movement, using circular patterns with changing directions, and jumping from random degrees of the circle. The speed of these movements was also under my control, and sometimes, it would be connected to the synthesizer's clock to change with the music rhythm.

2.1.2 Luminare

Luminare is a collaborative piece for voice and live electronics created by Juulia Haverinen¹ and me. This piece delves into the idea of connection, initially between the light we emit and our own beings, and subsequently extending to our environment and other individuals. Our exploration involves representing the sounds of nature through our voices, aiming to mimic the calls of birds and the whispers of the wind using live electronics. To achieve this, we employ photo sensors.

We use the sensors as controllers. Depending on the amount of light the sensors were receiving, sounds were playing, and more or fewer sound effects were applied to the treatment of our voices.



Video 2: Luminare teaser

This was a challenging piece to execute because of the changing qualities of the sensors depending on their batteries and the time they had been active. This experience taught me to have an adaptative scale for the sensors so that the mapping would be done quickly and efficiently right before the performance.

2.1.3 Chronovariations

*Chronovariations*² is a composition and sound installation by Heli Hartikainen in which I collaborated as a performer and software programmer developing the live-electronics

¹ Juulia Haverinen is a composer and sound artist who enjoys multidisciplinary collaborations and often works with voice and electronics. She studies music technology at the University of Arts Helsinki.

² Visit <https://helihartikainen.com> for more information about the project.

and the installation patch, that selects the sound to be sent to 9 transducers attached to metal structures.

It was premiered as Hartikainen's master's concert at the Sibelius Academy (Uniarts Helsinki) and then performed at FLOW FESTIVAL 2022. The binaural album recording happened in March 2023 in Nousiainen's church, and it is being released later in the year.



Video 3: Chronovariations teaser – Heli Hartikainen's Master's concert in Black Box

Chronovariations has been a central pillar for the development of my skills in improvising with live electronics and live sound spatialization. It not only provided a platform where to enhance my collaborative skills but also helped me in the process of translating ideas into tangible artistic expression by having to bring Heli's vision to life. Chronovariations really contributed to bringing clarity to my creative process and shaping my own artistic path.

2.1.4 NYKY ensemble and Liisa Pentti

This interdisciplinary artistic collaboration between Sibelius Academy's NYKY Ensemble and Liisa Pentti +Co dance group is a reproduction of Liisa's work "Ref2020" and a live adaptation of Brian Eno's *Reflection*, a performative concept by choreographer Liisa Pentti³ and composer Libero Mureddu⁴.

Reflection is an electronic generative piece for which there is no code available. Libero wanted the piece to maintain its generative nature, allowing the music to be different in each performance. For this, we had to "reverse engineer" what we could hear from the recordings in terms of musical content and the way it was organized.

Jaakko Kilpeläinen and I worked together on transcribing and arranging the music. Jaakko orchestrated the musical fragments, and I worked on recreating the generative system and the software for the performance. The system chooses the musical fragments (.png files) to be played in real-time by the players, who receive the score on their iPads. This was the first time I used Drawsocket platform⁵ for sending the score over a wireless network.

2.1.5 Not to, and sleep

This quadraphonic piece was created as a collaboration between the Sibelius Academy Department of Music Technology and Musica Nova, for the concert *New Music for Voice and Electronics*.

³ <https://liisapentti.com>

⁴ <https://www.liberomureddu.com>

⁵ Drawsocket is an node.js based server/client platform for generating synchronized, browser-based displays across an array of networked devices.

Not to, and sleep is an exploration of the sonic space that occurs during the state between being awake and being asleep. Some of us, experience what is known as "sonic hypnagogic hallucinations".

These hallucinations generally involve background sounds (phone ringing, a doorbell, people talking, conversations, etc.), loud noises (exploding sounds, crashes, bangs), and our "inner voice". Unlike dreams, these sounds typically lack a coherent narrative. Hypnagogia has long been linked to the creative process and revered as a source of creative inspiration and intuitive thinking by many artists, scientists, and philosophers (Summer 2023). As these sounds, voices, and conversations can have a personal nature, I worked with singer Taavi Oramo to find out which were some of the most recurrent words and sounds to include in the piece.



Video 4: Not to, and sleep teaser

I consciously used this piece as a "test" towards *Nexe*. I wanted to explore sounds of breathing and different sound effects that could be useful, as well as the use of multichannel with voice. I believe the composition process and performance were helpful in the development of *Nexe*.

2.1.6 Blop, blop

Blop blop is an interactive multichannel piece played in a 26-speaker dome. It was composed as part of *Sounding Ashes*, an interactive sound installation for Musica Nova festival in Helsinki that combines pieces of different students.

For this piece I used recorded sounds of singer Tuuli Lindeberg. These sounds reacted to the amount of movement in the space and the presence over time. As people moved in the space, sampled sounds of the mouth were played at randomized points in the space. Depending on the presence over time, drones created out of the voice or other tracks would be activated or switched off. The placement of all the sound sources was configured differently, and its movement speed and rotation depended on the data input.

I created the piece in the studio, using random data input and setting temporary thresholds. Once we built the dome and had time to test our pieces there, we were able to adjust the different parameters of our interactions.



Figure 2: building the dome for
Sounding Ashes

While working on the piece, I was hoping for it to be clear when there was an interaction, so having the time to adjust was crucial. Nonetheless, the results were quite different since the audience activity in the space varied.

It wasn't a sonically elaborated piece, but it was a great opportunity for me to test and discover ways to map and think about interactive and ambisonic sounds.

2.1.7 Venus of the Baltic Sea

Venus of the Baltic Sea is a composition made in collaboration with Juulia Haverinen, as part of the ArtsAdapt Project⁶ in 2023.

In one of the ArtsAdapt sessions, we got to meet researcher and hydrologist Inese Huttunen, working as part of the BlueAdapt team. She explained how the nutrient load, caused mainly by agriculture, is transferred through rivers into the Baltic Sea and she showed us her work, which depicted future possible scenarios based on this load. This was a source of inspiration for developing a piece that would deal with the state of the Baltic Sea.

I was especially interested in creating a sonification out of Inese's data. Inspired by Botticelli's painting "Birth of Venus", Juulia began to think of a modern Venus born out of the toxic waters. A new creature, a human-water hybrid with plastic flesh.

We brought our ideas together and started to work on a piece that aimed to capture the initial sentiments of this new organism, while sonically representing the past and future of the Baltic Sea, using Inese's data. We decided to let all the different trajectories be heard in our piece since, at this moment in time, all these futures are still possible.

The soundscape is composed of pre-recorded and amplified voices, a choir singing live, and a hydrophone as a concrete water element, which we use together with a set of effects and the solo voice of the Baltic Venus. The data also manipulates the effects on the hydrophone and the solo voice.

⁶ <https://www.uniarts.fi/en/projects/arsadapt-artists-for-a-sustainable-future/>

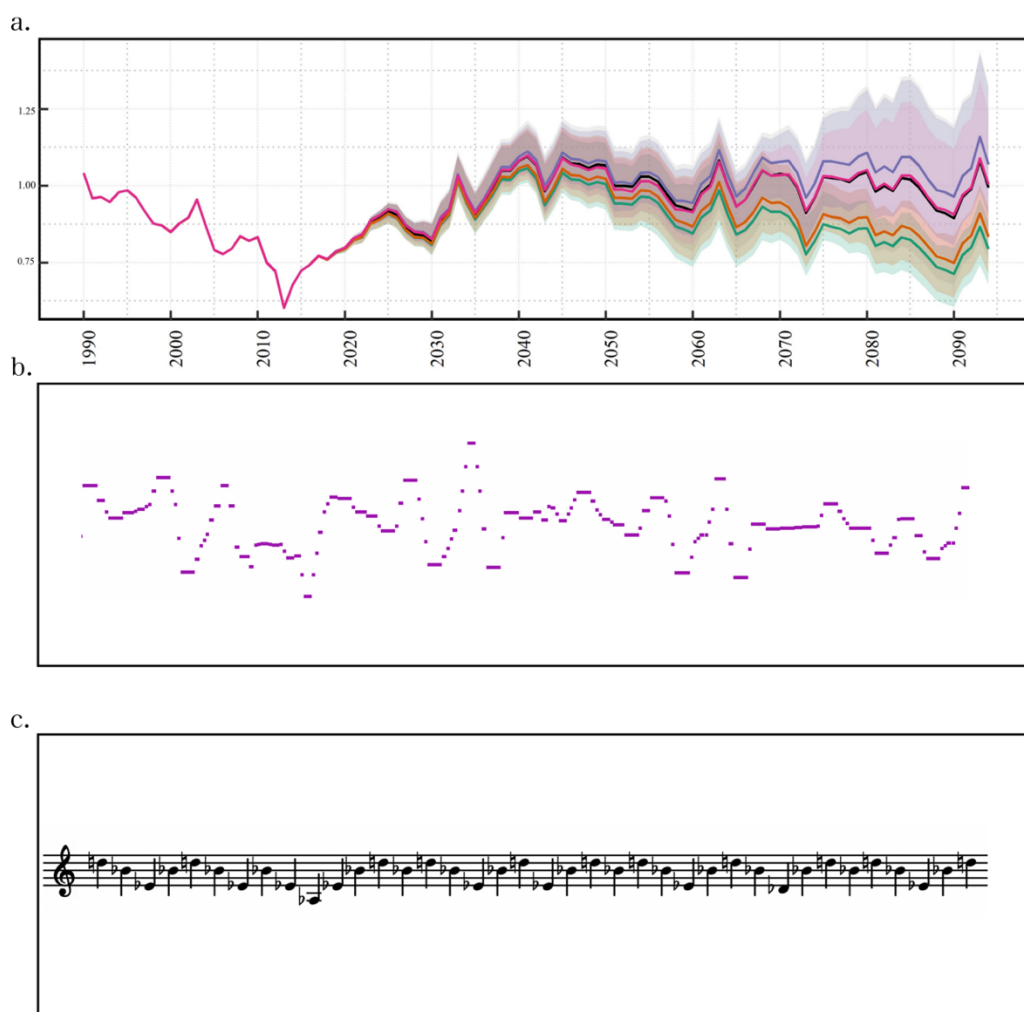


Figure 3: Process from data to melody from *Venus of the Baltic Sea* project

This piece was key for *Nexe* since it allowed me to develop a system in which I could use a stream of data and translate it into a score (see 3.2.1). With this piece, we also explored different ways in which the choir could create the sounds without having a score. We decided to use pre-recorded voices and live sounds of the hydrophone as guides for the singers.

2.1.8 Despertar en llamas

Despertar en Llamas (Awakening in Flames) is a generative musical work for tenor saxophone, oboe, viola, and live electronics, that arises from a fascination with the complexity and beauty of the natural world. It was commissioned and premiered by

Vertixe Sonora at Vang Festival 2023 in Madrid. Through a diversity of data reflecting the dynamics and fragility of ecosystems, the piece aims to create constantly evolving soundscapes that interweave the delicacy of life with the vulnerability of the world we inhabit.

Each section of the work represents a different aspect of the relationship between humanity and nature, from the harmony of the forest to the devastation of fire and the hopeful rebirth of nature after disaster. The sounds of nature and fire form the basis of the instrumental music, and using live electronics, they are transformed and manipulated in real-time to create emotive and moving sound textures.

While the musical content and generative system functioned quite satisfactorily, my challenge arose when I had to create the performance patch for external supervision. Being constrained by pre-set configurations and relinquishing the control of the live electronics and timing to the system autonomously was a struggle for me. Personally, I appreciate the spontaneity that comes with having direct control over those parameters.

2.2 Towards Nexe

In this section, we will dig deeper into specific topics that have shaped my decisions and are essential to *Nexe*. The insights gained from previous case studies have provided me with a better understanding of different techniques and tools, and new artistic approaches. While I'll briefly introduce *Nexe*, the primary focus will be on the key elements derived from these studies and my learnings.

The term "Nexe" embodies the idea of connection. It's about how we're all linked together. The piece delves into the intricacies of human connection and shared experiences. It's all about realizing how connected we are and embracing the fact that what we do, what we say, or even just a gesture, resonates more than we think.

Nexe is a musical composition, a performance that evolves in real-time, combining dancers, singers, and technology to create an immersive experience. It's a celebration of human expression merging with the possibilities of technology, all guided by the nuanced power of language and movement.

The project takes inspiration from the ways genetics and social relationships shape human behavior and development. It's an exploration of how we become who we are, drawing inspiration from theories in genetics, sociology, and human behavior. The goal is to create a seamless audio-visual piece for the audience, where the relationship between movement and sound isn't necessarily obvious. There are guidelines for the performers, but they also have room for creative input.

2.2.1 Interactivity

When working with pieces such as *Luminare* and *Blop Blop*, I explored different approaches to interactivity in terms of tools and responses or reactions. However, when I began my work with *Nexe*, I started to question the essence and meaning of “interactivity” and what it really means to be “interactive”.

According to Cambridge Dictionary, interactivity refers to "the involvement of users in the exchange of information with computers and the degree to which this happens." In the realm of music, Rowe (1993, 2) defines interactive computer music systems as those "whose behavior changes in response to musical input". Expanding this notion, Winkler (1998, 4) offers a broader perspective, describing interactive music as compositions or improvisations where software interprets live performances, shaping music generated or modified by computers and encompassing a diverse array of techniques.

In this definition, the elements of the interactive system, using Winkler's structure (1998, 6), would be:

1. **Human input, instruments:** Human activity is translated into digital information.
2. **Compute listening, performance analysis:** The computer receives the human input and analyzes the performance information for musical characteristics.

3. **Interpretation:** The software interprets the computer received information, generating data that will influence the composition.
4. **Computer composition:** Computer processes that are responsible for all aspects of the computer-generated music, are based on the results of the computer's interpretation of the performance.
5. **Sound generation and output, performance:** The computer outputs the result by either using sounds created internally or by sending musical information to devices that generate sound or performers.

Furthermore, this perspective on interactivity suggests various controllers that, using Winkler's suggestion (1998, 313–19), are: acoustic models (using pre-existing instrumental techniques, e.g. midi keyboard), new instruments (other devices producing midi data, e.g. modulation wheel), and sensors (measuring different types of data, e.g. proximity, acceleration).

Beyond the digital realm, interactive, as an adjective, signifies "involving communication between people or reactions between things that work together". Historically, music has always been inherently interactive, fostering connections among musicians as they respond to one another, whether in the conductor's orchestral gestures, the lead singer's cues in a rock band, or the spontaneous interplay among members of a jazz combo (Winkler 1998, 4).

This definition resonates profoundly with the ethos of *Nexe*, a project rooted in the concept of connection and diverse forms of communication with the world. In *Nexe*, performers are intricately linked through a computer, however, the overarching objective is to empower every individual, dancer, and musician, to influence and be influenced by others.

