

# Soundscape and Inner Resonance: An Analysis of Psychosomatic Perceptions within a Musical/Sensory Laboratory at School

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## Abstract

The relationship between music and moods, within a suitably structured acoustic landscape, is important for the conscious perception of specific emotions and sensations. Music/sensory workshops using Acusmonium can be held in schools, where participants and artists can let their inner experiences flow, creating a bodily resonance, including through movement in space. The research's musical performance was created through original works created with SOMA Laboratory organismic synthesizers and followed a narrative structure that guides listening like a sound story. The targeted use of frequencies and rhythms physically engages the body, synchronizing with the heartbeat and generating different emotional states. Each piece explores a specific psychosomatic reaction—movement, anger, fear, joy, and sadness—through specific acoustic parameters. Acousmatic music thus becomes a means of corporeal and symbolic communication, capable of evoking profound and universal sensations. Sounds act on the body and are in turn influenced by it, creating a resonant dialogue between perception, emotion, and the acoustic landscape. The statistical analysis, which also focused on the different experiences of men and women, was appropriately supported by the use of scales and questionnaires for the self-assessment of psychosomatic changes, administered on a test-retest basis. The results obtained through this approach, particularly innovative in the context of musical experimentation in schools, suggest a wider diffusion of this emotional journey methodology based on embodiment. Indeed, in addition to the development of introspective abilities and emotional perceptions in adolescents, in line with the most recent neuroscience studies, positive improvements in nonverbal communication and peer relationships emerge.

## Keywords

Acusmonium, Acousmatic Music, Adolescents, Embodiment, Synth,

## 1. Introduction

“At the moment a god manifests the will to bring himself or another god to life, to cause heaven and earth to appear, or to create humankind, he produces a sound. He exhales, sighs, speaks, sings, cries, screams, coughs, spits, sobs, thunders, or plays a musical instrument. In other cases, he makes use of a material object that symbolizes the creative voice. The source from which the world emanates is always an acoustic source” (Schneider, 1992: p. 13).

This ancestral image of the sound that gives life recalls the idea that human existence originates in a *profound, primitive resonance with the world*, to which one would generally wish to return.

According to the phenomenological view of the German philosopher E. Husserl, access to an *experiential mode* that precedes any classification or analysis of a rational and conscious nature is possible only through the *phenomenological epochè* or *suspension of judgment*, which *places in brackets* everything that is already known in order to gain access to a *pre-categorical dimension*.

Only through this freely chosen act is it possible to draw near to and belong to the *World-of-Life*, in German *Lebenswelt*, thereby arriving at a profound confrontation with the darkness and mystery of the *origins that precede consciousness*: in this way, the psyche “expands and gives life to the world around it, endowing it with meaning” (Caci, 2012: p. 190).

For E. Straus, a German-American psychiatrist and phenomenologist, subjective knowledge of the world always occurs through an *aesthetic experience* (Straus, 1935, 2010), divided into two alternating moments: first, *sensation*, which predisposes the body to seek meaning in relation to an event; subsequently, *perception*, which is connected to psychic processes and, through language, tends to offer an interpretation. *Aesthesiology* is the discipline that studies the functions of the senses, understood as specific spiritual characteristics that are suited to provide a differentiated representation of the environment: “The eye gives us the structure of the world, the skeleton of things; with the ear, instead, we listen to its beat, its pulse”. Sounds lack contours and boundaries, and for this reason, each interpenetrates the others, sometimes merging harmonically and consonantly, sometimes expressing itself dissonantly. Since sound “is born and dies,” it represents the natural narrative medium of human experience, understood as a *functional* unity between subject and environment, within which no genuine separation exists, as mutual influence occurs. Previously, the Russian psychiatrist E. Minkowski had regarded the environment as a *complex of inner and outer experiences, without distinction*, capable of determining a particular *flow of life*. “And this environment, once again, is neither a set of external stimuli, nor of atoms, nor of forces or energies; it is a moving wave that envelops us on all sides and constitutes the

medium without which we could not live” (Minkowski, 1998: p. 93).

Contrasting with this phenomenological perspective is the *thymic space*, laden with emotional meaning, *proposed by the Swiss psychiatrist L. Binswanger, who also reflects on the function termed estrospection* (Binswanger, 2022), understood as the capacity to *project* subjective experiences onto the surrounding world. This is an extremely interesting idea that anticipates, by a considerable margin, the neuroscientific conception of the *extended mind*. The *thymic space*, in this sense, becomes a place characterized by an *affective tone* that the Subject confers according to their personal state of mind. In this way, a *specific coloring* is attributed to the surrounding environment, which can in turn influence one’s personal way of *seeing* and *feeling* objects. Many individuals may *overuse, overestimate, or amplify* temporal horizons when they experience a *thymic space*, whose sonority in turn brings about a continuous transformation of moods, thoughts, and the very perception of time. This distinctive phenomenon is termed *chronodesis*.

For T. Fuchs, *consciousness is even embodied in the acting body* (*enactive consciousness*), and is not considered confined to the brain, although the latter is regarded as indispensable for the emergence of consciousness. Experiences, sedimented in bodily memory, progressively guide human action in the world, according to a circular and interactive structure (Fuchs, 2021).

Acousmatic music, by virtue of its distinctive structure, offers a syncretic perspective on the concepts discussed above, primarily by bringing the human mind closer to its origins, to the original substrate of acoustic perceptions and of Life. Moreover, listening fosters a *somatic experiential modality* because it acts on sensations and inner perceptions, producing an expansion and an alteration not only at the level of space, but also of time. It stimulates a tendency to dwell on the present moment, on the *here and now*, due to the lack of musical links with long-term memory and the difficulty of projecting oneself into the future time of the sonorities, which are highly unpredictable.

Moreover, the continuous changes in register create a soundscape so rich in *emotion-generating stimuli* that it fosters a particular sensitivity to sound that is not evident in other acoustic experiences, even when these are lived with great intensity. Through technical strategies, the composer can accompany the listener and guide him through a range of sensations and emotions that alternate and succeed one another along a specific trajectory, which is difficult to reproduce with traditional instruments. The internal reverberation of the sonorities, together with the sharing of the experience with the musician and with the group, contributes to the perception of mind-body unity because it facilitates the mentalization of somatic experiences, which are so important for the development of self-reflective capacity and the Self, according to P. Fonagy’s view (Fonagy et al., 1998).

The primary aim of our research is precisely the experimental investigation of intersubjective experiences, co-generated in one or more present moments and structured according to a musical program created by the Composer. According to the cognitive psychologist D. Stern (Stern, 2015), every mind is constituted *solely* through the ongoing interaction of *self-organized brain processes with the environ-*

*ment and with other minds*. Emotions, therefore, are generated primarily through an act of shared participation, enabled by a common evocative experience.

In this direction, research on emotional intelligence, as examined by D. Goleman (Goleman, 2006), identifies five components that a musical laboratory with acousmatic elements could help adolescents develop: self-awareness (the ability to achieve outcomes through the recognition of emotions), self-regulation, motivation, empathy (the ability to perceive the Other through a *flow of contact*), and social skills (interaction and understanding of intersubjective dynamics).

## 2. Embodiment Ed Emotions

Within recent neuroscience research, it is necessary to consider the importance of the psychosomatic perspective of the Portuguese neurophysiologist A. Damasio (Damasio, 1994, 2000, 2010). According to this new conception, *the mind is represented and experienced within the body (embodiment)*, as it constitutes the meeting point between the biological and experiential aspects of an organism, which are continually modified by sensorimotor activity and by stimuli originating from the environment. According to the renowned researcher, all mental processes, conscious and unconscious, as well as emotions and language, are *embodied* and, therefore, *linked to somatic physiological activity*.

Emotions are regarded as adaptive responses associated with biologically determined processes, dependent on brain structures shaped over the course of evolution and automatically activated, which regulate and represent bodily states.

The change produced by the activation of specific subcortical circuits constitutes the substrate from which the *feelings of emotions* originate, that is, the perceptions of a change in the subjective emotional experiences of which one is conscious and which appear as *images* (maps), *spontaneous representations of bodily state*. As soon as an emotion develops, a real-time change occurs in bodily maps, generated within brainstem regions and the insula. Knowing the *feelings of emotions* is therefore indispensable in order to become *a mind-oriented organism geared toward survival*, through the application of specific corrective behavioral maneuvers in the event of danger.

There are two types of emotion: *primary*, corresponding to *the five emotions universal basic emotions* identified by P. Ekman (Ekman & Friesen, 2007) (joy, fear, sadness, disgust, and anger), with the variants: (sadness) melancholy and dissatisfaction, (fear) panic and shyness; *secondary* or social emotions, such as embarrassment, jealousy, guilt, and pride, which are more elaborated, also depending on the culture of belonging.

Some emotions are specifically *individual* and linked to past experiences: they elicit automatic emotional reactions in response to certain stimuli (*somatic markers*).

When a new emotion arises, neurons in the hypothalamus, basal forebrain, and brainstem release chemicals such as serotonin, norepinephrine, and dopamine that affect other, higher brain regions, temporarily altering the functional mode

of many neural circuits.

In any case, each emotion is characterized by specific *schemas and subjective experiences* and activates particular brain regions: for example, sadness stimulates the ventromedial prefrontal cortex, the hypothalamus and the brain stem; fear and anger activate only the brainstem. Therefore, the *mode* of the subjective emotional reaction does not change over the course of life, even though the *reasons* that may elicit particular responses differ.

Moreover, there are *background emotions* that constitute the *overall self-perception of the body* dependent on posture, facial expression, the speed of eye movements, and bodily movements, from which we derive a general sense of well-being or ill-being. For example, when intense joy is perceived, one no longer feels the background emotion, but experiences the *feeling of a new emotion*.

Typically, the *inducers of background emotions are internal—reasoning processes or thoughts* that may promote the representation of the internal state; however, in many cases, they are linked to specific environmental stimuli. One may experience, such *emotions of background*, tension or relaxation, fatigue or energy, anticipation, or fear. Background emotions are signaled primarily by the viscera and by the *internal milieu* (the internal state of a particular organism). The latter helps the organism maintain homeostasis by modulating its functioning in response to events in the external world.

“The internal *milieu* sends signals to the brain: not through the nerves, but by relying on chemical substances that make their way directly into certain parts of the brain predisposed to receive their messages” (Damasio, 2000: p. 125).

Sensations also contribute to the *perception of the internal milieu*.

In the body, there are three sensory-detection systems: interoception, proprioception, exteroception.

*Interoception* records the *body's internal state*. This includes sensations of hunger, thirst, drowsiness, alertness, body temperature, tension, pain, or restlessness. Sensory neurons carry information from muscles, organs, and connective tissue to the brain. By contrast, *proprioception* refers to the *body's position in space* in relation to gravity. This awareness enables balance and is activated by neurons that send sensory information from the body's joints and the inner ear to the brain. Finally, *exteroception* refers to the *sensory experience of the external environment*, facilitated by sensory neurons that, from the body's periphery, transmit sensations to the brain through the five senses.

Perceptions of an organism's internal state, at the origins of existence, *during the first months of life*, constitute the *primordial feelings*, understood as a rudimentary sketch of the capacity to *feel as a function of the body* and to recognize oneself as an *entity separate from the external world*. This primitive Self, spontaneously generated, can be identified as the *Proto-self*, a first elementary form of consciousness, accompanied by a progressive sense of *bodily individuality relative to the environment*. For the emergence of the Self, necessary neural-organization devices such as the superior colliculus and associative thalamic nuclei are re-

quired; these interact with the regions that generate the *Proto-self*, namely the brainstem, the insular cortex, and the somatosensory cortices.

Subsequently, the refined maps will give rise to the mind and to the *core Self*, *endowed with perceptual intentionality*, which makes possible *awareness of feeling emotions* and the *relationship of the subject with a storable object*, without yet having access to verbal language. *Feelings (feelings)* are formed thanks to *core consciousness*, that is, thanks to the *capacity to feel emotions*. However, consciousness remains something transient that manifests only when the subject has an experience, in the *here and now*.

Only progressively does the extended consciousness or *the autobiographical Self* emerge, which corresponds to the *most developed and integrated level of human consciousness* because it enables the ability to preserve and maintain memories of the emotions and sensations arising from specific experiences and to integrate them among others, thanks to the *memory process*.

Thus, the *Self*, continually evolving, represents the outcome of conscious mental activities of varying complexity and is able to continue its vital development, *thanks to constant interaction with the environment*.

### 3. Music, Brain and Emotions

Body, mind and sound are inseparable: indeed a sequence of sounds, cannot be translated into pure sensory data because it always points back to something else, something deeper, capable of intervening, thanks to hearing, at the level of *embodiment*.

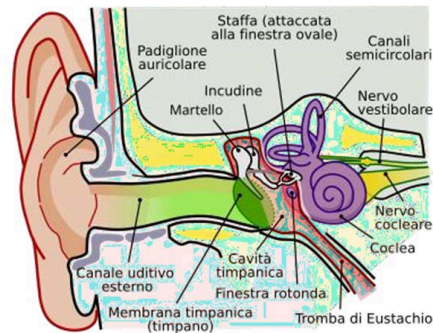
The perception of music is thus organized: the sounds, originating from the external environment, pass from the ear, to the eardrum, to the cochlea, and to the brainstem, the first stage of the sound within the brain. In this area, the vibrations are decoded by duration, intensity and frequency (**Figure 1**). Above the brainstem is located the *superior colliculus*, which, through its seven cellular layers, connects, via the structures of the periaqueductal gray matter and the cerebral cortex, *vision, hearing and movement*, providing the body with *spatial orientation* and *initial emotional recognition of external signals* (Tamietto & de Gelder, 2010). The auditory information then passes to the thalamus, connected to the amygdala, which assembles it, grasps its rhythm and, finally, sends it to the cerebral cortex (temporal lobe) for the final attribution of meaning.

It is also necessary to consider the *spatial position relative to the sound*, the *conditions of the auditory system*, and, above all, *the form that the brain assigns to the acoustic stimulus and that is integrated with musical experience*, all variables capable of interacting with the sound and modifying it (**Figure 2**).

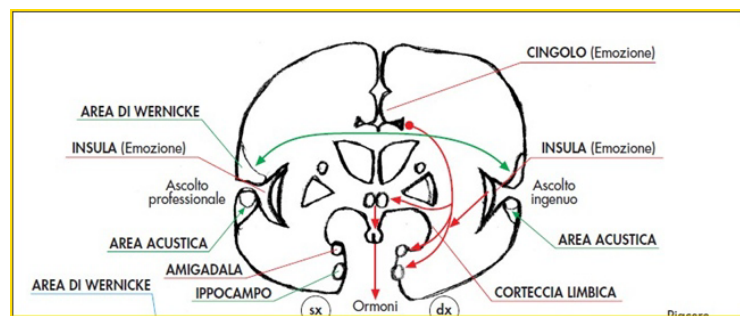
Moreover, music listening can influence the activity of the *endocrine, cardiovascular, respiratory and gastrointestinal systems*.

Through this complex psychosomatic process, music is able to evoke *emotions* and *feelings of emotions* in many people: for some listeners with musical expertise, *engagement is linked to appreciation of musical structure and composition*,

whereas for others emotional responsiveness is often elicited by associations with memory and recollection (Scherer, 2004). *Emotions not immediately connected to the type of sound*, but rather to the *structure of the piece* can be defined as *aesthetic emotions*, although *physiological responses triggered by particular timbres and rhythms are always present*.



**Figure 1.** Anatomical table of the auditory system, in which are visible (Timpano) eardrum, (Coclea) cochlea and (Tronco Cerebrale) brainstem.



**Figure 2.** Anatomical table of brain areas linked to hearing. Two (insule) islands and two (aree acustiche) acoustic areas, located in cerebral hemispheres, are visible.

According to Gritten and King (2006), music has the capacity to evoke emotions that are indispensable for the maintenance of an organism's homeostasis because they activate innate physiological processes *both at the level of the cerebral cortex (the insula and cingulate cortex, in particular for sadness, fear, and joy)* (Brattico et al., 2011; Koelsch et al., 2013; Sloboda, O'Neill, & Ivaldi, 2001) *and at the level of the limbic and paralimbic system* (Brattico, Bogert, & Jacobsen, 2013; Koelsch, 2010; Zatorre & Salimpoor, 2013).

Other studies have focused on the regions of the primary and secondary auditory cortex (Patterson, Uppenkamp, Johnsrude, & Griffiths, 2002; Peretz & Zatorre, 2005; Tramo, Shah, & Braid, 2002) and the inferior frontal regions (Brattico, Tervaniemi, Näätänen, & Peretz, 2006; Koelsch, 2009; Tillmann, Janata, & Bharucha, 2003).

Any unexpected change in acoustic features, pitch (frequencies), timbre, loudness, or timing can trigger an arousal response and intensify an emotional reaction. Physiological arousal, such as chills or changes in heart rate and skin con-

ductance, often coincides with sudden changes in acoustic features, especially when unexpected (Sloboda, 1991).

With regard to *listening to sounds perceived as pleasant*, an experiment conducted by Blood and Zatorre (2001) showed, using Brain imaging (PET), an increase in blood flow, in specific brain regions accompanying the perception of chills, associated with increased respiration and heart rate, characteristic of the *hyperarousal condition*, with excitation resulting from activation of the sympathetic nervous system. Indeed, chill intensity was correlated, in rCBF, with increased activity in the ventral striatum, orbitofrontal cortex, insular and anterior cingulate cortex, and with decreased activity in the amygdala, hippocampus, and ventromedial prefrontal cortex. The musical passages during which these psychosomatic reactions occurred depended on *individual personality characteristics* (Blood & Zatorre, 2001).

Another study conducted by V.N. Salimpoor (Salimpoor et al., 2009), using the same experimental methodology, also reported a *increase in skin conductance* and a *decrease in body temperature* during moments when chills were perceived most intensely, accompanied by increased *dopamine* production in the nucleus accumbens, as the so-called *reward circuit was activated during listening*. The most surprising finding emerged when dopamine release was detected in the right caudate nucleus even *during the anticipation of listening to music, as an anticipation of expected pleasure*.

During adolescence, *physiological dopamine deficiency* may lead to a compulsive pursuit of exciting conditions, often dangerous, capable of stimulating the reward circuit (Stern, 2015). Music could therefore represent a viable alternative to extreme experiences.

With regard to *inharmonic sounds*, A. Gritten and E. King (Gritten & King, 2006) focused on the processing of dissonance, particularly in the parahippocampal gyrus and the amygdala, based on fMRI (Gritten & King, 2006). According to the authors, the right amygdala may therefore be associated with *emotions of fear and sadness in relation to unpleasant memories evoked by music*. In these cases, alternating physiological responses may occur, characterized by fear (*hyperarousal*) or by emotional numbing and sadness (*hypoarousal*), as a result of the alternating activation of the sympathetic and parasympathetic nervous systems.