2.2.1.1 *Levels of indeterminacy*

Determining how music responds to different inputs and interactions was fundamental in crafting interactive elements in *Luminare* and *Blop Blop*. This concern carried over

when I started to develop *Nexe*. I regarded defining the levels of predetermined and indeterminate actions as a fundamental step in establishing a structured framework, essential for effective and purposeful interactive composition.

Following Winkler's definition (1998, 28–30), predetermined actions are those known in advance and represented through notated scores or algorithms, providing a reliable and detailed execution of the composer's vision. Indeterminate actions include musical elements with unspecified outcomes, typically involving improvisation or processes where results are uncertain, embracing uncertainty, spontaneity, and interactivity. However, indeterminate actions can be more challenging to implement and control.

When composing *Nexe*, the idea was for it to move in between the indeterminacy spectrum, without having entirely indeterminate actions. It was important to define what those actions could be and the amount of freedom since results could become unpredictable if the interaction agreed upon is disrupted. For instance, if a section anticipates significant movements that would impact the accelerometer, but the dancer remains still, the sonic result deviates from the original intent.

2.2.1.2 Response methods

The response to those actions is what can guide the degree of indeterminacy. I align with Rowe (1993, 7), who outlines three distinct yet combinable approaches: transformative (altering existing material or live sources), generative (using rules to create full musical output), and sequenced (allowing real-time input to influence aspects like tempo, dynamism, and rhythm). In *Nexe*, I wanted to explore especially the transformative and generative aspects of interactivity.

2.2.1.3 Interactive models

Whether a piece involves interaction with computers or just people, various models of interaction come into play. I will refer to Frengel's models (2014, 303–10). He utilizes instrumental-based naming conventions and metaphors to suggest different interaction models:

- **The instrumental model:** This model is crafted to operate akin to traditional instruments, granting performers total control over sound. Physical gestures directly influence the auditory output. An example would be the use of a midi controller.
- **The conductor model:** Control is distributed between the performer and the system. The performer steers specific parameters, molding the trajectory of the sound.
- **The reflexive model:** This model involves an interactive system with predetermined electronic responses to actions. Real-time processing or triggering of prepared sound files characterizes its operation.
- **The virtual-musical model:** The system behaves like a virtual musician, being creative and unpredictable in its output.

These interaction models are important in shaping and exploring diverse approaches to structuring the piece since they allow for diverse connections between performers.

While I do not necessarily require the audience to be consciously aware of the immersive elements, I am interested in understanding how these elements contribute to the overall feeling of immersion. Interactivity, in this context, will serve to establish a connection between performers and create a sense of a shared environment. My aim in integrating interactive elements, is that the performers become interconnected, unifying individual contributions into a cohesive whole.

2.2.2 Dance, gestures, and tracking technologies

When I began the development of *Nexe*, incorporating dance was evident to me. I envisioned the body's presence in space and its movements becoming integral to the piece. In my previous work, *Tilan Kudelmia*, I explored the interaction between music and dance through structural choices and the sharing of visual and auditory cues. I was now interested in further enhancing this interconnection by incorporating tracking technologies into the performance.

2.2.2.1 *Interactive dance*

Dance and music, although often seen as separate arts, share an intricate relationship deeply rooted in human history. In many cultures, they are inseparable, evolving together over millennia. With motion-tracking technology, dancers can now control sound, lighting, and more during live performances. Interactive dance, as defined by Siegel (2011, 191–93), involves a reciprocal influence between a dancer's movement and music. This interaction allows for precise synchronization and temporal freedom, varying from highly coordinated to more abstract forms. While dance and music can exist independently, their fusion through interactive techniques enhances artistic expression.

2.2.2.2 *Motion-tracking technologies*

After more than 100 years of development, motion capture technology has advanced greatly. In the initial stage, the motion capture technology was only capable of capturing a rough range of body movements. But now it is sensitive enough to capture the movement of the whole body.

As I started contemplating the most efficient to capture the dancer's movement I delved into different tracking technologies to explore the possibilities. Siegel (2011, 194–97), adopting Alex Mulder's taxonomy of technologies, divides them into three primary groups: inside-in (body sensors that have no relation to the space), inside-out (providing information about the performer's position in the space), and outside-in (using external sources or markers on the body). He also proposes hybrid systems, an example could be an accelerometer, capturing rotation in reference to a gravitational pull (inside-out), and relative acceleration (inside-in); and computer vision.

In the interactive piece *Blop Blop* part of *Sounding Ashes* installation, we used a camera using computer vision tracking "blobs", or zone of the objects. We used the amount of movement, the distance to the center, and the presence over time. Because it was a dark space with shadows, the input wasn't only dependent on the presence of people,

but how the shadows moved in the space. This made me think this might not be the best solution for *Nexe*.

After considering the space layout, audience positioning, planned movements with the dancers for different sections, and the requirement for sound sources to move dynamically in relation to the dancers, I opted for a body sensor. This choice allowed for capturing acceleration and compass localization data.

2.2.2.3 *Mapping motion to music*

After working with sensors in pieces like *Luminare*, I realized I had to develop a better mapping system to adjust and facilitate the use of incoming data. Mapping is defining the relationship between the input (dancer's movement) and the output (sonic result). This relationship might be very simple (one-to-one correspondence) or might be very complex, involving complicated schemes or algorithms in this translation.

Understanding the mapping process is key to refining raw motion data effectively. Schacher's approach (2022), which I have applied in other projects such as *Venus of the Baltic Sea* and *Despertar en Llamas*, involves several layers. First, raw movements captured from motion-tracking systems are decoded for further analysis. This includes adjusting and calibrating the data to specific measurement ranges and normalizing it (0 to 1, -1 to 1). After this, we can smoothen out the data, remove any noise or irregularities, and adjust the data curve to match the motion patterns. Once the data has been refined, we can modulate and upscale it, and trigger actions based on a specific threshold, introducing delays if needed to prevent unintended rapid triggers.

For *Nexe*, I aimed to develop a system in which the data could be calibrated differently depending on the movements and sections of the piece.

2.2.3 Voice in artistic practice

Our voice is more than mere sound. It's part of our identity and a way for us to project who we are outside our bodies. It shapes how others perceive us and choose to relate to us. It is able to define us emotionally, intellectually, and perhaps physically.

Throughout my practice, I have explored different ways in which our voice can be used with expressive means. Having a better understanding of the origins of our language and music influenced my perception of vocal expression.

The origins of language are debated, with theories ranging from singing preceding language to gestures, monkey-like sounds, and songs. McGilchrist (2010, 104) offers evidence that singing preceded language and argues that it is likely that language developed from music. Dunbar (1998, 132) explores connections between the grooming of monkeys and human gossip. Mithen (2006, 138) suggests that Neanderthals used the proto-linguistic “Hmmmm” for communication, this being the acronym for “*Holistic, Manipulative, Multi-Modal, Musical and Mimetic*”. From other perspectives, Eisenstein (1970, 155) says that intonation, i.e. the “melody of speech”, forms the basis of music. (Barker and Huesca 2018, 21)

While the origins and evolution of music and language are complex, I aim to explore this connection further. Barker and Huesca (2018, 2–3) suggest that words and music cohabit in the voice. These three elements are tools for communication, inseparable from our human experience. As shown in the diagram (see Figure 4), combining any two together,

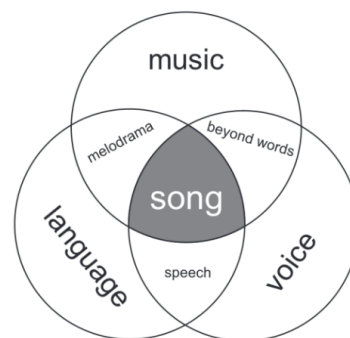


Figure 4: suggested relationship between voice/ music/language by Barker and Huesca (2018, 3)

provides specific modes, such as melodrama⁷, and the three of them combined produce a song.

In my practice, I explore the different ways in which the elements of language, voice, and music intertwine. I wish to find ways to blur the boundaries of this diagram. Can the sounds be placed in opposite parts of the diagram simultaneously? How does speech become music? How can the sounds “beyond the worlds” have meaning? To what extent does the perception of these sounds or the intention in its production play a role in this?

The interplay between musical and textual meaning, and the questions of balance and dominance between them, has been a recurrent theme throughout music history. From ancient Greece to Monteverdi’s operas and jazz (Fornäs 1997, 110–12).

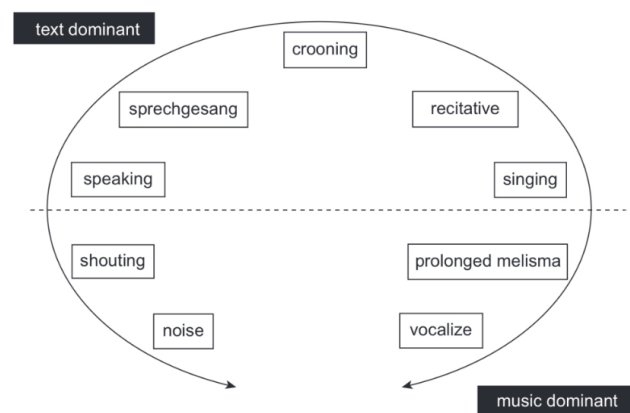


Figure 5: "The speech/song continuum: dominance of Music vs Text. Barker and Huesca (2018, 144)

Speech and its relationship with singing has fascinated composers such as Stockhausen and Emmett, who distinguished five degrees between speech and song: from parlando to quasi parlando, then to syllabic song, melismatic song, and singers singing without opening their mouths.

While this systematic gradation seems appealing, it overlooks the diverse perspectives of performers, composers, and audiences. Barker and Huesca (2018, 143–45) suggest

⁷A dramatic work that is accompanied by instrumental music to enhance the action.

that the development of music and text dominance appears cyclical, suggesting a more flexible boundary between the two.

In their examples, they propose two ways in which the boundaries between speech and music lead listeners to lose awareness of the words as language. For instance, we can find a prolonged melisma in Mozart's "Alleluja" from *Exsultate Jubilate* (1773), turning the word into pure musical expression. In Steve Reich's "Come Out" (1996), the repetitive phase patterning of the words gradually dissociates phonemes from their usual linguistic context.

In the twentieth century, there was a notable shift towards a fascination with the quality or nature of sound, particularly new sound, as the basis for musical expression. In vocal music, composers found new challenges to singers. Cage's *Aria* (1958) discarded traditional notation, relying on visual cues for singers to create unique sounds and gestures. Barberian's *Stripsody* (1966) extracted onomatopoeic elements from cartoon comics, presented in a comic-book-style score.

Between the two extremes of singing and speaking, countless vocal possibilities have been exploited, blurring the intentions between dramatic literature and musical composition, and exploring the boundaries of human expression through vocalization.

The works of Cathy Lane have greatly inspired my artistic journey. Lane focuses on the exploration of works that utilize words, often as a central element, manipulating the tension between their semantic meaning and abstract musical characteristics, primarily through technological means.

This practice finds roots in the early 20th century influenced by Marinetti's "parole in libertà", using words to directly mimic the sounds of the world; and Russian Futurists like Kruchenykh and Khlebnikov's Zaum poetry, incorporating dislocated syntax, nonsensical wordplay, and visual innovations. Artists like Hugo Ball, Tristan Tzara, and Hans Arp at the Cabaret Voltaire in Zurich experimented with sound poetry, aiming to transcend linguistic barriers. Dadaists and Surrealists continued this linguistic

experimentation. Evolving from performance-based art to phonetic composition with the introduction of tape recorders. Notable figures like Gysin, Burroughs, Amirkhanian, Cage, Ashley, La Barbara, and others contributed to text-sound art. Composers such as Berio, Dodge, Wishart, and Lansky focused on the spoken word in their compositions shaping the evolving landscape of text-sound art, bridging linguistic experimentation with musical composition. (Lane 2006, 3–4)

In *Not to, and Sleep*, I had my first exploration using words not only by their semantic meaning but by the absence of meaning as well as its musicality. My aim in *Nexe* was to explore this further in detail and find ways to create similar sounds to processed recordings, but live.

2.2.4 Immersive media

In recent years, my artistic practice has been centered around a common element: multichannel audio. What captivates me the most about it is its immersive properties. My objective has been to integrate acoustic sources and live electronics into this immersive experience. While my previous work primarily involved positioning the acoustic sources facing the audience or in alignment with the speaker setup, I wanted to further explore with their placement. For instance, in *Venus of the Baltic Sea*, we decided to position the choir within the audience, enhancing the textural richness of the performance and creating a more intimate connection between the performers and the audience.

The exploration of spatial arrangements is deeply rooted in the history of composition. Boren's exploration (2018, 45–49) reveals how composers utilized space to create immersive experiences for listeners. In the Baroque era, Heinrich Biber's *Missa Salisburgensis* utilized five different choirs and distinct instruments in Salzburg Cathedral. In the 19th century, Hector Berlioz placed brass choirs in cardinal directions, to call to judgment in his *Requiem* in 1837. Boren suggests that Berlioz conceived the piece not as isolated sound sources, but as a 3D immersive environment, shaped by

orchestration. Henry Brant pioneered acoustic spatial music, starting with *Antipnoy I* (1953), and continuing his spatial compositions for 50 years.

Innovations like microphones and recordings transformed how music could be placed in the space. John Cage utilized phonograph recordings and wireless radios with spatial separation in his works, such as *Imaginary Landscape Nos. 1 and 4* (1939-1951). In the European electroacoustic tradition, space became one more musical element. Pierre Schaeffer and Pierre Henry with their *musique concrète*, and Stockhausen, pioneering the electroacoustic tradition, explored different speaker setups and spatial techniques. Venues like the Philips Pavilion, designed by Xenakis, featured innovative pieces, like Varese's *Poem Electronique*, played through desynchronized tape recorders across 425 speakers. (Boren 2018, 55–56)

Multichannel systems are designed to envelop the listeners within a space surrounded by loudspeakers, that not only produce sound but serve as physical boundaries, enhancing the feeling of being within a specific environment.

In *Tilan Kudelmia* and *Chornovariations*, I utilized VBAP method (Vector-base amplitude panning), which positions virtual sound sources using simple and efficient mathematical equations. VBAP allows the creation of complex soundscapes in two or three dimensions, using any arrangement of loudspeakers (Pulkki 1997, 456–57). Its efficiency and simplicity are the reasons why I decided to use this technique. *Tilan Kudelmia* and *Chronovariations* didn't require sound elevation; my focus was on creating sharp and precise sounds around the audience, emphasizing the electronic elements of the music, and in the case of *Chronovariations*, accentuating the resonance of the individual metal objects placed in the space.