Other studies have focused more on the phenomena of synchronization of music with brain rhythms (Entrainment) (Large, 2008; Nozaradan et al., 2011), sometimes so intense as to cause trance phenomena in music (Jovanov, 2011), in that listening would be able to *influence brain waves through rhythm and frequencies* (Becker-Blease, 2004). Indeed, the organization of the central nervous system is determined by bioelectrical processes that allow information to travel along neural circuits. Fluctuations in electricity produced by sounds give rise to electrical activity patterns, brain waves *or brainrhythms*, detectable with anelectroencephalogram (EEG) and summarized in the table below (Figure 3).

Frequencies	Designation	Wavedominantpresentin:
30–42 Hz	WaveGamma	Activitymentalhigh,perception,problem solving,tension
14–30Hz	WaveBeta	Activitymentalalert,concentration,cognition
8–13.9 Hz	WaveAlpha	Relaxationwakeful,phaseofdrowsinesspre-sleeporpre-wakefulness
4,7,5 Hz	WaveTheta	Dreaming,REM sleep,states1and2 sleepNREM,deep meditation
<4Hz	WaveDelta	Sleepdeep NREM

**Figure 3.** Cerebral frequencies recorded with electroencephalogram, associated with the different types of brain waves.

The unit of measurement for brain oscillations is the *Hertz* (Hz), that is, the frequency of a periodic phenomenon equivalent to 1 cycle per second, whereas amplitude is measured in microvolts (mV). When music is listened to, it produces effects on brain frequencies because each musical note corresponds to specific frequencies. The generated sounds are converted by the inner ear into vibrations that are subsequently processed in brain regions (**Figure 4**).



**Figure 4.** Frequencies of the musical notes corresponding to the natural scale.

### Music Acousmatic, Resonance Inner and Psychosomatic Reactions

*Tonal music* has always been associated with a specific *emotional code*, linked to the frequencies of the sounds that make up a piece through multiple musical dimensions: not only *ascents and descents*, but also *melody, harmony, rhythm, and timbre* can elicit emotions in both the composer and the listener. Nevertheless, well-structured music is always related to the continuous changes in the acoustic frequencies present in the composition (Cook, 2011). The emotions evoked by a tonal musical piece activate *the same universal patterns*: outward movements and visceral alterations that change the functioning of the heart, lungs, intestine, skin, and endocrine system. Moreover, the same piece may produce different impressions depending on the performer, even if the reactions may differ only in their level of intensity.

The Austrian musician A. Schoenberg revolutionized the classical tonal system through the new language of *atonal music* or *emancipated dissonance*, equivalent

to V. Kandinskij's renunciation of representational art, with the explicit aim of offering pure color a deeper contact with the soul in order to *enter into emotional resonance*. The renowned Russian painter, in *Concerning the Spiritual in Art* (Kandinskij, 2005), explicitly refers to the similarity between pictorial freedom and atonal music: "Only the Viennese composer Arnold Schoenberg, recognized enthusiastically only by a few, is today proceeding by completely renouncing what is commonly considered beautiful, and calling blessed all the means that can serve *self-expression*. [...] Schoenberg's music leads us into a new region where *musical experiences are not of an acoustic order, but purely psychic*. Here begins the *music of the future*." (Kandinskij, 2005: p. 64)

The creation by the Austrian composer of an original score, in which dissonance is treated in the same way as consonance, has prompted subsequent investigations in music psychology to determine whether the emotional reactions elicited can still be subsumed within the classic *patterns* long studied. In particular, such research became indispensable following the revolutionary innovation introduced by acousmatic music.

It is a musical genre characterized by the use of recorded sounds, processed and organized for playback through electroacoustic diffusion. This genre emerged with the development of sound recording and manipulation technologies and is closely linked to electronic music and electroacoustic composition.

The term *acousmatic* derives from the Greek plural "akousmatikoi", referring to Pythagoras' disciples, who listened to the master behind a veil without seeing him, focusing exclusively on the sound of his voice. Similarly, in acousmatic music the listener does not perceive the sound source but becomes immersed in a purely auditory dimension. This approach was theorized and developed by composers such as P. Schaeffer (Schaeffer, 1966), the father of *Musique Concrète*, who emphasized the importance of "sound in itself", separated from its physical source and original context. The defining characteristics of acousmatic music can be traced back to three fundamental elements:

- 1) *Concrete sounds*: the creation of acousmatic music involves the use of compositional material consisting of real sounds (environmental recordings, objects, acoustic instruments, etc.), electronically transformed and processed;
- 2) *absence of a traditional score*: composition takes place directly on an electronic medium (tape, DAW, live electronics, etc.), without a score in the traditional sense, with the possibility of using a reference notation, such as spectral analysis and electronic scores that employ customized, ad hoc symbols;
- 3) *Sound spatialization*: diffusion often takes place in appropriately treated environments, such as an acousmonium or a loudspeaker orchestra, which can provide an immersive experience for the listener.

Murray Schafer (1985) is the Canadian musicologist who, beginning in the 1960s, founded the *World Soundscape Project* (WSP) with the aim of promoting innovative sound research and identifying solutions for a balanced soundscape in which the relationship between humanity and the environment can be harmonious.

In musical composition, elements such as keynote sounds (*keynote sounds*), sound signals (*sound signals*) and soundmarks (*soundmarks*) are introduced. Keynote sounds are derived, for example, from nature: wind, water, forests, birds, insects, and animals. *Signals* are produced by sounds such as alarm devices, bells, whistles, horns, and sirens. *Soundmarks* are characteristic of a geographical area.

The listening process also differs from the traditional one: the innate tendency of auditory perception requires reference points, anchors on which to construct a melodic and harmonic framework that does not generate harshness and ambiguity; because acousmatic music seeks abstraction from the sound source, given that sounds have no clear association with their origin, the listener focuses exclusively on their timbral, dynamic, and spatial qualities. This abstraction makes it possible to evoke emotions more directly and less mediated by cultural or cognitive contexts, with a limited *attribution of meaning*. Moreover, emotional responses may be influenced by the space-time modification produced, with a tendency to refer primarily to the *here and now*.

Indeed, diffusion engages the listener at a physical level through spatialization techniques that can vary from a simple opening on the stereophonic plane, progressing through more complex systems, such as quadraphony, octophony, surround sound, and ambisonics. In this way, an intense sensory connection is established, designed to produce a spatial perception of sound (near, far, moving) capable of evoking feelings of calm, tension, wonder, or fear.

Another strength of acousmatic composition is its focus on timbre and on the frequency spectrum used in the works: *low frequencies* can physically stimulate the body, evoking sensations of weight or stability, whereas *high frequencies and bright sounds* can elicit states of alertness or lightness; *complex timbres and harmonic sounds* can generate aesthetic pleasure and inward reflection.

Under these conditions, visual attention is focused exclusively on the Performer's gestures, the group, and the surrounding environment, which is generally rather minimal. Consequently, this musical practice may promote greater concentration on listening and on the individual and intersubjective psychosomatic domain.

As the French physician A. Tomatis suggests, "A person immersed in an acoustic bath can adopt two attitudes: either they show no involvement, or, conversely, they become maximally engaged, consciously adhering to the universe of sounds, to the point of *entering into resonance*." (Tomatis, 2003: pp. 179-180).

The *psychoacoustics* regarded as the science that investigates the brain's mechanisms for processing sound. Knowledge of these mechanisms is essential in acousmatic composition because it enables the Composer to achieve highly evocative sonic effects that can foster empathic engagement on the part of the listener: hearing is not limited to receiving sound, because auditory cells in the ear can enter a *deep interactive resonance* with external stimuli perceived during performance.

Such *phenomenological experience* enables to perceive intensely the stimulus, through a psychosomatic reaction, and to achieve sonic integration within *em-*

*bodiment*. According to the musicologist A. Mazzoni (Mazzoni, 2021), the acoustic stimuli of contemporary music are capable of eliciting *embodied mental cognition*.

Indeed, listening to acousmatic music cannot rely on *reassuring* memories of other previously heard compositions, as occurs in tonal music; for this reason, the ear can only grasp the *essence of sounds* free from semantic structures, *in relation to the representation of what occurs in the body*.

P. Schaeffer coined the term *reduced listening*, associated with a *sound object*, with the aim of abstracting sound from its original context in order to incorporate it into a composition, selecting it for morphology, mass, dynamics, and micro-structure. The Composer thus introduced a new form of solfège, “understood as an art for training oneself to listen better.”

In *Traitè des objets musicaux* del 1966 four types of listening are described:

1) Listening means paying attention to something or someone, identifying the sound as a clue to a source or an event (Concrete/Objective).

2) Hearing is the passive perception of a sound that one neither wishes to listen to nor to understand. One is affected by sounds without paying particular attention (Concrete/Subjective).

3) Hearing entails highlighting an intention to listen by selecting what is of greatest interest, in order to determine a qualification of what is heard (Abstract/Subjective).

4) To understand is to attribute meaning, as if sound were a sign, as a function of a language or a code (Abstract/Objectual).

This mode of sonic engagement is accompanied by the *intersubjectivity* that is experienced during a concert, regardless of musical genre: listeners remain connected to what is happening in the surrounding environment, to the musician, and to the other people present.