In *Blop Blop*, an interactive multichannel piece played in a 26-speaker dome, as well as in the fixed media sections of *Not to, and Sleep*, I used ambisonic technique using *ICST*

*Ambisonic Tools*⁸ and *SPARTA plugins*,⁹ respectively. Ambisonics, explains Jaroszewicz (2015, 54–58), was developed by Michael Gerzon in the 1970s as an alternative to quadraphonic systems. It provides a unified framework for storing, manipulating, and reproducing spatial sound scenes. Basic ambisonic functions can encode monophonic sound signals in specific directions or rotate the sound scene. What makes it interesting for me is its ability to recreate the original sound field, without relying on phantom sources like in VBAP or DBAP¹⁰, generating a spherical audio environment around the audience, situating the “sweet spot” in the center of a sphere. Its accuracy depends on the chosen order.

Jaroszewicz (2015, 154) proposes that “the creation of sound fields and diffusion creates an immersive experience that is more related to the space than the work”. Instead of being only about the artistic composition, or content of the sound, the immersive quality is tied with how the sound occupies and interacts with the physical space. Moreover, Chagas (2008, 190) emphasizes how sound can acquire a tangible property: “When space becomes a parameter of composition, sound develops a ‘tactile’ dimension. Similar to a body, it occupies a unique position in the space from which it can exclude other spaces”.

These perspectives accentuate the importance of space as a vital component of immersive composition, a concept I deeply resonate with. In the process of preparing to compose *Nexe*, I consistently reflected on how the various elements within the performance space could interact and contribute to the immersive experience. These considerations prompted other questions that have become central to my artistic exploration: What truly defines a fully immersive experience? How can a musical composition enhance the sense of immersion?

⁸ <https://www.zhdk.ch/en/researchproject/ambisonics-580119>

⁹ <https://leomccormack.github.io/sparta-site/docs/plugins/sparta-suite/>

¹⁰ Distance Based Amplitude Panning

My objective isn't necessarily to provide definitive answers but to delve into these inquiries through my composition process.

2.2.5 Use of live electronics

In my work, I have been combining electronic tools with live performances in different ways. Within a single piece or performance, I often incorporate different approaches, such as generating electronic music entirely through modular synthesizers, as showcased in *Tilan Kudelmia*. Another technique I explore is “Mixed music”. This involves using pre-recorded sounds in combination with live instrumental/vocal performances (Emmerson and Smalley 2001, 4). This is demonstrated in *Not to, and Sleep*, where different sounds of pots pans, and squeaky chairs are played during the performance. Additionally, I delved into live electronic music, where the sound produced by the performer is modified in real time (*ibid.*).

Live electronics have become a central part of my artistic practice. Beyond enhancing acoustic performances, live electronics facilitate the transformation of a sound, creating with it entirely new environments. While we are familiar with the natural sounds of voices and instruments, like saxophone (*Chronovariations*), live electronics open the door to new sonic worlds.

I find inspiration in the compositions of Kaija Saariaho. Saariaho’s relationship with electronics is seen as an extension of orchestration, blending voice and instruments with technology, and as a way to contribute to the narration of the piece. She transitioned from analog to digital tools, using synthesis and spatial techniques to enrich her sound. (Campion, Saariaho, and Barrière 2017, 11–12) In her work, Saariaho prioritizes close collaboration with musicians for better rehearsals and satisfying outcomes, aiming for subtle electronic integration that goes unnoticed by listeners. To maintain the pieces' integrity, the electronic components are shared with a degree of flexibility in sound configuration, carefully balancing creative adaptability without compromising the original artistic vision. (op. cit., 17)

In my approach to composing with live electronics, my focus isn't solely on the sonic result. I believe that a big part of the essence of composition lies in being open to the performer's intention and musical input.

In my attempt to incorporate fixed live electronics in *Despertar en Llamas*, I found the rigid structure limiting. As a generative piece, there should have been more room for flexibility to explore the sonic elements in real time.

I enjoy the spontaneity of improvisation, valuing pieces that come alive and adapt to both performers and the performance spaces. While I haven't yet written a piece where individuals manipulate electronics on their own, I'm intrigued by the idea of exploring how different people can improvise and shape a piece using the same tools. The resulting performance might be different, but the essence of its origins is there. For me, composing isn't about ownership; I don't expect the piece to be solely mine. The essence of a composition goes beyond its sounds, residing in the intentions and expressions of the performers.

2.2.6 Score and instructions

In my exploration of generative systems with live musicians, I found Drawsocket to be invaluable. Developed at the Hochschule für Musik und Theater, Hamburg, it's a node.js based server/client platform designed for synchronized, browser-based displays across networked devices, primarily for distributed notation in music and spatial performance contexts (Gottfried and Hajdu 2019, 1).

I used Drawsocket when participating in Nyky ensemble's performance and in my composition *Despertar en Llamas*. I believe that generative systems bring a fresh dimension to music when integrated with live musicians. They create dynamic, ever-changing soundscapes, where performers respond and adapt in real time. I find that this enriches the live performance making it a unique experience for those performing and listening.

I'm particularly interested in real-time composition. Eigenfeldt (2011, 146) defines it as:

“the application of musical agents to interact in musical ways, during performance. Each agent has the potential to control an independent musical gesture – either pitch-based or timbral – and the complexity of the interactions, along with the quantity of simultaneous gestures, cannot be controlled in any detailed way using existing performative actions.”

In my exploration with *Nexe*, I delve into interactive systems that generate musical structures in real time, allowing for variability and unexpected creative expression. I will go into the process of developing the different elements later (see 3.2 Inside *Nexe*)

3 NEXE

In this chapter, I will delve into *Nexe*. I will first start by describing the practical implementation, going into how *Nexe*'s concept was shaped, refined, and structured, and then dive deeper into *Nexe* itself, providing an in-depth analysis of its sections.

3.1 Implementation

In this first part, I'll discuss the initial ideas that inspired *Nexe* and how its central theme emerged. I'll also explain how the piece gradually took shape and formed distinct sections. Then, I'll cover the practical aspects, detailing what occurred during the working sessions and how I determined the spatial setup.

3.1.1 Conception of the idea

As I was walking in a park in Cambridge at the end of 2020, I stumbled upon a big, majestic tree. Its leaves rustled in the wind, and I couldn't help but think about its roots, largely hidden beneath the grass, and how important they are for keeping the tree not only from falling, but alive.

This got me thinking about the similarities between humans and trees. We are both part of nature, and nature is a part of us. We have our genetic code, yet we are adaptable

and share our environments with other living beings. I could also see the tree as a network, where its different parts are connected in all directions, and somehow, I imagined a dance happening at the roots while the leaves seemed to be coming together, like different individuals sharing their unique stories through a collective song. This moment inspired me to explore a project that connects physical movements with the sounds our bodies produce and find ways in which they could be connected.

Over the next few weeks, I thought of what this piece would entail, and it all became clearer as I was writing my master's application for which I needed a final project. In the description, I wrote:

“the creation of a musical piece that will connect dance movements with a vocal ensemble, making innovative use of sensors to not only capture the movements of the dancers in order to generate and allow manipulation of electronic sounds; but to also be used to produce a set of musical instructions for the vocalists, which are dynamically defined, in response to the movements of the dancers.

[...]

The idea is to create a seamless audio-visual piece for spectators, where it is not obvious whether the movement is leading the sound or vice versa, with some “rules” for performers to facilitate the process. For example, a combination of pre-choreographed sections with improvisations, and use of descriptive musical instructions within a piece.

The use of preset instructions and input from the sensors translating movements from dancers in this half-composed, half-improvised piece can also be used to develop a performance in which vocalists work together yet without individuals seeing each other or the dancers, relying solely on their prior instruction and the real-time signals received during the performance.

There are many considerations in trying to create something that not only explores the relationship between movement and music, but which will stand alone as a cohesive performance piece.”

Since that moment, all the decisions made in the development of the piece have been a refinement exploration, and discovery of the possibilities of this original idea.

3.1.2 Finding a topic

The topic wasn't quite clear at first. I thought of the trees, nature, bodies... I thought my interest was in our similarities with trees, the life within them, and its connection to the environment, but little by little I started to ask myself questions about us, humans. Why is it that we are “special”? What differentiates us from all the other living beings? What is it that makes each one of us also different from each other? How do we get to be who we are? What takes part in shaping what we become? What is human nature? What is it that really makes us humans? To answer all these questions, I started to explore theories of human behavior, genetics, sociology, human development, philosophy, etc.

I was especially inspired by the influence of our environment and social interactions in our development, by how hazard plays a role in our forming, and the power of language. Some of the significant theories that inspired sections of the piece will be further explained.

It is, however, because of the finding out of the influence of all around us in our lives that I wanted the title of the piece to reference these connections. “Nexe” is the Catalan for “Nexus”¹¹. I chose it to be in Catalan since it is one of my mother tongues.

¹¹ Merriam Webster Dictionary: Connection, link.

3.1.3 Sections and structure

After choosing the topic, and starting to read different theories, I began to form sonic images (Godøy 2010, 54) of what the piece could be. Multiple sounds, shapes, and speeds were part of a mass. A body where everything was happening within it, and around it. Something you could observe from the outside, but also be a part of. This idea had a major impact on my decision to make the piece immersive.

I first started by creating a scheme (see Figure 6) describing the topic, what I could imagine in the different sections, and how the movement could influence it.

I thought of different sections. Some being “improvised”, and some being fixed.

For those “improvised” sections, I imagined providing the dancers with control over musical parameters, the text, and electronics, while the fixed parts would have only choir sections, or fixed electronics and pre-recorded materials.

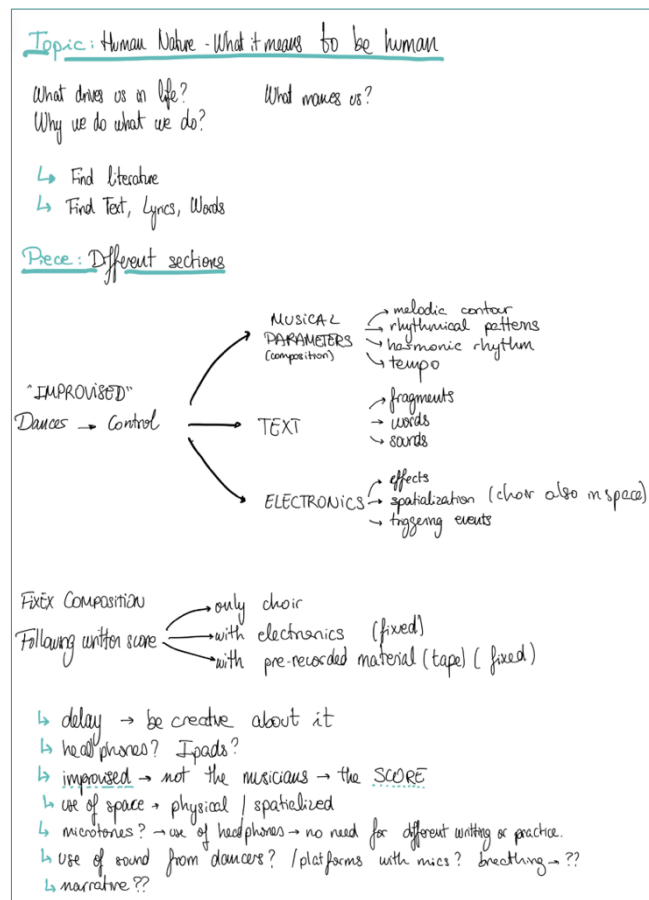


Figure 6: description of the elements at the beginning of the composition

There were many other questions regarding the use of space, the sounds of the dancers, the use of tablets or headphones for the singers, etc. All the different ideas kept on developing after this.

To understand better the sonic body that was in my imagination, I made a mind map:

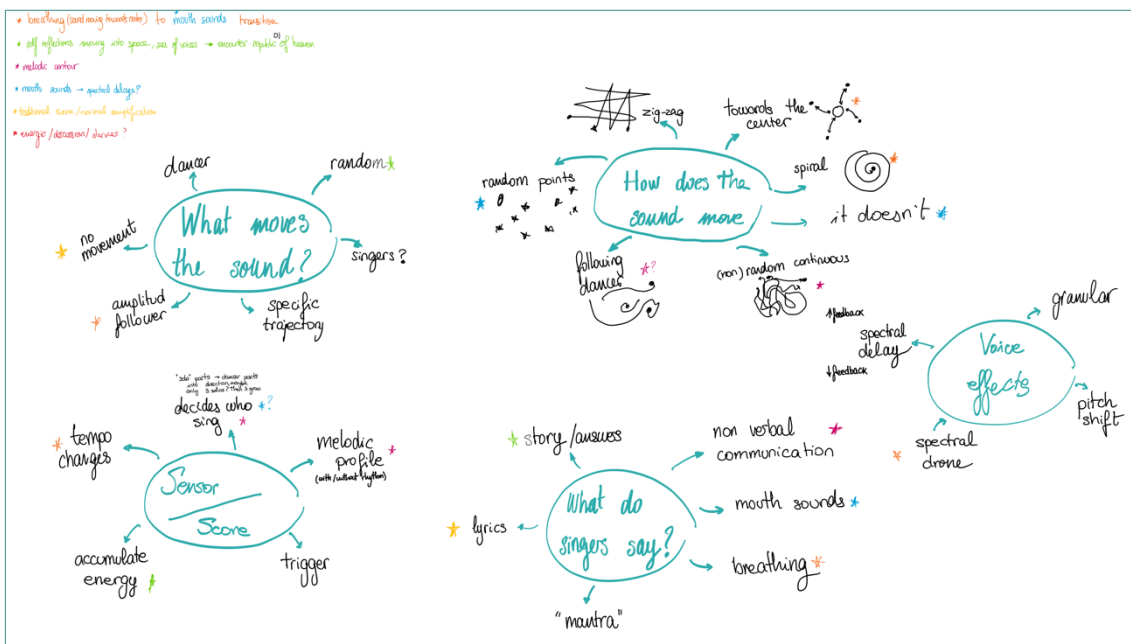


Figure 7: Mind map of different sonic images.

Although some of the descriptions didn't quite fit under the questions, it did help with having a more concise vision of the sounds, and how they could connect and be different sections.

How does the sound move?

- Towards the centre *
- Zigzag *
- Random points *
- Following dancer *
- Random continuous *
- It doesn't *
- Spiral *

What do singers say?

- Story/answers *
- Lyrics *
- Mantra *
- Breathing *
- Mouth Sounds *
- Non-verbal communication *

Voice effects:

- Spectral delay *
- Granular *
- Pitch Shift *
- Spectral Drone *

What moves the sound?