Building on these scientifically grounded concepts, we can argue that acousmatic music provides an ideal platform for creating pieces capable of eliciting profound psychosomatic responses through pure sound and the creative manipulation of sonic spaces. This approach makes it possible to engage emotional dimensions that are often inaccessible with traditional instruments, owing to the opportunity to work directly on sensory perception and the listener’s psychology.

A careful and refined combination of natural and synthetic sounds makes it possible to create emotionally evocative soundscapes, offering listeners an implicit, suggested narrative that stimulates individual imagination. Accordingly, each listener can construct a story based on their own sensibility; during the workshop, each participant indeed created and recounted such a story, as indicated by the analysis of the collected data.

#### **4. The Inner Resonance Elicited by Listening to the Pieces Composed for the Acousmatic Music Workshop**

The compositional framework underlying the creation of Gabriele Barlera’s pieces

was based primarily on the search for distinctive timbres. For this reason, the SOMA Laboratory instrument line was employed—specifically Lyra-8, Cosmos, Enner, Ether, and ROAT—which offers high timbral quality and enables the exploration of a new concept of sound. Two self-built noise boxes were also added for sound processing, featuring metal strings bowed with an arch, following an approach that combines elements of traditional acoustics with possibilities for electronic manipulation, thereby enabling the exploration of unique timbres and particularly rich sonic textures. Finally, a digital audio workstation running Steinberg Cubase Pro was integrated into the live electronics chain, suitable for managing pre-programmed sequences and for the complete recording of the performance. Sound manipulation focused on slowing down and retuning sounds to make them mysterious and surreal, as well as on dynamic changes, with sudden shifts from loud to soft or vice versa to evoke surprise or anxiety. To this end, continually different and shifting positions within the listening space were identified in order to affect listeners' sense of safety or vulnerability.

The narrative approach of the compositions is intended to guide listening through specific moments—such as an introduction, climax, development, and conclusion—ultimately creating a fully fledged sonic story. The precise use of frequencies generates bodily vibrations and highly diverse reflexes that physically engage the listener; rhythmic impulses are indispensable elements of the compositions and tend to synchronize with the listener's heartbeat, depending on the type of stimulation, to promote a range of behaviors that express the individual's personal emotional state.

Specifically, in line with the experiment's initial design, the compositional intent sought to elicit various emotional responses—such as excitement, joy, anger/rage, panic, anxiety, fear, sadness, and calm/harmony—through the use of particular frequencies, textures, rhythmic sequences, and masses sound balanced. Also the evolution of the spectrum sound and of the dynamics interactive has been carefully designed to support the development of a guided psychoacoustic pathway for subjects participants in the laboratory. The use of *organic* analog *synthesizers from* SOMA Laboratory to construct *emotional pathways* is an innovative and compelling approach, as these instruments are characterized by their ability to generate dynamic, “animated” sounds, often shaped by external inputs and environmental interactions. This makes it possible to explore not only timbre but also the spontaneous and natural evolution of sound, creating genuine emotional narratives. The new generation of analog synthesizers consists of instruments designed to behave in a “biological” manner: they employ sounds that emerge from complex dynamic processes, often unpredictable, which require the musician's presence and bodily contact. Their main features include chaotic circuits capable of producing variable sonic behaviors rich in texture, high interactivity—responding to touch, sensors, or environmental conditions—and a natural aesthetic, as the sound evolves as a living organism would. Creating works with this type of synthesis means creating emotional pathways, constructing sonic journeys that

elicit emotions, as discussed in several studies by the composer Peter Scherer. The musician used a Moog synthesizer to systematically vary the configurations of acoustic cues, asking listeners to assign to the sounds the corresponding evoked emotional states.

The six pieces specifically composed by Gabriele Barlera for the laboratory project exhibit sonic characteristics corresponding to specific configurations of acoustic parameters, designed to elicit multiple psychosomatic responses, such as:

- *movement*, comprising factors that predict rapid sequences, high registers, extensive use of harmonics in textures, sound gestures with sharply defined contours and wide variation in tonal fields, with a predominance of dynamic and bright parameters that tend to convey energy and intense stimulation;
- *anger*, achieved through the use of large spectral jumps, textures with modulated contours that are predominantly ascending and strident, broad variations in frequency range characterized by intense sounds, marked timbral energy, and dynamism conveyed through high pitches;
- *fear*, elicited through signals rapid and piercing acoustic, with sounds designed to convey tension and unease, including through high speeds and rising contours;
- *joy*, associated with lively and open sounds, with tonal variations that promote movement and positive energy;
- *sadness*, evoked by slow sounds, dark and descending, that evoke introspection and melancholy.

For these reasons, the relationship between *acousmatic music* and *body language* proves to be extremely fruitful for exploration artistic and educational purposes. The sounds produced constitute powerful expressive means that can touch deep emotional chords, tell stories, and convey universal symbolic meanings, capable of leading to a vibration of the soul and to a self/world resonance.

*The specific frequencies employed therefore exert a pronounced influence also on corporeality, owing to their strong capacity to evoke primordial sensations associated with the soundscape: sound objects act from the outside on the body and, conversely, giving rise to a resonant circuit of sounds that are sometimes distinct but more often overlapping.*

For all these reasons, acousmatic music may elicit phenomena involving the activation of *primordial feelings* and of deep, *archaic parts of the Self*, such as those belonging to the *Proto-self* or, more frequently, to the *core self*, that is, the consciousness of the object situated in the *here and now* which, during listening, evokes a *pre-reflective sense of subjectivity*, specific to early infancy, *linked to the initial representation of the body schema*.

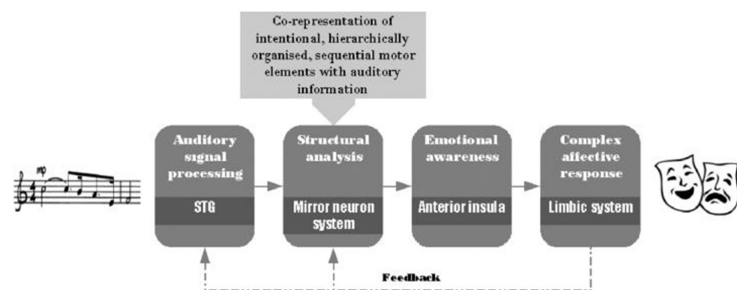
As the English composer T. Wishart states: “In listening [...] we are left adrift in an entirely aural world [...]. Sounds can once again assume some of the ‘magical’ power they must have had for pre-literate peoples. If we allow it, we can return to the stage of perception in which Myths have their power, where the environment is vibrant with meaningful sounds.” (Wishart, 1985; cited in Polato, M.,

2018). This evokes, *as it were, primitive art* that recalls the *unspoiled world* of Picasso's masks, so close to the *primordial forces of nature*.

Moreover, empathic understanding during the performance of a musical piece is physiologically associated with the activation of the so-called *mirror neurons*. They are activated in parieto-motor regions, in Broca's area, and across much of the premotor cortex and the inferior parietal lobule of the brain, both in the individual who physically executes the gesture with the *acousmatic* and in the individual who observes the same actions performed by the Other, as a result of *embodied simulation* (Varela et al., 2024), that is, *somatic resonance, unconscious, automatic, and pre-reflective*, achieved *through the internal representation of movement that occurs in both subjects*. Thus, it is the activation of a neural mechanism, shared by observer and observed, by musician and spectator, that produces a *co-transformation* within *co-presence, in reciprocal resonance*. In this way, it is possible to understand how music *acts within the body* and how the gestures performed by the Musician can exert a particular influence on emotional perception.

The same activation of mirror neurons also occurs during small-group listening, aided by the observation of facial expressions and by the role of music itself, which fosters more collaborative and empathic behaviors, promoting in participants a sense of belonging and engagement.

In Carr et al. (2003), It was demonstrated that the anterior insula can be regarded as a neural relay station between the mirror neuron system and the limbic system, which is involved in emotion processing, in order to provide a subject with an automatic representation of the musical stimulus (Carr et al., 2003) (Figure 5).



**Figure 5.** Example of processing visual and auditory and co-representation by watching a concert, through mirror neurons activity.

In conclusion, the musician J. Shacher (Shacher, 2019) argues that bodily characteristics, together with its ability to *resonate*, to remember, and to re-engage emotions through *physical movement*, help to create a *shared rhythmic experience with the musician*, which is essential for strengthening the *sense of personal and social identity*.

### Recent Research on the Effects of Music on Emotions of Adolescents

In recent years, numerous studies have been conducted to study how listening to

music has a measurable effect on emotions in adolescents.

As regards recent studies on the topic, a research from Romania has highlighted the relationship between adolescents' emotional states and the kind of music listened to (pop, rock, classical, jazz), under the supervision of teachers. The research allowed to discover how feelings and emotions are expressed through music activities at school, conducted under experimental conditions (Rucsanda, 2015).

In another Finnish study (Saarikallio et al., 2014), sixty-one 14-year-olds adolescents (45 females) were given three music-related tasks that assessed emotion perception and emotion expression listening to music. This important research investigated whether adolescents' abilities in both perceiving and expressing emotions through music would be reflective of their general abilities of socio-emotional communication and interaction.

A Chinese research (Chen, 2023) focused on the influence of music on the psychological well-being of adolescents, such as the facilitation of emotional expression and regulation, fortification of social bonds and the sense of belonging, as well as the influence on creativity.