- Dancer *
- No movement *
- Amplitude follower *
- Specific trajectory *
- Random *
- Singers *

Sensor/Score:

- Decides who sing *
- Tempo changes *
- Accumulate energy *
- Trigger events *
- Melodic profile *

To have a clearer vision of those possible sections, I made some color markings thinking of what the different sections could be:

- Breathing *
- Mouth Sounds *
- Self-reflections *
- Melodic Contour *
- Traditional score *

After this phase, I gathered all the elements onto a single table (Figure 8 and Table 1: elements for Nexe during the composition process. Here, I meticulously organized sound descriptions, interactions, and sources of inspiration. At this point, how the sections would be organized remained undecided, leaving flexibility for exploring further through the collaborative process.

	SOUND FX	SOUND MOV.-WHAT	SOUND MOV.-HOW	INTERACTION	REACTION	VOICE-WHAT	MEANING	DURATION	CONDUCT
A	SPECTRAL DRONE	INTERACTION	TOWARDS CENTER	AMPLITUDE FOLLOWER	- SOUND MOVEMENT - FX CHANGES	BREATHING	LIFE PLURALITY COMING TOGETHER	3 min	
B	BUBBLER SPECTRAL DRONE	COMPUTER ? INTERACTION ?	RANDOM CONTINUOUS	ACCELEROMETERS ?	- SCORE: melodic profile - SOUND MOVEMENT	REAL TIME SCORE - 2 A (spontaneous) B	- PREDISPOSED and AFFECTED - DEVELOPMENT	15 min	will respond to libretto... more because it goes with the...
C	NO	NO	NO	-	-	SCORE A	- THE DESIGNED PATH	5 min	rehearsed
D	BUBBLER SPECTRAL DELAY ?	COMPUTER	RANDOM POINTS	ACCELEROMETER or CAMERA	- SCORE: tempo - FX CHANGES: trigger	MOUTH SOUNDS ?	- NON VERBAL COMMUNICATION	5 min	
E	SPECTRAL DRONE DELAY	INTERACTION	CONTINUOUS - Has random?	COMPASS	SOUND MOVEMENT	STORY ?	WHAT WE BECOME?	8 min	
F		NO - space division	NO	CAMERA ?	HARMONIC CONTENT ?	"DUO" B A	- ORCHID AND DANDELION - SINGLE GENE	10 min	
G						# harmonic material			

Figure 8: table of elements for Nexe

Table 1 presents a more refined version of this table:

	A	B	C	D	E	F
Meaning:	Life plurality, coming together	Predisposed/affected, development	The designed path	Non verbal communication	What we become	Orchid dandelion, single gene
What does the voice do:	Breathing	Real-time score	Score	Mouth Sounds	Story	Duo
Duration:	3 min	15 min	5 min	5 min	8 min	10 min
Sound FX:	Spectral drone	Bubbler/spectral drone	NO	Bubbler/Spectral delay	Spectral Drone/Delay	NO
What moves the sound:	Interaction	Computer/Interaction	NO	Computer	Interaction	NO – space division
How does the sound move:	Towards center	Random continuous	NO	Random points	Continuous	NO
Interaction:	Amplitude follower	Accelerometer	-	Accelerometer / camera	Compass	Camera?
Reaction:	Sound movement, soundFX changes	Score (melodic profile), Sound movement	-	Score (tempo), soundFX changes	Sound Movement	Harmonic content?
Conducting:	?	Follow towards right	Rehearsed – who?	?	?	?

Table 1: elements for Nexe during the composition process

From here onwards, I started to focus on the independent sections without following any chronological order. The development and analysis of each individual section can be found in section 3.2 Inside Nexe.

Deciding the order in which the different sections would be performed, happened at the very end of the compositional process, after discussing with choreographer Lydia Touliaou.

The way we reached the conclusions for the structure was based in the intensity of the music and choreography throughout the concert, also considering moments for breaks for dancers and singers and overall dramaturgy.

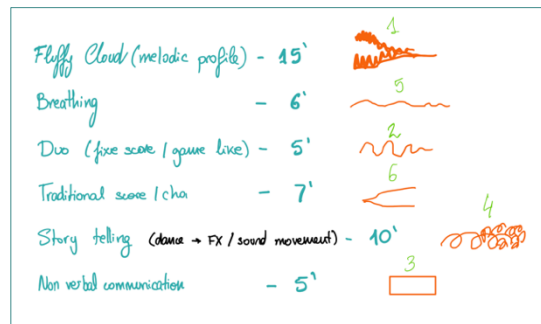


Figure 9: draft with intensity shapes for each section

After doodling some intensity shapes, we proceeded to create the structure. At the end of this process, the sonic score looked like this:

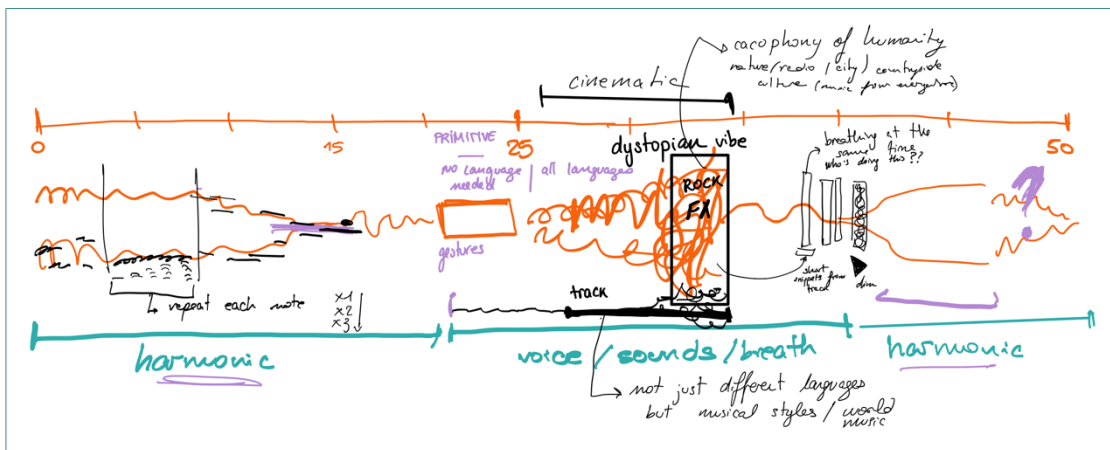


Figure 10: draft of the general structure

3.1.4 Collaborative sessions

A key element of the development of Nexe was the collaborative sessions with choreographers and singers.

Lydia Touliatou, Ronja Syvälahti, and Christy Poinsettia Ma choreographed the piece and danced in it. I collaborated more closely with Lydia¹² since she joined the project in its early stages. During our collaborations, we explored different subjects around the topic of *Nexe*, and, because I had already been connecting some theories to musical sections, we delved into them and explored ways in which their presence in the space could interact with the singers and the computer in the generation and modification of the sounds. We also discussed structural and dramaturgical aspects of the piece and how we could benefit from giving space for each other in the composition.

One of the most important aspects was finding the different bodily movements to be mapped and considering whether restrictions were needed to make interaction work.

Elisa Härmä and Juulia Haverinen were part of the vocal experimentation. In our sessions, we aimed to find the right sound effects and more specific sound qualities, as well as consider different ways to give the instructions or to provide the pitch for the singers to stay within the established harmonic framework. Later, during the rehearsals, we came up with alternative ways to approach the performance in the case of computer failure. I collaborated very closely with Juulia, who wrote the lyrics for the piece and helped me with other elements of the composition. This collaboration will be further explained in the different sections of *Nexe*.

During these processes, I decided to create a common board where all the information is together for the performers to see and use. This was intended to facilitate the understanding of the overall piece structure and the elements of each section.

¹² Lydia is a Helsinki-based choreographer and performer. She's occupied with the evolution of a movement vocabulary, emerging from choreographic experimentations on her formal dance training in Bharatanatyam. She's currently working as a research assistant at "Terra-Performing" research project, funded by the Academy of Finland, with principal investigator Dr. Samir Bhowmik.



Figure 11: Table with piece description for organization purposes.

I thoroughly enjoyed working and discussing my artistic ideas through the different collaborative sessions. It helped me test and refine my concepts and allowed me to see my ideas more clearly. It was also valuable to be open to others' ideas, as it influenced my own creative process.

3.1.5 Spatial configuration

One of my main goals for this project was to create an immersive experience for the audience. While they would not directly be engaged in the interactive discourse, I aimed to make them feel connected to the evolving connections within the performance. Sensing the dynamic relationships among performers, technology, and spectators.

Proper spatial arrangement was crucial for achieving this, positioning the audience strategically within the hall. While most multichannel concerts I have been to adopt frontal seating, limiting the view to one side of the room, I wanted to challenge this norm.

While I aimed to maintain the concept of a seated concert experience for the audience, as opposed to more immersive art forms such as immersive theatre performances with

participatory audiences (Machon 2016, 34), I also sought a way for the audience to enjoy the "sweet spot" while challenging the visual aspect of traditional dynamics in seeing performances.

To achieve this, I wanted to place the audience in the center of the room at varying heights, facing different directions, while the singers and dancers surrounded them. This deliberate arrangement made it impossible for the audience to capture every aspect of the performance at once. Yet, with this intentional limitation, I wanted to find a way for the audience to engage with the piece, reflecting the idea that much of what influences us in our lives and development goes unnoticed.

This decision was influenced by discussions with Lydia, who supported the idea of a different spatial arrangement and suggested a rhomboid seating layout, maximizing the use of space, and ensuring a more engaging and immersive experience for the audience.

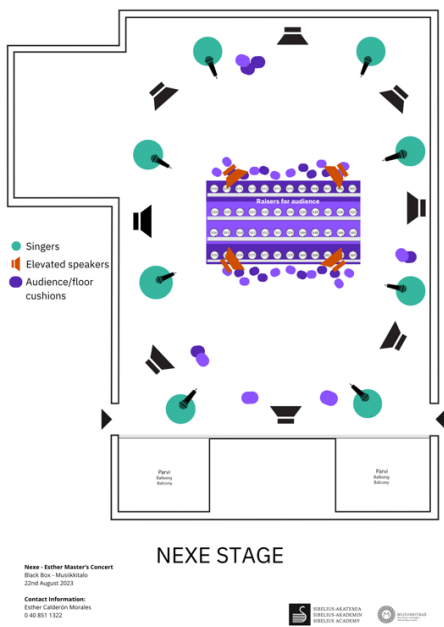


Figure 13: first proposed configuration of stage

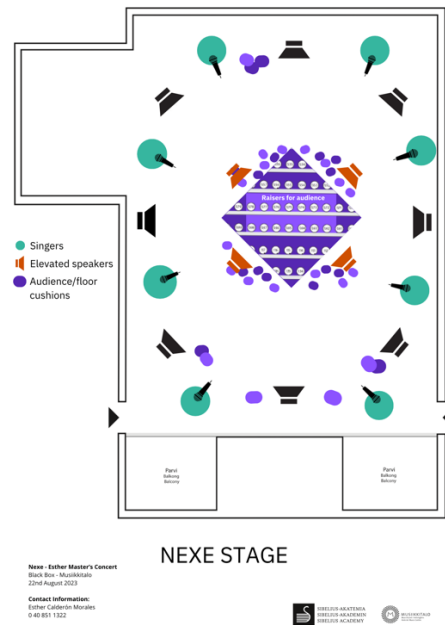


Figure 12: second and final configuration of stage

The concert configuration looked like this:

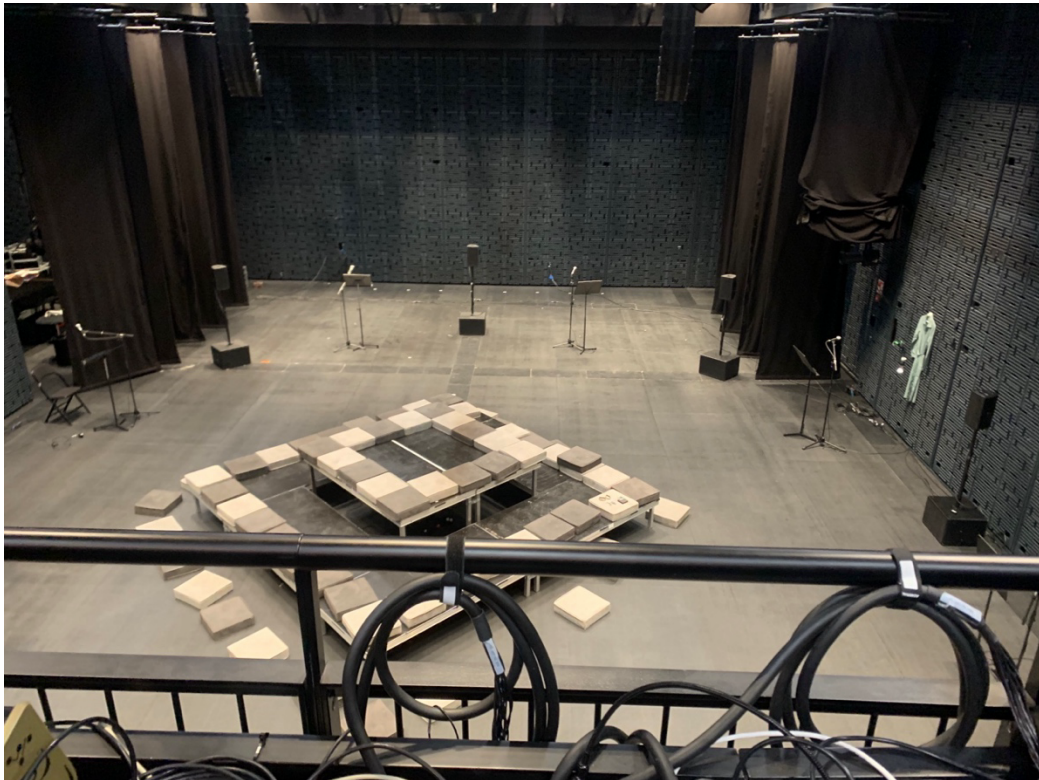


Figure 14: stage configuration in Black Box, Musiikkitalo



Figure 15: Stage configuration with audience and performers.

3.2 Inside Nexe

Inside Nexe is an in-depth explanation of the different sections that shape the piece, and I will do this in the order in which the sections were performed since their composition was not linear. In each sub-section, I will first discuss the theoretical concepts that have inspired the compositional elements and then I will dive into its technical aspects. I will also include some of the choregraphical aspects described by Lydia Touliatou.

3.2.1 The Invisible Thread: real-time interactive composition

When learning about what makes us human and how we become who we are, I came across the dilemma of nature versus nurture. For years, scientists have been debating whether our inherited traits have a more important role in our lives than our surroundings. However, the discussion no longer evolves around the extremes but it focuses on the interplay between genetics and the environment. (Bjorklund and Moore 2003, 307–8) Plomin and Asbury (2005, 86) agree, emphasizing the vital roles both genetics and the environment play in our mental health and cognitive development. However, understanding this relationship remains a complex and elusive task (Lorenzen 2001, 46).

The environment, as described by Pinker (2008, 13), encompasses the perceptual inputs that influence us, and according to Steinberg (2006, 14) can even trigger epigenetic¹³ changes associated with conditions, like psychiatric diseases. Moreover, Moore (Bjorklund and Moore 2003, 311) introduces the idea of a microenvironment, emphasizing the influence of genes, molecules, and cells alongside external factors (macroenvironment) in our development.

¹³ Unlike genetic changes, epigenetic changes are reversible and do not change your DNA sequence, but they can change how your body reads a DNA sequence. (CDC 2022)

After learning about this, I wanted to know more about what surrounded us. What is really our environment? Is it just the people around us? The tree outside our window? The school we studied in? I believe it is, but there was more to it. I came across the "atmospheric turn", which refers to a shift in how we perceive and study our surroundings. Grounded in the idea of "atmosphere", it emphasizes the qualitative and emotional aspects of our sensory experiences within a specific environment. This concept has led to interdisciplinary convergence, exploring the qualities and emotional dimensions of the spaces we inhabit. (Griffero 2019, 414) It also allows us to escape the conventional dualisms of nature and culture (Sobecka 2018, 44).

The holistic interaction between genes and our environment, and the shift of perspective towards the emotional dimensions of our surroundings, were a big source of inspiration in the development of the piece's first movement.

I thought of these connections and how they are not always noticeable to us. How could I create a link, a connection that could evolve into something else? What is the environment in a setup with a vocal ensemble and dancers? What is the thread that joins it all without it being obvious or seen?

A pitch set. Defined. That would be my DNA. The dancers' movement, what happens outside this pitch set, could interact with it, and create something different, something new. A melodic profile. This melody or motive won't skimpily sound, but it will be sung by a singer, with a certain level of freedom and variation. A soundscape will form and will change with the interaction of the different singers.

This is what I thought of. I aimed for this movement to be a collaboration of pre-decided materials, influenced by the movement, sounds, and the space itself, all in continue evolution and change. This relationships between the micro and macro environment and the object and interaction can be seen in Figure 14:

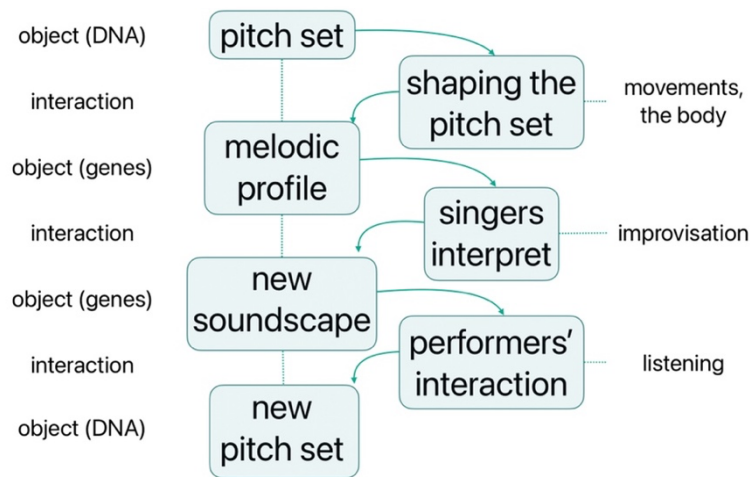


Figure 14: cycle-connections between micro- (object) and macroenvironments
(interaction)

This movement is divided in three different sections, with different sonic qualities present in the singers' scores and the live electronics.

1. In the initial section, a drone is introduced to assist the singers in finding the right pitch and establishing the mood. The intention was for the singers to begin with an allegro tempo, bringing energy and a definite direction to their performance. Within this part, the singers were given rhythmic freedom while repeating each melody, focusing on the use of 'a/ä' sounds.
2. In the second section, the aim was to amplify the energy and bring playfulness by incorporating 'da/ba' sounds, mimicking baby sounds, and creating a lively atmosphere, by singing the melody as fast as possible, and repeating it without a break. After all the singers had entered this section, the live electronics would bring some chaos to the playful atmosphere.
3. The third section is the culmination of the energetic chaos into paused, long notes. The instructions here were to sing each note of the melody for as long as possible until singing the following note.

It was crucial for me to convey to the singers that my instructions were not rigid requirements. If they couldn't play too fast or transition smoothly from one melody to another, I wanted this section to be adaptable. They were given the freedom to take breaks, immerse themselves in the performance, and make their own choices.

The rhythmic aspect of this section didn't matter to me. I welcomed the chaos and the opportunity for the singers to decide for themselves in this part of the performance.

For the whole section, “the choreographic condition was that of “awakening”. Awakening the body through the stimulus of the sound gradually, bringing the performer’s full physicality on stage”.

This section presented the greatest technical challenge for me because I had to employ real-time composition techniques. When I began working on this part, I developed what I called the "Pitch Retrieval Procedure," outlining the workflow for how this section should unfold according to my vision:

1. *Decide pitch*
 - a. *0 to what?*
 - b. *How many pitches are there available for each person?*
2. *List of pitch over time*
 - a. *How do I create a list?*
 - b. *Data comes from 0 to 1*
 - c. *Adjust data to pitch set*
3. *Send the melodic profile to singers*
 - a. *Bach roll – Max score – Drawsocket?*

I began developing the various technical aspects simultaneously. While thinking of the profile and storing data, my first task was to figure out a method to translate contours into melodies. After that, I worked on transferring the sensor data into these contours. Lastly, I had to find a way to send the score to the singers. Since the choir wasn't fully formed, I postponed the decision about the pitch set until later.

3.2.1.1 Data input

After explaining the concept and plan of this section to the choreographers, we tested and discussed different possibilities for acquiring the data. The first test had no sensors, or generation of pitch or sound in any way. We focused on grasping the overall energy

of the section. After this became clearer, I chose to use the “Y” information provided by the compass in the body sensor.

We also discuss how the data could be “recorded”. We thought of using different gestures or positions for activating this, but, in the end, we decided that the dancers wouldn’t make decisions on it, nor would I, following the topic of this section. It would record randomly based on certain parameters and the length of the sections.

3.2.1.2 Real-time interactive composition: from movement to melody

When I first started working on the melodic profile generation, I came across two different options: cage¹⁴ profile generator (cage.profile.gen) and MOZ’s library DRAWnotes.

Cage.profile.gen: it generates a melodic profile starting from a pitch breakpoint function.

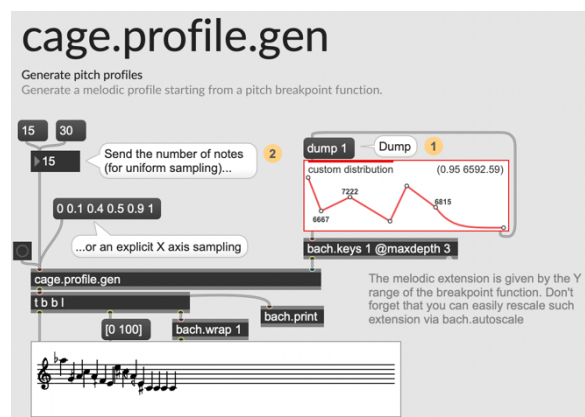


Figure 15: cage.profile.gen object overview

¹⁴ Cage is a modular software library that performs high-level compositional tasks, such as melodic material generation and symbolic frequency modulation, allowing for easy analysis, modification, and customization, while inheriting fundamental principles from its predecessor, Bach.

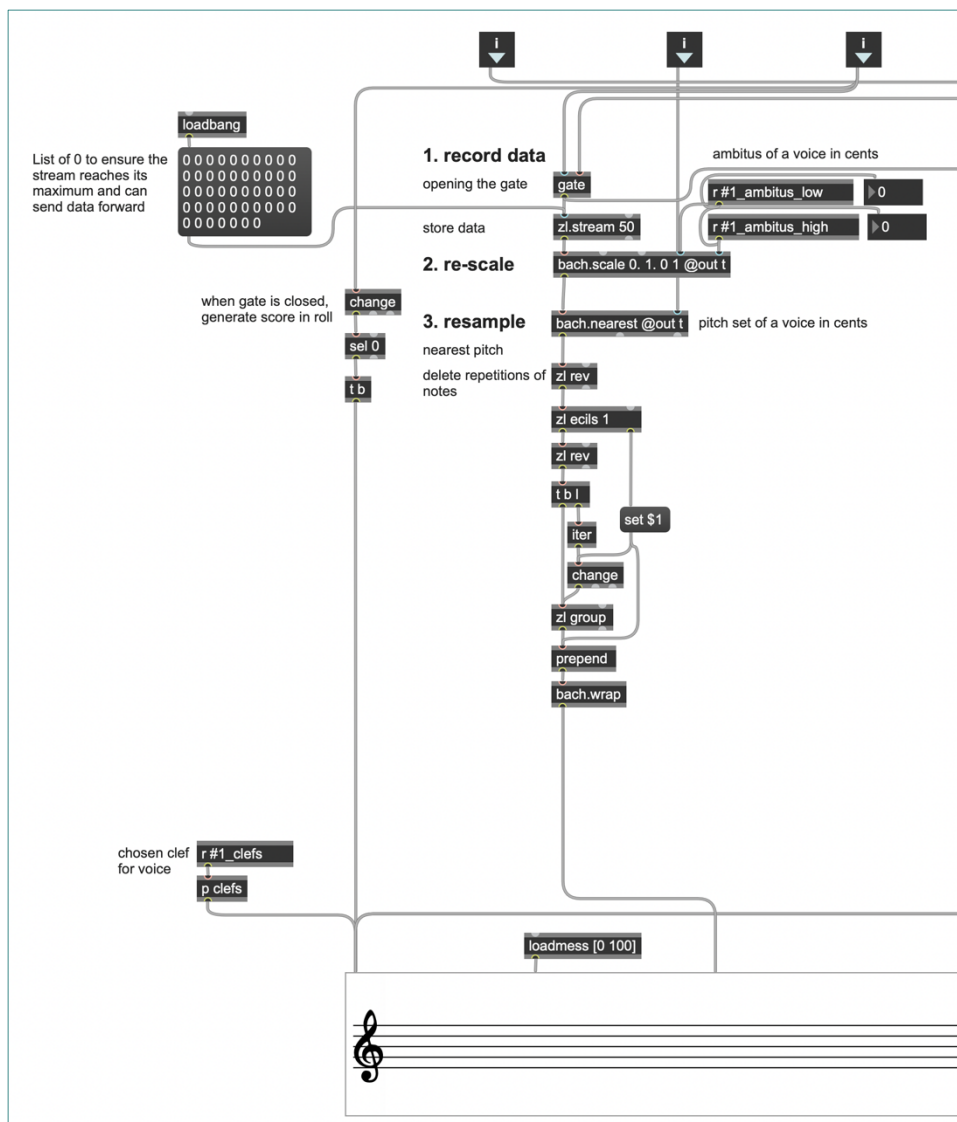


Figure 19: Solution to the creation of melodic profile generation with stream input.

During the experimenting and test sessions, it became clear the importance of having the right number of data stored in the **zl.stream** object while the **gate** was opened. We decided with the choreographers that the gate would be opened for 5 seconds and the stream of stored data (also dependent on the amount of information the sensor itself was sending) was 50.

3.2.1.3 Real-time interactive composition: sending the profile to the singers

Because I had prior experience using Draw-socket for sending other scores, I attempted to stick with it. While I had read about the possibility of using Max-score, the translation

3.2.1.4 Real-time interactive composition: outputting process



Figure 21: performance patcher of melodic profile generator

Since this seemed like a heavy process for the computer, I decided that there would only be one profile being generated and saved at the same time. This way would give enough time to avoid overwhelming the computer, ensuring everything gets done without issues. The selection of the voices receiving the score was randomized and the total duration was adjustable.

The process for generating the score first needed information on the ambitus of each singer and the clef they sing in. Once this was ready and the system was working, each profile generation worked as follows:

1. Specify the part to name the image and introduce the pitch set.
2. Open **gate** to start recording.
3. Close **gate** to stop recording and bang to build the score in the **bach.roll**.
4. Initiate fade of previous image and export **bach.roll** png.
5. Choose image to be sent with Drawsocket.

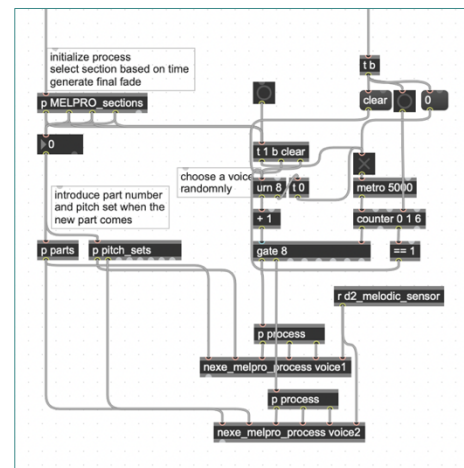


Figure 22: Process patcher for all the voices

3.2.1.5 Defining pitch-set

Once I was sure the technical part of this section was working, I developed a questionnaire for the singers where I could get some information regarding their ambitus and how comfortable they were with sight reading and distances between notes.

Once I had all the answers, I created a score with the possible notes for each singer and instructions.

The image shows a musical score extract for 'The Invisible Thread'. It consists of three systems of staves. The top system is labeled 'chords' and contains two staves (treble and bass clef) with chord symbols. The middle system is labeled 'Singer 1' and contains two staves (treble and bass clef) with a melodic line. The bottom system is labeled 'Singer 2' and contains two staves (treble and bass clef) with a melodic line. Above the score, there are three numbered instructions: 1. 'Allegro. Change rhythm of each repetition. [A/A]', 2. 'Repeat melody as fast as possible. [da/ba]', and 3. 'Sing each note for as long as you can. [a/a/o]'. The score is in a key with one flat (B-flat) and a 4/4 time signature.

Figure 23: extract of score for *The Invisible Thread*

The pitch set was included in a drone that changed with each section to facilitate that the singers could find the right notes.

3.2.1.6 Outcome

The technical development of this section posed several challenges. One issue revolved around the volume of data transmitted to the computer from sensors and the complexities of prioritizing data processing in Max. These processes became particularly burdensome, especially when saving images.

Despite these challenges, I successfully managed to ensure all elements functioned and data transmission worked seamlessly once we were allowed to be in the space. However, on the day of the concert, the score stopped sending the profiles. As an emergency plan, I had previously practiced improvisation with the performers based on their pitch set, and I had prepared a message to send in case no score was being sent. This preparation allowed us to adapt quickly to the situation, ensuring a seamless performance despite the technical hiccup. Nonetheless, I am eager to explore more efficient methods to address these technical complexities.