Another Chinese study (Wei et al., 2025) recruited 120 adolescents who listened to three different arrangements of the same song. Emotional responses were assessed using the Positive and Negative Affect Schedule (PANAS).

All these studies are very important because they serve to obtain scientific validations regarding the emotional effects produced by listening to music in adolescence.

Finally, we would like to highlight the importance of a Kazakh research (2023) (<https://somasynths.com/psychosomatic/>) which highlighted the importance of listening to music composed with the use of synthesizers, such as Soma, specifically designed to promote psychosomatic reactions to listening to music.

The first edition of "psychoSOMatic" live concept was created at the end of October 2023, organized by SOMA Laboratory and Creative Community SOMA RU, in Kazakhstan. The principal goal of SOMA Laboratory (with the use of LYRA-8 and TERRA instruments), according to the Author's intentions, was "to create a conscious awareness of our inner emotional states in the context of a musical performance, where audience and artist can react to each other through movement and music. The essence of this concept is that, throughout the concert, the listener carries out the practice of recognizing and reflecting on their own psycho-emotional state and uses this awareness to become an active participant in the performance. [...] The artist also gets the opportunity to develop a conscious approach to building the psycho-emotional dramaturgy of their performance."

The Authors wrote an interesting paper and filmed a video of the Laboratory, both of which are visible on the website.

We have drawn inspiration from this experience, adapting the experimental protocol to the Italian school situation. We created new questionnaires to better record emotions and sensations experienced during the Laboratory, reported in **Appendix**.

## 5. Methodology of Intervention

### 5.1. Preliminary Training Operations for the Formation of the Laboratory Musical/Sensory with the Acousmatic Music

The workshop was offered to a group of 15 students (7 males, 8 females) from class 1 AM (n. 24 class members) of the Music High School at the “ArcoEste”, Upper Secondary Institute in Mantua.

The participants were students from a first class of music high school, aged between 14 and 15.

The recruitment took place on a voluntary basis among the students of the class involved in the workshop, in accordance with the class council and the school management. There were no students in the class with disabilities or any specific hearing-related conditions, discomfort with intense sound stimuli or documented difficulties that could interfere with sensory activities.

The selection of students was dictated by the number we deemed ideal for the workshop and their availability to participate given their prior commitments. So six male students did not participate in the workshop.

All of participants possessed a musical background consistent with the course of study of the music high school, including individual instrumental practice, theoretical literacy and first experiences of analytical listening and sound production, a condition that guaranteed a basic familiarity with musical language and conscious listening, although without requiring specific skills in electronic or acousmatic music.

No selection criteria related to the level of musical competence were applied. Since the participants were minors, participation in the laboratory and in the collection of research observations was preceded by an informed consent procedure: parents or legal guardians received a detailed communication on the purposes, methods of carrying out the activities, type of sound experiences and use of the data collected for research purposes and educational documentation.

Written consent from parents or guardians was then acquired, along with informed assent from students. The project was carried out with the approval of the school institution and under the supervision of the teachers involved, guaranteeing privacy protection, anonymity of data and the possibility for students to interrupt participation at any time, without consequences on the educational path.

### 5.2. Study Design

The initial hypothesis is that *the sensory experience elicited by acousmatic sound can help adolescents establish a deep psychosomatic connection, foster relationships within the group, and enhance their ability to draw on internal resources.*

*The second hypothesis proposed that gender reaction to acousmatic music should show significant differences, such as great relaxation, calmness, and ability to unwind, at the end of the concert, in males; great panic, fear and anger/rage during the concert and, consequently, less relaxation at the end of the musical performance, in females.*

We also hypothesized that *specific frequencies in the acoustic landscape might have a pronounced influence on emotions. Specifically, sudden low frequencies might induce anxiety, while fast oscillations of high frequencies, on the contrary, might produce a calming effect.*

### 5.3. Setting of the Laboratory

A sufficiently large room is required to allow participants to move freely. Eight large rectangular sheets of paper bearing labels (**Figure 6**) referring to as many emotions and moods are taped to the floor, creating a vertical progression ranging from excitement to calm. On each sheet, the corresponding emotion is identified by its color, according to the emotion-color pairing established by the Swiss psychologist Max Luscher (Luscher, 1983), author of the eponymous color test. Next to each sign, on the left and right, rubber mats are placed horizontally to provide support if participants feel the need. The background of the acousmatic station is black.

EXCITATION
JOY
ANGER/RAGE
PANIC
ANXIETY
FEAR
SADNESS
CALM/HARMONY

**Figure 6.** Eight sheets of paper placed on the floor, with colored signs that indicate as many emotions and moods.

Group members may move forward or backward and position themselves either standing or on the ground, always on the sides of the individual posters, following changes in the flow of emotions and sensations experienced.

The laboratory was designed as an immersive and perceptually neutral listening experience, aimed at establishing a direct relationship between sound stimulus, body perception and emotional experience, configuring itself as a temporary acousmatic space in which sound is perceived as an autonomous event, devoid of visual references to its origin.

The activity took place in a room free of furniture, parallelepiped in shape (eight meters wide, sixteen meters long and four meters high), designed to allow students to move along the longitudinal axis, experimenting with variations in distance, sound pressure and spatial perception. The technical setup was placed on one of the short walls, with the monitors hidden behind a full-wall black curtain to hide

the sound sources and reduce visual distractions, so as to promote an acousmatic perception in which the sound spreads in space without an identifiable direction.

The students freely occupied the central and front part of the room, without fixed seats or positions, being able to approach or move away from the speakers, stop at resonant points or move along the length of the room as a form of sensory exploration of sound. The musical component combined pre-recorded materials and live production.

#### 5.4. Session Sequence

The pre-recorded pieces, composed specifically for the workshop, provided the structural backbone of the performance, with textures, sound environments and evolutionary processes formally and timbre defined, designed to guide the listening through different emotional and psychosomatic states.

The musician's live intervention was grafted onto this material through organic synthesizers and noise boxes, which made it possible to modulate sound parameters, generate timbre variations, frequency modulations, saturations and dynamic transitions, creating micro-variations and perceptual adaptations linked to the space and presence of the participants.

The sound design included a wide musical dynamics, with excursions between areas of low sound density and moments of greater acoustic pressure, keeping the output power of the system constant to ensure that the perceptions of intensity derive from the internal dynamics of the compositions, such as spectral density, rhythmic articulation, presence of low or high frequencies and timbral complexity.

The variations in sound color, rhythmic energy and frequency content thus became primary in generating bodily and emotional sensations: the low frequencies and noise bands created pressure and body tension, while the high frequencies and rarefied textures generated lightness and relaxation. The total duration of the session was about an hour, enough to progressively go through different states of listening and perceptual adaptation.

In the early stages, the students gradually entered the immersive environment, becoming accustomed to the sound and the ability to move freely. Subsequently, the sonic narrative developed through sections characterized by rhythmic, timbral, and frequency configurations connected to the emotional dimensions being explored.

No interpretative instructions were given on the emotions to be perceived, allowing the relationship between sound, body, and space to emerge spontaneously. The musician maintained a discreet yet visible presence, serving as a point of reference, while the centrality of the experience was entrusted to the acousmatic diffusion of sound and its interaction with the architecture and the movement of the participants, configuring the workshop as an active listening environment in which body, emotion, and acoustic space entered into a dynamic relationship.

Girls and boys are encouraged, by Psychologist Grazia De Mori, to participate

actively in the performance through gestures and body movements, in a way that can, in turn, influence the sounds produced during the performance.

### 5.5. Recording Procedures

The musical performance is carried out in *Live Electronics*, a musical practice involving the use of electronic equipment to manipulate sounds in real time, enabling musicians to interact directly with the sound and with participants during the performance.

The songs used in the workshop were composed in a recording studio using the Cubase Pro Digital Audio Workstation, developed by Steinberg Media Technologies GmbH. The production involved the use of various sound synthesis and manipulation tools, including granular and wavetable samplers, FM synthesizers, and sound materials sampled specifically for the project. The entire compositional process was oriented toward targeted timbral research, with the goal of building a sonic identity for each song consistent with the underlying expressive concept, also expressed in the titles of the compositions.

Once the structure of the songs was completed in the production environment, the pre-recorded material was developed by the composer through targeted live electronics interventions using SOMA Laboratory synthesizers, specifically the SOMA Enner, SOMA Lyra-8, and SOMA Cosmos. These instruments are characterized by a strong gestural component and rich timbral variability and allowed the pre-recorded sequences to be integrated with a real-time performative dimension. The musical approach adopted combines three main elements: the acousmatic diffusion system, the Digital Audio Workstation used for sequence management, and a series of standalone synthesizers intended for live sound manipulation.

This configuration allows the composer-musician, thanks also to a customized acousmatic score that provides precise reference points for musical gestures, to dynamically modulate the sound experience during listening, adapting the construction of the soundscape to the audience's perceptual reactions and, specifically for this project, to the laboratory's methodological needs. This configuration also led to the creation of a recording entitled "SOUND PERSPECTIVES," available on all major digital streaming platforms, which contains the tracks used for the research.

### 5.6. Registration of the Laboratory

The laboratory relied on audio/video documentation and a photographic service featuring rear-view images, in order not to influence or distract the boys and girls. So 15 students, who participated in the workshop, were observed throughout the musical performance and immortalized in 59 photos and a recorded video, allowing us to determine the precise moments, during the piece, at which they experienced particular emotions.