3.2.2 I, or me: narrative-based duo composition

While discussing the overall topic of the piece with a psychologist friend of mine, I was briefly introduced to the theory of “the orchid and the dandelion”. I was immediately captivated by it, and I started to explore more about it.

According to Dr. W. Thomas Boyce’s research (Boyce 2019), there are two types of children, opposite poles of a spectrum of social and physical sensitivity: the orchid children and the dandelion children. Dandelion children, as the flower, can thrive almost anywhere. They are relatively indifferent to their environment, normally seen as extroverted and outgoing children who are quite comfortable with novel situations and have average health. Orchid children, however, flourish beautifully under conditions of nurture and care but can weaken under stress and neglect. They show exceptional biological sensitivity to their social environment and bear higher risks of illness and developmental disorders. Other studies (Lionetti et al. 2018, 8) suggest a third type of children: the tulips, with a medium sensitivity to their environment.

Boyce (2019) remarks on the importance of the epigenome as a nexus for the external and the biological world and how these variations in children originate from genetic variations and develop differently depending on the environment.

When thinking of different ways of approaching this section, I imagined what it would be if a person had a different genetic composition. If the same person was born in the same environment but was more or less sensitive to the world around, having developed different temperaments (Pinker 2008, 14). Instead of a story where what happens to the protagonist is different through life, the story would be the same, but, the reactions and the way to perceive all these experiences would be different.

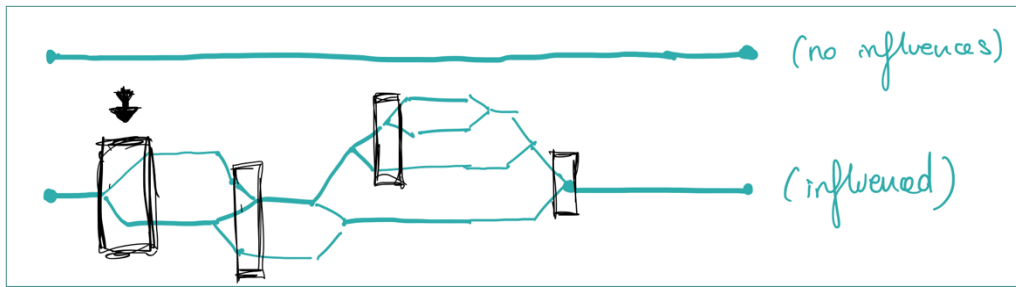


Figure 24: Duo section sketch

As I tried to explain the concept to Juulia Haverinen, the lyricist, with a sketch, I realized its similarities with different game narrative structures. It became clear to me then, that I wanted this piece to be a duo. One voice would follow a linear, non-interactive narrative, suggesting a more neutral reaction to the experiences, while the other voice would confront the possibility of singing various alternatives to the score, in the style of a branching narrative (Starks 2018, 3), singing in parallel with the linear narrative.

3.2.2.1 Structure development

The development of this section in Nexa was furthered by Juulia Haverinen, the lyricist, who approached it as an inner monologue. She aimed to portray the potential for personal growth and change, focusing on the dominant traits in one's temperament or personality. In a live performance, these contrasts could be conveyed to the audience:

- Blue: steady, and stable.
- Green: deeply introverted as a defining quality.
- Pink: spontaneous and optimistic.
- Orange: marked by self-doubt and anxious worry.

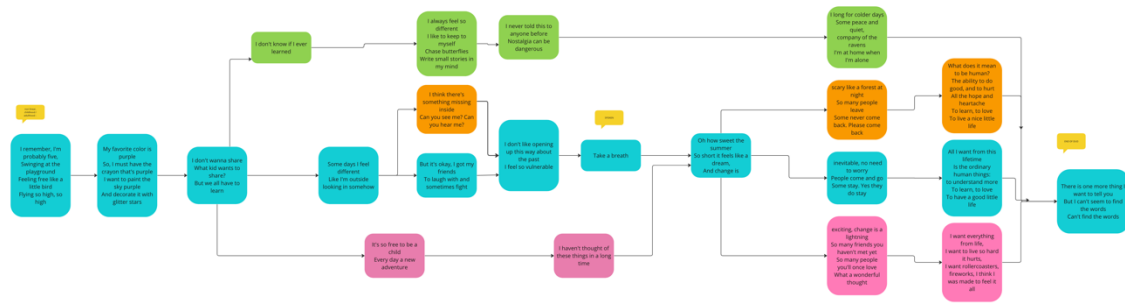


Figure 25: I or me lyrics, branched narrative

In the text's structure, the lines start close together, representing a starting point, and then gradually spread apart. Once a path is activated, it might not be able to go back to the neutral state.

3.2.2.2 Music Composition

I aimed to create melodies that reflected the various emotions and energies present in Juulia's text. I tried to put myself in the shoes of the person and imagine how they would think and sing these thoughts in their mind. I also thought the different voices could relate to different ages, which made the compositional process a bit more exciting.

I began by composing the main voice and the blue line as they both represented the same individual. My goal was to establish a sense of unity and a shared essence, incorporating elements that conveyed a youthful quality. For the pink line, I introduced melodic elements that were more playful and childlike, originating from melodic turns in the blue melody, often straying from the rhythm of the main voice, bringing the idea of a carefree melody. In contrast, the green line was designed to be slower, portraying a self-reflective and occasionally somber mood. It sometimes moved at half the tempo of the main voice to enhance this effect. As for the orange line, I crafted a melody similar to the blue line but incorporated dissonant intervals. This dissonance helped convey an underlying sense of anxiety, suggesting that despite attempting to maintain a neutral tone, traces of unease were present throughout.

By using these melodies, I aimed to make the composition more engaging and relatable by portraying the complex inner world of the person. My aim was for the audience to connect with the character's diverse emotions and experiences.

23 $\text{♩} = 100$

Main $\text{I just don't wan na share. But we_all have to learn.}$

Blue $\text{What kid wants to share? But we_all have to learn.}$

Pink $\text{But we'll have to learn.}$

Green I don't

Figure 26: example of branched section in *I, or me*

3.2.2.3 Choosing the path – reading the score

When deciding how or when the branching in the score was going to be decided, we initially explored two main possibilities with the dancers:

- a) The first one included using the sensors, and the path would be selected based on the differences in movement between two the dancers.
- b) We also thought of using the performance space as a ruler, so that either the singers or I would see the position of a dancer, and the voice would have one or other color depending on this.

However, after advancing more on the development of the overall piece, it was decided that this section would not include movement. We too thought of possibilities that could still use previous movements to the section, like the use of stored data from other sections.

Initially, my intention was for the singers to receive the chosen path during their performance. However, due to the perceived difficulty, the singers preferred to know the path beforehand, preventing timing confusion and eliminating the need for the Drawsocket system. To determine the path, I randomly asked another singer, not part of the duo, about their upbringing, focusing on the topics mentioned in the text.

Surprisingly, all the responses were neutral, leading us to decide that the singers would follow the blue line.

3.2.3 When words are not there

This section explores non-verbal communication, finding its inspiration in body language, its gestures, and its expressivity. I was originally inspired by infants' and caregivers' relationship, and how they are able to communicate through gestures and vocalizations (Van Der Klis, Adriaans, and Kager 2023, 1–2).

Although originally, I wanted to combine dancers' gestures with vocalizations or sounds produced with the mouth, we decided, when working together with the choreographers, that this would be a silent section where we would focus on the gestures and the sound of people in the space.

Following Lydia's description of this section: the dancers came up with a set of 9 gestures, which they then executed in a randomized sequence. As the dancers traversed the stage, the singers joined them in a tail-like formation. Together, dancers and singers replicated these gestures while moving cohesively through space. Some singers introduced their unique gestures into the performance.

Having encircled the stage once, the singers gradually retreated to their original positions. At this point, the singers moved to the following section while the dancers delved deeper into the gestures, experimenting with various levels and qualities, eventually expanding them into full-body movements.

3.2.4 Storytelling: generative system

This section seamlessly blends two distinct ideas. The first involves singers producing vocal sounds devoid of apparent meaning for the audience, while the second entails the singers directly communicating with the audience using sentences loaded with significance. Both segments draw inspiration from different practices, but they

ultimately employ communication and language, exploring their musicality to craft diverse soundscapes.

For *Storytelling*, I wanted to reference a multitude of languages, including Spanish, Finnish, English, Swedish, Hebrew, Chinese, and Greek, which were the native tongues of the singers. This diverse linguistic blend served to enrich the narrative. A shared source of inspiration for both sections lies in acousmatic music compositions that use language as their primary material. These works prioritize the sonic qualities of language over its conventional meaning, engaging in a delicate interplay between semantics and abstract musical characteristics, as evidenced by Lane (2006, 3). It's worth noticing that while these inspirations are vital, the piece aligns more closely with the ethos of acousmatic music than with traditional live performances, with sound movement being a significant influence on the overall composition.

3.2.4.1 *Non-semantic section*

In my exploration of diverse vocalizations that the singers could produce, several ideas shaped the development of this section:

- Origins of language: delving into the origins of human language and its implications, I was intrigued by Diamond's perspective (2006, 55–56), which suggests that our developed anatomical vocal structure is the basis for spoken complex language. Instead of focusing on primitive sounds, my interest leaned more towards its outcome, which is the vast array of vowels and consonants unique to human speech, contrasting with other animals.
- Babies' vocalizations: considering how children initiate communication and form words before fully developing language, I found inspiration in the natural progression of early speech.
- Glossolalia: *“(“speaking in tongues”) is a rhythmic utterance of word-like strings of sounds, regularly occurring in religious mass gatherings or various forms of private religious practices (e.g., prayer and meditation)”*. (Kéri, Kállai, and Csigó 2020, 1–2)

In composing this section, my central concerns revolved around the variety of sounds to be used and the rhythm in which they would be presented.

Initially, I decided to incorporate sounds specific to each language that the singers could speak, preferably using their mother tongue, celebrating the richness of languages and vocal possibilities.

Regarding the rhythm, I initially considered creating a connection or interaction with the dancers, allowing the singers to produce random consonants and vowels in response. However, I abandoned this idea because it didn't align with my sonic vision and the essence I wanted to convey.

I aimed for the sounds to be delivered with a natural rhythm resembling speech, providing the singers with the freedom to infuse their expressions with communicative intentionality.

Considering how this could be accomplished, I decided to use speech as the structure. The singers would have a formed sentence in mind, that would be delivered only by using the consonants, vowels, or syllables present in that sentence. Lane (2006, 5) refers to this as the *"dissolution of semantic meaning through deconstruction"*, one of the several compositional techniques used in spoken word works, that splits words into smaller units. The semantics are part of the process of creating the sentence, but they disappear, leaving only the musical aspect of the speech.

An example of this would be:

Winter	is	my	favorite	time	of	the	year
/w/ /n/ /t/ /r/	/z/ /m/	/f/ /v/ /r/ /t/	/t/ /m/	/v/	/ð/	/j/ /r/	
/ɪ/ /ə/	/ɪ/ /aɪ/	/eɪ/ /ə/ /ɪ/	/aɪ/	/ə/	/ə/	/ɪə/	

I became very interested in what happens to the singers while they produce sounds this way, moving from semantics to non-semantics, but keeping the structure. I started investigating this with the help of Professor Jim Hyun Kim, who introduced us to a non-

verbal micro-phenomenological approach to interview technique that helps deepen the experience to be able to evoke it later. While I won't delve into it at this moment, it's an area I'm keen on exploring further.

Although I made a choice not to directly link the generation of sounds with the movements of the dancers, I still wanted to create a meaningful connection between the gestures of the dancers and the sounds being produced. To achieve this, I opted to use the accelerometers attached to the three dancers. These accelerometers determined the level of granulation applied to the sound effects. This decision added an element of variability and enhanced the connectivity between the dancers' movements and the auditory experience. By allowing the accelerometers to influence the texture and intensity of the sounds, I aimed to create a more immersive and dynamic performance, where the physical gestures of the dancers directly shaped the auditory landscape.

3.2.4.2 *Semantic section*

This section is a further exploration of language and communication. I aimed to encapsulate the importance of language and its ability to shape our understanding of the world and influence our interactions.

From an evolutive point of view, Diamond (2006, 55–56) considers that, although human evolution was ongoing, it was the ability to speak that revolutionized our existence. Language represents a unique human talent, functioning as a “*combinatorial algorithm allowing an infinite number of new thoughts to be expressed*” (Pinker 2008, 6).

My inspiration stemmed from Trevor Wishart's *Encounters in the Republic of Heavens* (Wishart 2020, 11), and his emphasis on the importance of using complete spoken phrases. This approach makes both the subject being discussed and the speaker instantly identifiable.

In this acousmatic piece, (Wishart 2020, 9) meant to create a "poetic snapshot of the diversity of human life" by capturing the "diversity of human expression and the sense

of an entire community of speakers". Utilizing an 8-channel sound-surround setup, he aimed to immerse the audience within this English-speaking community, recording voices, and their "natural" speech patterns, from a cross-section of ages and genders, thereby encapsulating the vast range of human experiences and expressions.

The exploration of the diversity of human expression was what interested me the most, however, my aim wasn't necessarily to ensure complete understanding from the audience, especially considering the diverse languages being used. Instead, I wanted the singers to feel a connection, as if they could be understood if someone in the audience spoke their language. The underlying intention to communicate effectively remained a central focus for me. Starting from the non-amplified voices of the singers, my purpose was to create a voicescape¹⁶ of different stories, a dynamic space where the phrases in various languages would eventually blend and fill the space. The dancer's interaction would make the sounds travel in the sphere around the audience.

The voicescape, as defined by Smith and Dean (2003, 113), is a complex, multidimensional realm where voices are projected into space. Within this space, multiple voices coexist, some manipulated digitally, blending identities, and altering natural characteristics, establishing a connection between voice and place.

Describing one of their works (*The Erotics of Gossip*), Smith and Dean (2003, 121) write:

"At the moments where the greatest density of phrase overlap occurs, an impression is created of a speaking crowd, rather than a group of

¹⁶ "Voicescapes" is a term constructed by Smith and Dean (2003, 113) to suit their theoretical purposes about Technodramas. Sound technodrama is a hybrid, cross-genre and technological area of performance and radio art. It has links with theatre and performance art, but emphasizes the voice rather than the body, through the creation of voicescapes which involve both live performance and digital modification of the voice. Sound technodramas are therefore simultaneously dramatic, poetic, narrative and discursive, sonic, and technological. They may also use visual multimedia components

speaking individuals: this is another way in which the voicescape decenters voices”

I intended to transition from the emphasis on language and voice to a new musical phase. This phase was designed to introduce the cacophony of sounds that followed.