This methodology allowed us to observe the participants moment by moment and determine which poster they were currently sitting on, depending on the emo-

tion they were experiencing and the timing of each piece. This allowed us to monitor their constant movement, to quantify the participants' displacements from one poster to another, as their emotions changed for each composition. The time recorded by the digital image, allowed for precise and unambiguous control, with the possibility of converting the data into an analyzable emotion time series. The data were individually coded and checked by the authors, achieving excellent agreement.

The link between the spectrogram and the affective dimension was conceived as an explicit method for comparing objective acoustic parameters and participants' subjective assessments during and after listening, starting from the hypothesis that specific spectral configurations—that is, the distribution of energy across different frequency bands over time—are more likely to be associated with certain emotional perceptions or psychosomatic states.

This made it possible to establish a link between the frequencies used in the creation of each piece and the perceived psychosomatic effects, in order to understand which *compositional characteristics* can be attributed to the elicited effect.

### 5.7. Measures and Analysis Plan

To assess emotions, sensations, and mood states, a test–retest procedure is implemented using specific scales and self-report questionnaires, scored from 1 to 10, to be completed before and after the laboratory experience. Responses to the questionnaires refer to what was experienced during the musical performance.

For the evaluation of the laboratory experience, more specifically, the Scale for the Assessment of Distress or *SUD Scale* (Subjective Units of Distress Scale by J. Wolpe) and the *Subjective Well-Being Scale: calm and relaxation* by G.A. Fava, previously used by the SIMP (Società Italiana Medicina Psicosomatica) during the period of the Covid-19 pandemic (Cagiada et al., 2022) are selected. The questionnaires, instead, are developed specifically for the laboratory: *Questionnaire for the assessment of emotions* (arousal, joy, anger/rage, panic, fear, sadness) and *Questionnaire for the assessment of sensations* (variation in heart rate, variation in breathing, sensation of cold, sensation of heat, need to move, need to shout). By contrast, the occurrences on the posters of *anxiety* and *calm* are recorded only through photographs and audio/video recordings.

At the end of the concert, particular alterations in perception that may arise in an individual during an acousmatic performance are also assessed (perception of space, perception of the flow of time, perception of being in tune with the external environment, perception to be aligned with the gestures performed by the Musician during the performance of the pieces). All questions and responses are specifically coded to facilitate statistical analysis.

Spectral analyses were performed with iAnalyze 5 software using the Fast Fourier Transform (FFT), a fundamental algorithm in digital audio that allows a signal to be transformed from the time domain (amplitude) to the frequency domain

(spectrum).

This process allows us to observe and analyze the distribution of frequencies used within the sound composition. The analysis used for the study was performed with an acquisition window of 4096 samples, producing a spectrogram capable of representing the entire sound spectrum of the signal. This representation displays the frequencies in Hertz (Hz) and their intensity in decibels (dB) over a time dimension expressed in minutes and seconds.

The color map of the spectrogram indicates the energy intensity of the frequency components: more saturated and bright colors correspond to higher sound energy levels, while darker or muted tones indicate a lower energy presence of the frequencies in the spectrum.

At the end of the workshop, students were invited to share their personal inner experience with the group facilitator and the composer/performer, thereby enabling verbal expression of lived experiences and emotional states and fostering shared reflection and processing of the musical/sensory experience.

## 6. Results and Evaluation of Results

The results reported below are selected and presented based on the significance of the changes perceived in the body before and during the concert performance.

The transition from the Pre-listening (P) to Post-listening (D) phase was tested not only through significance (p-value), but above all through Cohen's *d*, which measures the actual strength of the change. The study showed large effects in the emotional domain, with a peak value ( $d = 1.76$ ) for panic. Non-significant data (e.g., relating to some physical sensations) have been reported in full to demonstrate the scientific integrity of our findings.

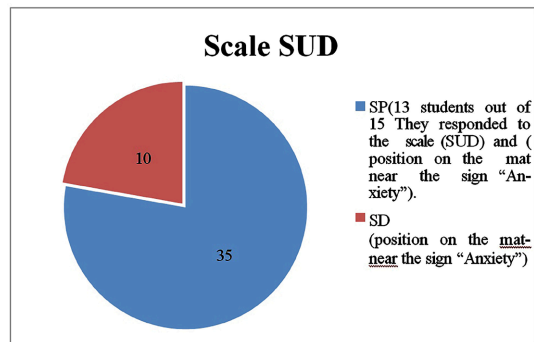
### Results of the Scales and of the Questionnaires: Statistical Analysis

The graphs, produced by the Mathematics teacher of the class, Prof. Raffaele Vilella, illustrate the changes that occurred at the psychosomatic level, using the scores assigned by participants on the Scales (before and after the musical performance) and on the Questionnaires. The latter made it possible to capture the self-assessment of perceptions and sensations and to conduct the comparison between what was perceived before the concert (P. in blue) and during the musical performance (D. in red), by examining the responses provided by participants at the end of the performance.

In the following analysis of the results, the statistically most relevant and significant changes are highlighted.

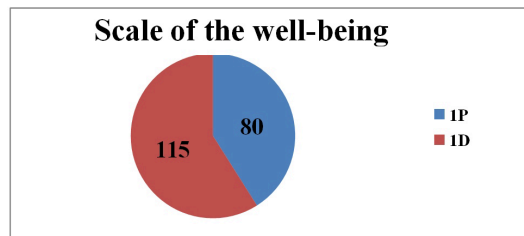
#### **1—Scale sud and scale of subjective well-being—Sample 15 students—Scores of the 15 students before and during the execution**

Regarding the SOUTH SCALE (Figure 7), there was a significant decrease in self-perceived stress, which, relative to the beginning of the concert, declined by approximately 75%.

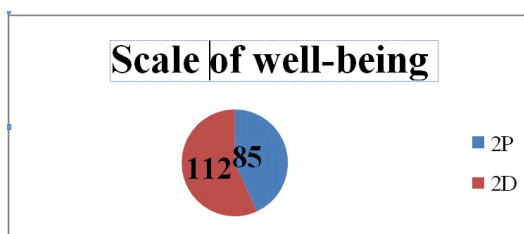


**Figure 7.** Scale sud.

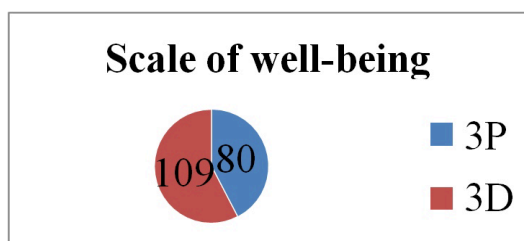
The results obtained with the SUD scale are consistent with those of the WELL-BEING Scale regarding improvements in perceived relaxation (1P - 1D) (**Figure 8**), perceived calmness (2P - 2D) (**Figure 9**), and the ability to relax (3P - 3D) (**Figure 10**), although the latter is somewhat less pronounced.



**Figure 8.** Scale of the well-being 1p and 1d.



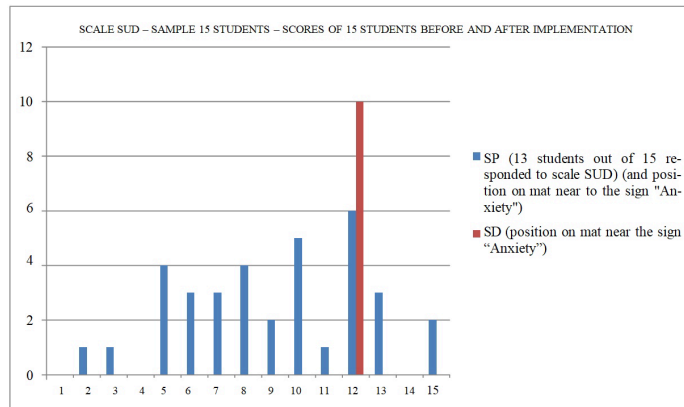
**Figure 9.** Scale of the well-being 2p and 2d.



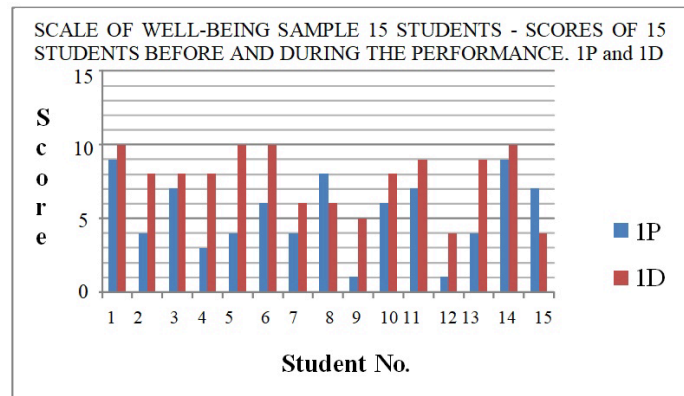
**Figure 10.** Scale of the well-being 3p and 3d.