3.2.4.3 Providing the structure

To ensure that both sections would use speech-like structures and would feel natural for the singers to do in their native languages, I decided on a structure based on answering to questions. I created a generative system that sent singers a variety of questions at different times. These questions would have different durations: 30 seconds for elaborated responses, and 5 seconds for one-word answer.

The questions were carefully crafted to evoke generally neutral or positive thoughts, making it easier for the singers to respond. To ensure the comfort and at easy participating in the performance, I asked in the questionnaire about their boundaries, and offered to suggest or compose alternative answers. This wasn't necessary after all; however, I wrote some suggestions for the answers.

The questions to be answer during the performances were:

Long questions:

- What is your favourite season? Why?
- What do you like to do to relax after a long day?
- What is a thing that you love doing, but nobody knows about?
- What are you are grateful for. Why?
- What is something you've always wanted to try but haven't had the chance to do yet?
- What is the most cherished possession you own? Why is it special?
- Who is your closest person? Why?
- What is a moment when you felt genuinely proud of yourself?
- What is your first memory?
- What's your favourite childhood memory?
- What's your favourite time of day?

Short questions

- What's your zodiac sign?
- What's your favourite sport?
- What's your favourite ice cream flavour?
- What's your favourite hobby?
- What's your favourite animal?
- What's your favourite mode of transportation?
- What's your favourite place to relax?
- What's your favourite social media platform?
- What's your favourite painter?

When sent, the questions looked like this:



Figure 27: example of Storytelling sent questions

3.2.5 All of ... – Acousmatic, generative

I envisioned this section as an organic expansion of the preceding one, aiming to reflect not only the diversity within human language and culture but also embracing the richness of the world surrounding us. To capture this, and with the help of Juulia Haverinen, we gather an array of sounds of music from global cultures, animal calls, environmental sounds, human activities, machines, etc.

Originally, my concept involved creating an acousmatic composition where everything would have been meticulously orchestrated. However, after listening to the diverse samples, I recognize that our lives and our world are not always harmonious or predictable, it can be a cacophony.

I chose not to impose my compositional ideas upon the sounds. Instead, I decided to create a system that would decide this for me. I had previously used generative systems in other compositions and sections of the piece, but I developed those with questions of timing, clashing, and harmonies in mind. This time, my intention was to bring a system that could relate to the topic of life, adaptation, and evolution.

After learning about different genetic algorithms used in music compositions and game-related adaptations (Eldridge and Bown 2018, 14), I chose to use the “Game of life” as a creative tool.

3.2.5.1 Generative system – Game of Life

The Game of Life is a cellular automaton (French 2013, 1–3) whose evolution is determined by its initial state. The life algorithm was developed by John Conway, and it is based on the following rules:

- A cell is either alive or dead.
- If a live cell has two or three live neighbors, it remains alive. Otherwise, it dies.
- If a dead cell has exactly three live neighbors it becomes alive again. otherwise, it stays dead.

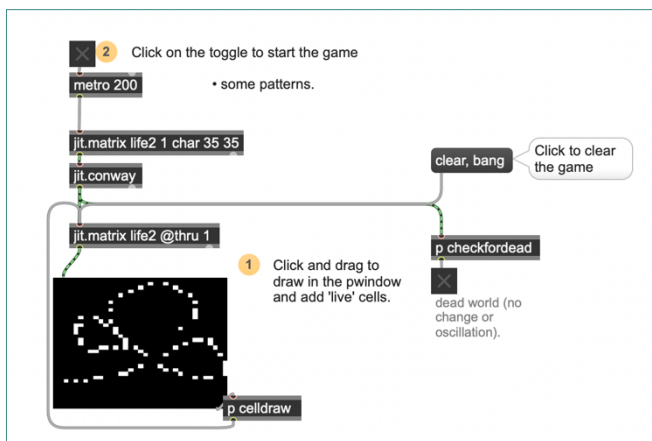


Figure 28: example of jit.conway structure

After looking for different tools, I found the jitter ¹⁷ object: **jit.conway**. This object can either choose from an image or use the mouse to draw in the window and add the “live” cells. I decided to draw myself to test different patterns and thinking forward into the possibility to desing an interactive installation with the same system.

One of the first challenges was to work out a way to divide the matrix to obtain information about the different “populations” of sounds. Because of the jit.matrix configuration, I was only able to read the data regarding “alive” cells horizontally.

¹⁷ Jitter is an open-ended toolkit for patching video and graphics in Max.

These decisions were based on the nature of the sound files, the interplay between the different “populations”, and the desire to keep the sounds distinctive within the overall complexity. The aim was to envelop the audience, making them feel part of the cacophony of the world around us.



Video 5: Game of life in action

3.2.6 Take a breath

This section, although rooted in a simple concept, carries deep significance as a source of compositional inspiration. Despite its obvious and simple nature, the act of breathing unites all of us humans, and it is an essential element of our existence.

I used breathing as a way to explore the self-organization theory. According to Eldridge and Bown (2018, 13):

Self-organization refers to the process whereby an observed complex macro-level structure emerges from a series of local interactions between relatively simple agents.

Post-war experimental composers and pioneers of free improvisation have previously delved into self-organizing processes, that allow for new ways in which ensembles can interact. For instance, Cornelius Cardew’s text score, Paragraph V of The Great Learning, instructs singers to begin on a random note, and, with each breath, select a note sung by their neighbors. Despite the initial randomness, a unified harmony emerges. (Eldridge and Bown 2018, 14–15)

As a yoga practitioner, I am aware of the benefits of mindful breathing, creating a mind-body connection. It’s intriguing how, during yoga classes, movements synchronize with

the breath, leading most participants to breathe together eventually. Initially, I resisted this experience, as it made me uncomfortable. Now it is one of my most cherished experiences in my week.

This experience led me to think that the singers might naturally resist synchronizing their breaths. Furthermore, producing audible breath sounds can be challenging and less relaxing for some individuals. During the experiments with the singers, it became evident that specific instructions were necessary. They needed to know when to let go and start attuning to each other's breathing, for which I sent the instructions via the network platform. It was also essential to emphasize that they could take breaks during this section to prevent exhaustion.

The involvement of live electronics was minimal, focusing primarily on the interactivity between each singer and their breathing. Each voice was paired with an envelope follower, guiding the voice toward the center (where the audience was positioned) during inhalation and back towards the singer during exhalation. This setup aimed to convey the notion that the audience forms a collective organism, gradually synchronizing their breathing, and operating as a unified entity.

From the choreography perspective: "dancers were still, lying or sitting on the floor making minor movements as adjustments from the breathing. They were free to follow the tempo of the singers' breathing as well as their own. Each dancer held their own spot in space."

3.2.7 Your form

For the final section of Nexa, I opted for a more conventional format, akin to a traditionally composed choir piece. I wanted to create a contrast between the structured, predetermined nature of the composition, and the underlying message that it seeks to convey: self-determination.

Juulia and I worked together again in this section. When shaping the essence of the musical content, I envisioned a hymn. She started to work based on this, exploring the

concepts of freedom, choice, and interconnectedness, drawing parallels between human identity and the fluidity of water. She emphasizes the idea that our forms and roles are not fixed but can be flexible and interconnected, akin to the varied scales and patterns found in nature. Additionally, the text underscores the importance of hope, proactive action, and the refusal to accept things as they are, suggesting a call for positive change and growth.

As I contemplated the musical content for this section, I couldn't stop thinking about the harmonies and melodies that I had written in a previous piece some years ago, based on a poem by Octavio Paz. *Otoño* is a poem about the search for meaning and connection, interlaced with themes of introspection and spiritual questioning. I thought I could reutilize some of its content as part of *Nexe*, since it had never been performed before.

To my surprise, and although I knew the topics were related to some extent, Juulia's text fit Paz's structure almost perfectly.

<p>Look out there Look at those constellations of freckles On your face</p> <p>?</p> <p>1. Reach out to me, I crave for connection 2. 3. 4. 5.</p> <p>You have the same fine fibers and organelles ? , ?</p> <p>Right there inside your cells</p> <p>Humans are 60% water And water has many forms Hence, it's your choice; choose a form</p> <p>I still feel hope, sometimes Looking into the dewy morning Looking at my mother's face I still feel hope, sometimes</p>	<p>En llamas, en otoños incendiadas, arde a veces mi corazón, puro y solo.</p> <p>El viento lo despierta, toca su centro y lo suspende en luz que sonríe para nadie:</p> <p>¡cuánta belleza suelta!</p> <p>Busco unas manos, una presencia, un cuerpo, lo que rompe los muros y hace nacer las formas embriagadas, un roce, un son, un giro, un ala apenas, celestes frutos de luz desnuda.</p> <p>Busco dentro mí,</p> <p>huesos, violines intocados, vértebras delicadas y sombrías, labios que sueñan labios, manos que sueñan pájaros...</p> <p>Y algo que no se sabe y dice "nunca" cae del cielo, de ti, mi Dios y mi adversario.</p>
--	---

Figure 31: similarities between Juulia's text (left) and Paz's poem (right).

After seeing this, I decided to experiment with my previous piece, using Juulia's text. It felt like an organic adjustment, so I decided to use *Otoño's* structure and musical content for *Your form*, and I asked Juulia to write some additional sentences.

The final text was as follows:

Look at those constellations of freckles
On your face

I can feel your breath
the ghost in the machine
what a miracle and so mundane

Reach out to me,
I long for connection
Some proof of existence,
a presence, a body

Look at me like into the mirror
You have the same fine fibers and organelles
Right there inside your cells

Humans are 60% water
And water has many forms
Hence, it's your choice; choose a form

I still feel hope, sometimes
Looking into the dewy morning
Looking at my mother's face
I still feel hope, sometimes

The composition is made for 8 distinct voices, and I deliberately chose not to incorporate live electronics to emphasize human presence, and to have another section in which technology wouldn't take part.

This also influenced other decisions. For instance, while I had contemplated using various technological methods to help the singers follow the score and sing together, we ultimately chose to have a human conducting the piece. I was glad two of the singers agreed to sing while conducting, seeing each other to give the cues simultaneously. We thought of using two singers so that every one of the singers could see them.

The dancers moved as a trio creating different compositional constellations with their bodies around the space. Once the formation was mutually decided, it was followed by a long pause, until one of the performers suggested its resolution and the initiation for configuring a new constellation in the space.

Musically, *Your Form* is structured in three main sections. In the first one, the voices flow organically with each other, with solo parts that add some individuality at the end of the verses. When composing the second section, I wanted to convey the themes of search and longing into a call, aiming for the rhythms to resemble the sound of a bell. Following this, the voices cascade one after the other, uniting in unison with the last word. This call is repeated three times. After this, the third section starts, with a more homorhythmic texture, that, for a moment breaks away from this uniformity with a free temporal part. The piece ends after a solo element that incorporates melodic characteristics of *I, or me* from *Nexe*.

4 Conclusions

This concluding chapter is an attempt to summarize and reflect on the central topics in the theses. My exploration investigates the nature of humans and our connection with each other and the world around us. While many theoretical frameworks from fields such as human development, sociology, and philosophy have influenced and shaped certain aspects of music composition, the process of translating these theories into music goes beyond sonic ideas. The use of different structures and tools was crucial for this. Technology played a key role, incorporating an array of immersive and interactive tools and modes for human interaction.

Working on and towards *Nexe* from a technological perspective has opened a universe of possibilities for crafting different soundscapes and using alternative approaches to composition. Coming from a more instrumental background, the music technological tools and skills have enriched my compositional vocabulary, allowing me to explore new dimensions in my artistic expression.

I won't know for sure to what level the use of technology and interactivity has intervened in crafting an immersive experience since this would need a more extensive study. However, my goal was to use technology as my stepping stone, leading me to create a complete artistic creation, which I believe I have achieved.

The use and exploration of voice from the case studies until the realization of *Nexe* taught me valuable lessons about the beauty and versatility of human expression through voice. This is a medium I am eager to continue exploring.

After performing *Nexe* and writing about it, I can see how things could have been different in the use of technology, the tools, the chosen vocal sounds, the durations of the sections or the overall piece, and many more. The different paths and approaches that I explored to bring this piece to life represent one among multiple possibilities. Different tools or methods may have been used, but the essence of it would have remained.

Now, while finishing these conclusions, I experienced a moment of introspection. I envisioned my younger self, perhaps at the age of 4 or 6, as part of *Nexe*'s audience. This reflection made me realize the trajectory of my growth as a composer. As a composer, I continuously strive for improvement, often overlooking the significant progress made with each new composition. Looking back from the case studies to the present, I feel a sense of accomplishment that I might not have recognized without writing this thesis.

This parallel within *Nexe* mirrors our own lives – we are the product of our past experiences, our actions, thoughts, and the lessons we have learned, as well as our aspirations for the future. These are some of the insights I have gained through the process of writing *Nexe*. As for my aspirations for the future, they are diverse and continually evolving. They are certain to involve further exploration of the voice, live electronics, collaborations with dancers, interactive and generative systems, and much more.

As I conclude this thesis, I find myself continuously drawn back to Juulia's lyrics for Nexe's last section:

*Humans are 60% water
And water has many forms
Hence, it's your choice; choose a form.*

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Annex

NEXE MATERIALS¹⁸:

https://drive.google.com/drive/folders/1T8VXfwRjL1_u5xbby3Bf0KaTQ5Dr35V8



Access the QR or click on the link. You can find different materials and folders including:

- Case studies – Portfolio Videos
- Nexe score (pdf)
- The Invisible Thread:
 - Melodic Profile Generation – Max Patch: it explains the process of generating the profile. It can be used as an object.

Melodic_Profile_Generation INSERTNAME

- Invisible Thread Chords for each section:
 - LOW and HI to be played together
 - Db
 - Bb
- Story Telling:
 - A series of images with both long and short questions
- All Of:
 - All Of – 12 Channels (wav)
 - All Of – binaural mix (wav)
 - Game of Life Player:
 - Game of life player – Max Patch
 - File player
 - Sounds for testing the player
- Take a breath:
 - Breathing image
 - Breathing together image
- Your Form:
 - Your Form first chord

¹⁸ If the links or QR code don't work, please contact me at esthercalderonmorales@gmail.com

I. The Invisible Thread

1 Allegro. Change rhythm of each repetition.

2 Repeat melody as fast as possible.

3 Sing each note for as long as you can.

The musical score is arranged in a system with ten staves. The top staff is for the Piano, and the remaining nine staves are for voices, labeled 'voice 1' through 'voice 8' on the left. The Piano part consists of two staves (treble and bass clef) with chords and some melodic lines. The voice parts are arranged in pairs: voices 1 and 2, 3 and 4, 5 and 6, and 7 and 8. Each voice part has a treble clef staff with a vocal line and a bass clef staff with a chordal accompaniment. The score is divided into three measures by double bar lines. The first measure is marked with a '1' and the instruction 'Allegro. Change rhythm of each repetition.' The second measure is marked with a '2' and the instruction 'Repeat melody as fast as possible.' The third measure is marked with a '3' and the instruction 'Sing each note for as long as you can.' The key signature has two flats (B-flat and E-flat), and the time signature is 4/4.