Regarding individual differences among the 15 participants, the histograms highlight the subjective improvements reported, to a marked extent, by almost all participants at the end of the concert for the same variables mentioned above. On the SUD scale (**Figure 11**) and on the Well-Being Scale (**Figures 12-14**), distress

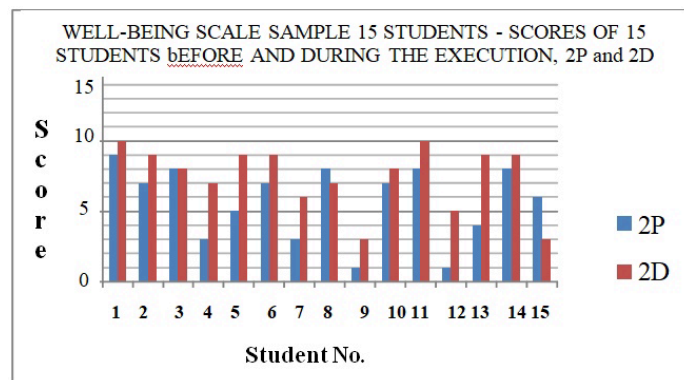
appears to have decreased substantially at the end of the performance. By contrast, it increased for only one participant.



**Figure 11.** 1—Scale sud—Sample 15 students—Scores of 15 students before and after implementation.



**Figure 12.** 1—Scale of well-being sample 15 students—Scores of 15 students before and during the performance, 1p and 1d.



**Figure 13.** 1—Well-being scale sample 15 students—Scores of 15 students before and during the execution, 2p and 2d.

**2—Questionnaire emotions—Scores of 15 students before and during the execution**

Regarding emotions, the scores recorded before and during the concert increased, with a notable rise in anger (3EP - 3ED) (Figure 15) and panic (4EP - 4ED) (Figure 16), as well as in fear (5EP - 5ED) (Figure 17). Overall, these results indicate a substantial effect of acousmatic music on the psyche, consistent with the Composer’s intention to elicit different types of emozione. The individual students’ scores also corroborate this general trend (Figures 18-20).

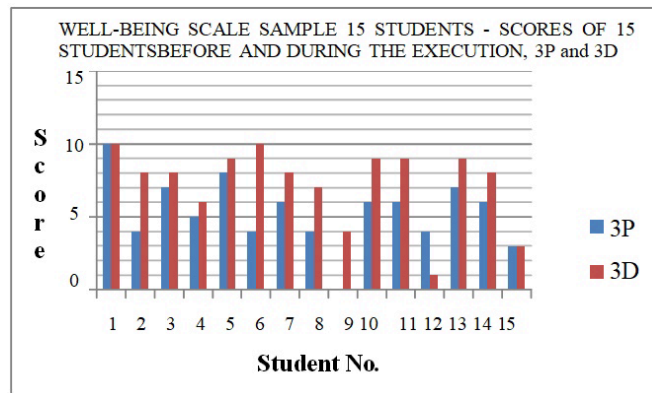


Figure 14. 1—Well-being scale sample 15 students—Scores of 15 students before and during the execution, 3p and 3d.

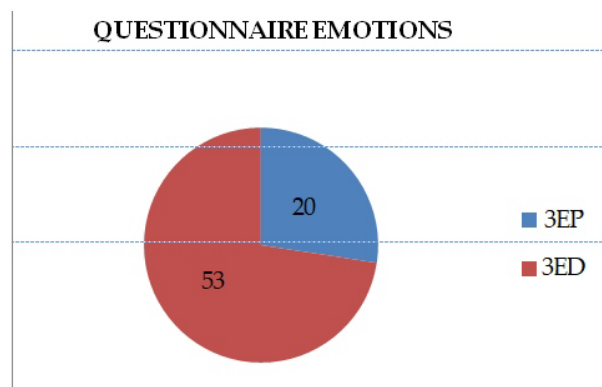


Figure 15. 2—Questionnaire emotions of 15 students before and during the execution, 3ep and 3ed.

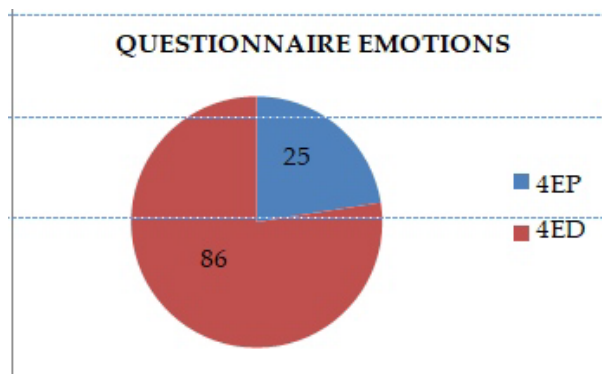
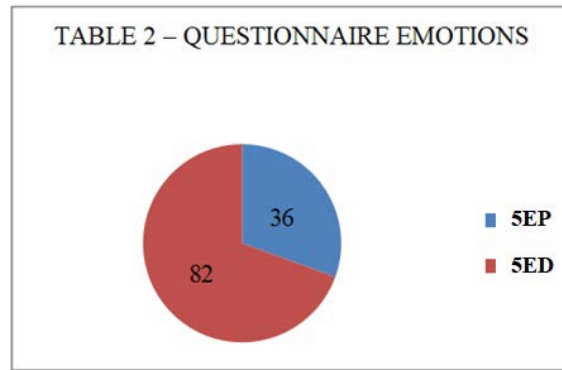
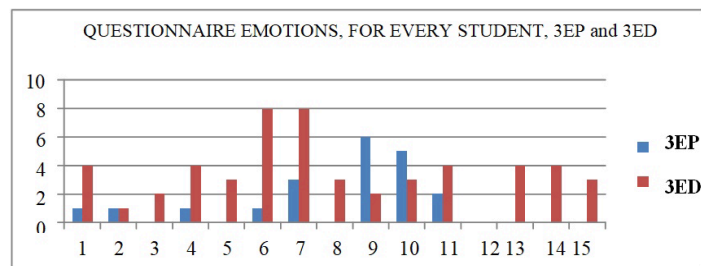


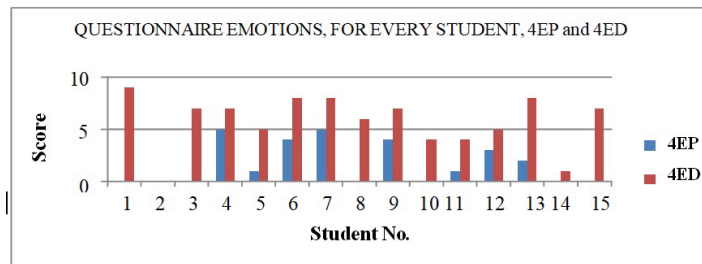
Figure 16. 2—Questionnaire emotions of 15 students before and during the execution, 4ep and 4ed.



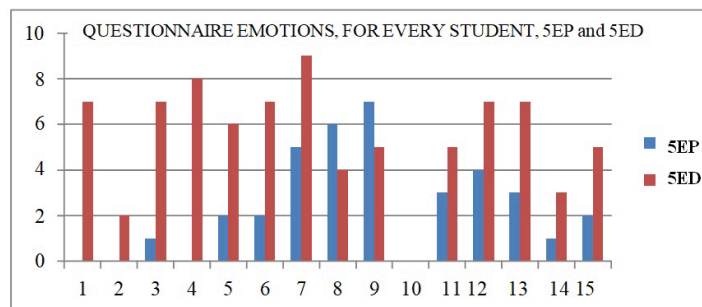
**Figure 17.** 2—Questionnaire emotions, of 15 students before and during the execution, 5ep and 5ed.



**Figure 18.** 2—Questionnaire emotions, for every student, 3ep and 3ed.



**Figure 19.** 2—Questionnaire emotions, for every student, 4ep and 4ed.



**Figure 20.** 2—Questionnaire emotions, for every student, 5ep and 5ed.

**3—Questionnaire sensations—Scores of 15 students before and during the execution**

Regarding sensations, a decrease in scores was observed for changes in breathing (2SP - 2SD) (**Figure 21**) (less intense during the concert), the sensation of cold (3SP

- 3SD) (Figure 22) (less intense during the performance), and the need to move (5SP - 5SD) (Figure 23) (less intense during the concert), with greater heterogeneity in participants' responses than for changes in breathing (Figures 24-26).

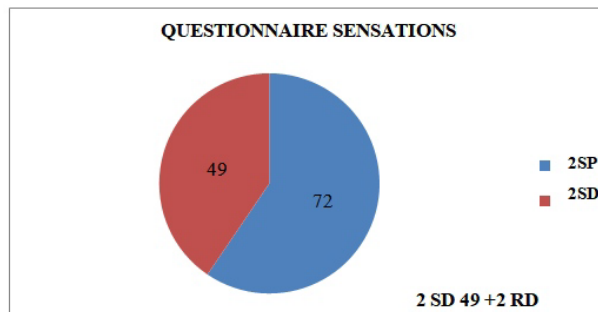


Figure 21. 3—Questionnaire sensations, 2sp and 2sd.

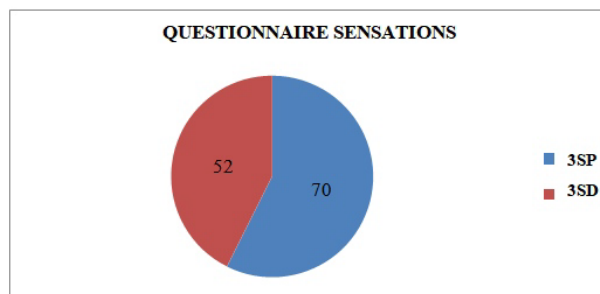


Figure 22. 3—Questionnaire sensations, 3sp and 3sd.