II. I or me

♩ = 85

Main *mf*
I re mem - ber

Blue *mf*
I - am pro ba bly pro ba bly five.

8
Main
Swing - ging Swing - ging Swing - ging swing - ing at the play ground.

Blue
Swing - ing swing - ing swing - ing at the play ground.

11
Main
Feel ing Feel ing Feel ing free like a bird fly - ing so - -

Blue
Feel - ing, feel - ing feel - ing free like a bird fly - ing

14
Main
high. Juvenile feeling *mp*
My fa vourite co lor is pur ple so

Blue
so - high. *mp*
My fa vourite co lor is pur ple so

18

Main I must have the cra yon that's pur ple and I want to paintthe sky pur ple and

Blue I must have the cra yon that's pur ple and I want to paintthe sky pur ple and

21 *cresc.*

Main de - cor - rate it with gli tter stars.

Blue de - cor - rate it with gli tter stars.

23 *mp*

Main I just don't wan na share. But we_all have to learn.

Green *mf* I don't

Blue *mp* What kid wants to share? But we_all have to learn.

Pink But we'll have to learn.

30

Main
Some days I feel right. Some days I feel dif fe rent, like I'm on the out side

Green
know I don't know_if I'll ne

Blue
Some days I feel right. Some days I feel dif fe rent, like I'm on the out side

Pink
Child like
f
It's so free to be a child!

33

Main
look ing in some how. But it's O K I've

Green
ver learn. I al way feel so

Orange
I think__ there's

Blue
look ing in some how. But it's O K I've

Pink
E - very day, every day a new ad ven ture. It's so free to be a child!

36 ♩ = 100

Main
got my friends to laugh with and some times fight.

Green
dif ferent. I like to keep to my self.

Orange
some - thing mis-sin in - side me can you see me? hear me?

Blue
got my friends to laugh with and some times fight.

Pink

38

Main
I don't like o pe ning up a bout the past. I feel so vul nera ble.

Green
Chase but - ter flies, write_s mall sto ries in my mind

Blue
I don't like o pe ning up a bout the past. I feel so vul nera ble.

Pink
I ha ven't thought of these things in a long time

42

Main
Take a breath(Breathe) Oh how sweet the summer

Green
Take a breath(Breathe)

Blue
Take a breath(Breathe) So short it feels

Pink
Take a breath(Breathe)

50

Main
In e vi ta ble

Green
I long for cold er days

Orange
s-ca - ry like a

Blue
like a dream, and change is... In e vi ta ble

Pink
ex ci ting. Change is a light ning so

54

Main

no need to wo rry

Green

com pa ny of the ra vens

Orange

fo - rest at night so ma - ny peo - ple leave

Blue

no need to

Pink

ma ny friends you ha ven't met some people you'll once love. What a won der ful

56

Main

Peo ple come and go and some rea lly stay. Yes they do stay.

Green

Orange

ne-ver ne - ver some ne-ver-come back please come back

Blue

noneed no need wo rry cause yes they do they do stay

Pink

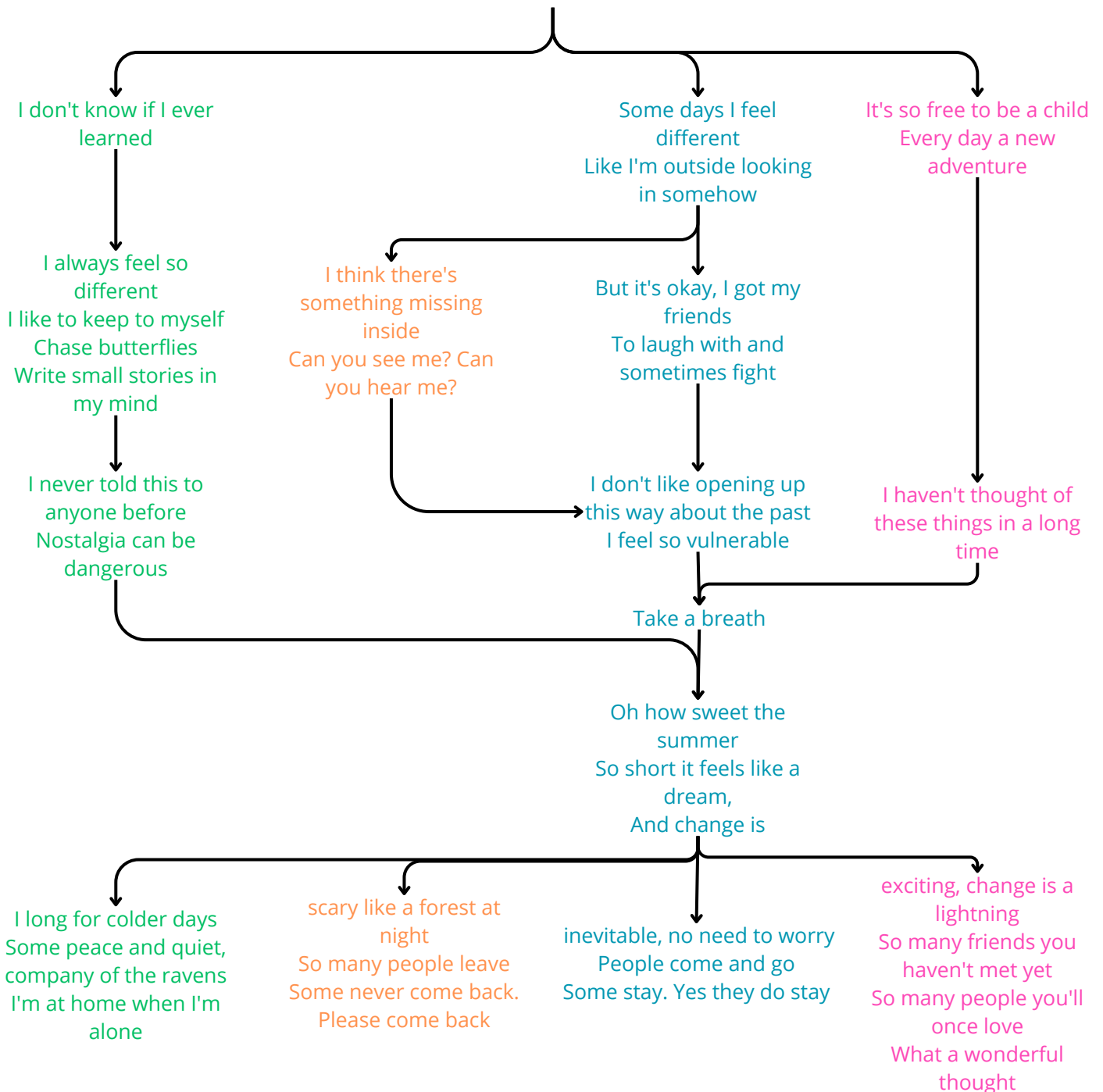
thought

I, or me

I remember, I'm probably five,
Swinging at the playground
Feeling free like a little bird
Flying so high, so high

My favorite color is purple
So, I must have the crayon that's purple
I want to paint the sky purple
And decorate it with glitter stars

I don't wanna share
What kid wants to share?
But we all have to learn



III. When words are not there

Choose a few simple gestures (1 to 5) based on a movement you do on daily basis. Or be creative and find something you would not normally do. Move in the space while doing them.

IV. Storytelling

Storytelling has two sections that answer to the following questions in different ways. The long questions are answered for 30 seconds, and the short ones can only be answer with a word or two. It is preferable that each singer answers in their mother tongue or in a language that they feel comfortable and can add variability to the section:

Long questions:

- What is your favourite season? Why?
- What do you like to do to relax after a long day?
- What is a thing that you love doing, but nobody knows about?
- What are you are grateful for. Why?
- What is something you've always wanted to try but haven't had the chance to do yet?
- What is the most cherished possession you own? Why is it special?
- Who is your closest person? Why?
- What is a moment when you felt genuinely proud of yourself?
- What is your first memory?
- What's your favourite childhood memory?
- What's your favourite time of day?

Short questions

- What's your zodiac sign?
- What's your favourite sport?
- What's your favourite ice cream flavour?
- What's your favourite hobby?
- What's your favourite animal?
- What's your favourite mode of transportation?
- What's your favourite place to relax?
- What's your favourite social media platform?
- What's your favourite painter?

The first section (6 min) has three parts. After reading the questions, one by one, each singer has to answer to them first using only consonants (answer around 5 long questions), only vowels (4) and then syllables (2). An example of this is:

Winter	is	my	favorite	time	of	the	year
/w/ /n/ /t/ /r/	/z/ /m/	/f/ /v/ /r/ /t/	/t/ /m/	/v/	/ð/	/j/ /r/	
/ɪ/ /ə/	/ɪ/ /aɪ/	/eɪ/ /ə/ /ɪ/	/aɪ/	/ə/	/ə/	/ɪə/	

Regarding the live electronics, a granular delay can be slowly introduced. I choose to link it to the acceleration data of the dancers, following their movements. Once all the singers have answered to their questions, there should be silence.

The second section (3 min) is where all the singers start to answer to the questions using full language. Other performers no amplified are also welcomed to participate in this. The idea for this section would be to create a sea of voices. If possible, each voice could move in space differently. I decided to link the dancer's compass data to their movement.

After this, allow the granular delay to start creating a chaos that merges with the following section.

V. All of...

You can find the binaural mix and 12 channels mix on the materials. It should be played during the crescendo of the previous section, and both the ending of Storytelling and All of.. should blend.

VI. Take a breath

For 6 minutes, the singers should breathe first at their own pace, and then, finding the common breath together. It should be a slow process.

Ideally, the use of an envelope follower connected to each singer's signal, should guide the movement of their voice towards the center when inhaling, and towards them when exhaling.

VII. Your form

♩ = 90

1

S. Look at those cons - - te - lla - - tions,
 Look at those cons - te - - lla - tions,
 Look at, look at those cons - te - lla - tions those
 Look at those cons - - te - lla - - tions,
 Look at those cons - te - lla - tions,
 Look at, look at cons - - te - lla - - tions,
 Look at, look, those cons - te - lla - tions,___

A. *p*
cresc.

T. *p*
cresc.

B. *p*
cresc.

5

cons - - te - lla - tions of freck - - les on your face.
 cons - te - lla - tions of freck - les. [ə]
 cons - te - lla - tions of freck - les. *poco f* *pp* [ə]
 cons - te - lla - tions of freck - les. *poco f* *pp* [ə]
 cons - te - lla - tions of freck - les. [ə]
 cons - te - lla - tions of freck - les. *poco f* *pp* [ə]

10

mp I can feel your breath
mp I can feel your breath your breath
 I can feel your breath I can feel your breath
 I can feel your breath I can feel your breath
 I can feel your breath

27

p Reach out to me Reach out to me to me *p* Reach out

Reach out *p* to me Reach out

33

to me Reach out to me reach out to me. *mp*
 Reach out to me. *mp*
 Reach out to me. *mp*

to me Reach out to me *p* Reach out to me. *mp*

38

mp | long | long | long | long for | long

mp | long | long | long | long for | long

mp | long | long for | long

mp | long for | long

43

I long I long for con - nec -

47

tion I long con - nec - tion. Long con - nec - tion. con - nec - tion. Con - nec - tion. Con - nec - tion.

51

mf

mf Some proof some proof of some proof of Some proof some proof Some proof Some proof

55 e - xis - tence, ex - - - ist - ence
of a bo - dy, ex - - - ist - ence
pre - sence, bo - dy, ex - ist - ence.
pre - sence, bo - dy, ex - - - ist - ence.
bo - dy, pre - sence, ex - - - ist - ence.
of a ex - - - ist - ence.
mf
Ex - ist - ence.

59 Look at me like in - to the mi - rror you have the same fine fi - bers
Look at me like in - to the mi - rror you have the same fine fi - bers
Look at me like in - to the mi - rror you have the same fine fi - bers
Look at me like in - to the mi - rror you have the same fine fi - bers

62 and or - ga - nelles, *pp* pre - sence, bo - dy. Look right there in - side your cells.
and or - ga - nelles, *pp* pre - sence, bo - dy. Look right there in - side your cells.
and or - ga - nelles, *pp* pre - sence, bo - dy. Look right there in - side your cells.
and or - ga - nelles, *p* pre - sence, bo - dy. Look right there in - side your cells.

67 *p* *cresc.* 15 - 20"

a pre - sence a

p *cresc.*

a bo - dy a

p *cresc.*

Reach out to me, look at me

p *cresc.*

To me

p *cresc.*

Ex - ist - ence.

p *cresc.*

Reach out to me, I long. Reach

p *cresc.*

I long

70 *mf*

Hu - mans are six - ty per - cernt wa - ter and

mf

Hu - mans are six - ty per - cernt wa - ter and

mf

Hu - mans are six - ty per - cernt wa - ter and

mf

Hu - mans are six - ty per - cernt wa - ter and

73 *p* *mf*

wa - ter has ma - ny forms. It's your choice, so chose a form

wa - ter has ma - ny forms. It's your choice, so chose a form

wa - ter has ma - ny forms. It's your choice, so chose a form

wa - ter has ma - ny forms. It's your choice, so chose a form

Soprano solo

76 *mp*

I still feel _____ hope, some - times. Look - ing _____ in _____

81

to the de - wy mor - ning. Look - ing at my mo - ther's face, _____ I still feel _____ hope some -

86 *pp* *mp* *dim al niente*

times a pre - sence a

mp *dim al niente*

a bo - dy a

mp *dim al niente*

reach-out to me _____ look at me

mp *dim al niente*

to me

mp *dim al niente*

ex - ist - ence

mp *dim al niente*

Reach out to me, I long.

pp *mp* *dim al niente*

I long

Your Form

Look at those constellations of freckles
On your face

I can feel your breath
the ghost in the machine
what a miracle and so mundane

Reach out to me,
I long for connection
Some proof of existence,
a presence, a body

Look at me like into the mirror
You have the same fine fibers and organelles
Right there inside your cells

Humans are 60% water
And water has many forms
Hence, it's your choice; choose a form

I still feel hope, sometimes
Looking into the dewy morning
Looking at my mother's face
I still feel hope, sometimes