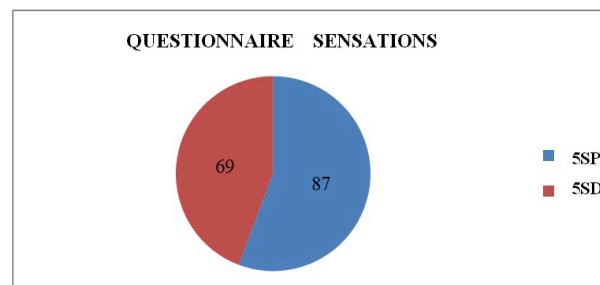


Figure 23. 3—Questionnaire sensations, 5sp and 5sd.

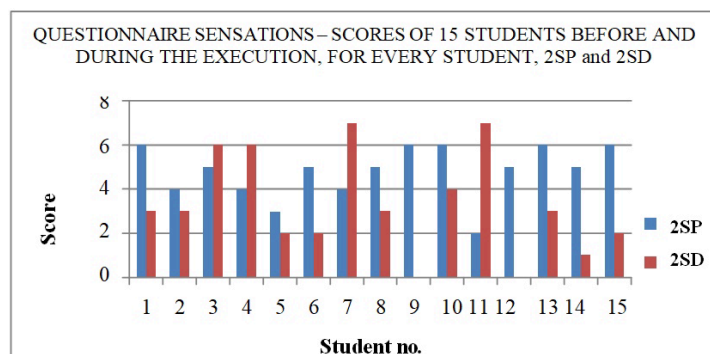
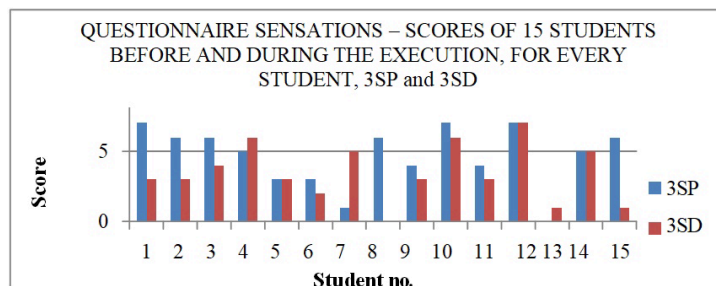


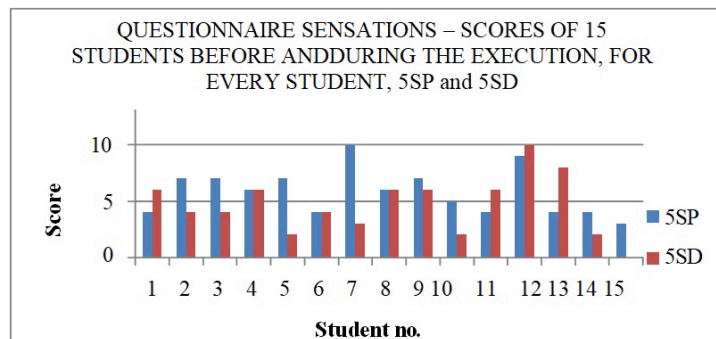
Figure 24. 3—Questionnaire sensations—Scores of 15 students before and during the execution, for every student, 2sp and 2sd.

**4—Questionnaire 4 unusual sensations—Scores of the 15 students during task performance**

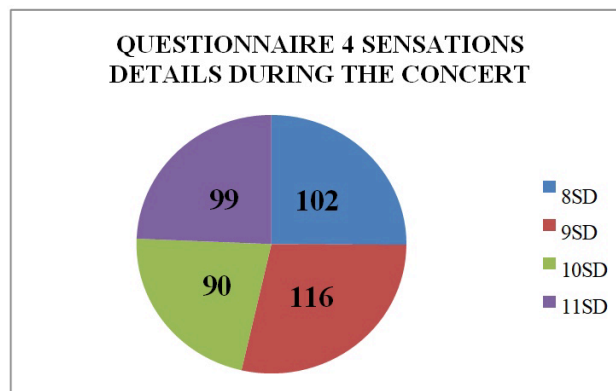
With respect to variations in the perception of space (8SD), in the perception of the passage of time (9SD), in the perception of being attuned to the external environment (10SD), and of being attuned to the gestures performed by Prof. Barlera while playing the pieces (11SD), there is a general tendency to experience a marked change across these dimensions, although the most significant variation concerns the perception of time, which during the concert passed more quickly than usual (**Figure 27**). This finding indicates complete immersion in the music, to the point of momentarily losing contact with reality.



**Figure 25.** 3—Questionnaire sensations—Scores of 15 students before and during the execution, for every student, 3sp and 3sd.



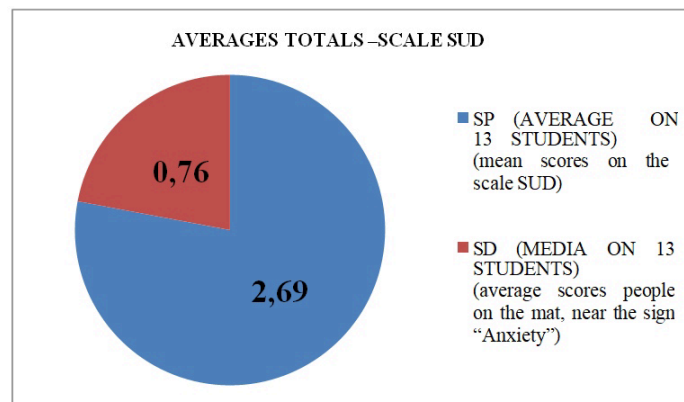
**Figure 26.** 3—Questionnaire sensations—Scores of 15 students before and during the execution, for every student, 5sp and 5sd.



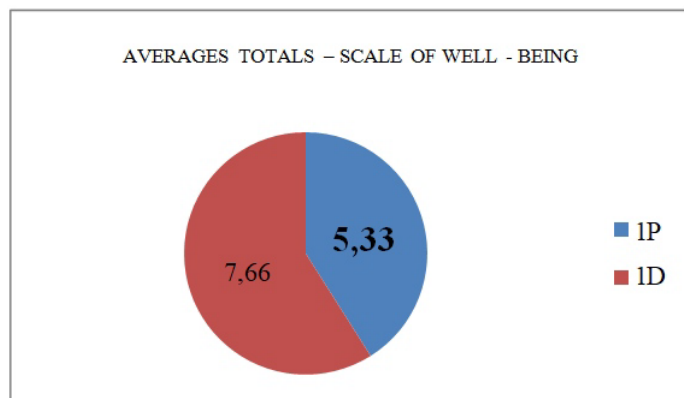
**Figure 27.** 4—Questionnaire 4 sensations.

### 5—Overall means—Scale south and scale of subjective well-being

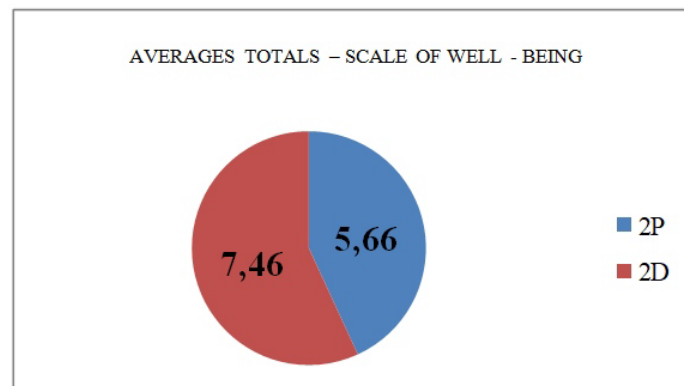
For as regards the overall means, a percentage decrease of as much as two points (SP-SD) was perceived in the level of perceived distress after the concert (0.76%) on the SOUTH SCALE (**Figure 28**); this is also evident in the WELL-BEING SCALE, particularly with regard to perceived relaxation (1P - 1D) (7.66%) (**Figure 29**), the ability to feel calm (2P - 2D) (7.46%) (**Figure 30**) and the perceived effectiveness in the ability to relax (3P - 3D) (7.26%) (**Figure 31**).



**Figure 28.** 5—Averages totals—Scale sud.



**Figure 29.** 5—Averages totals—Scale of well—Being, 1p and 1d.



**Figure 30.** 5—Averages totals—Scale of well—Being, 2p and 2d.

6—Means totals—Questionnaire emotions

Regarding the overall mean levels of emotions, anger/rage (3EP - 3ED) (3.53%) (Figure 32), panic (4EP - ED) (5.73%) (Figure 33), and fear (5EP - 5ED) (5.46%) (Figure 34) were perceived as progressively increasing over the course of the concert, with a marked rise in experienced panic of as much as four percentage points and in fear of three percentage points, relative to the initial baseline emotions.

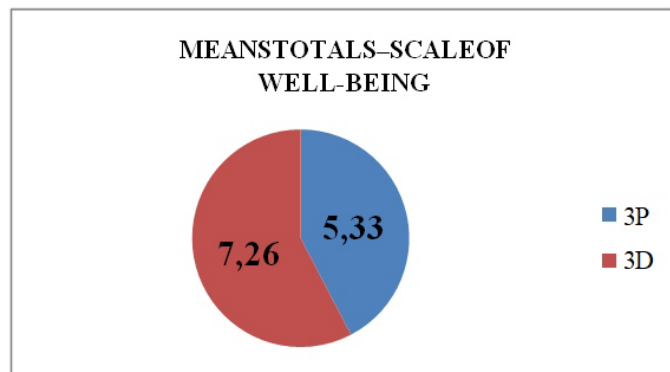


Figure 31. 5—Averages totals—Scale of well—Being, 3p and 3d.

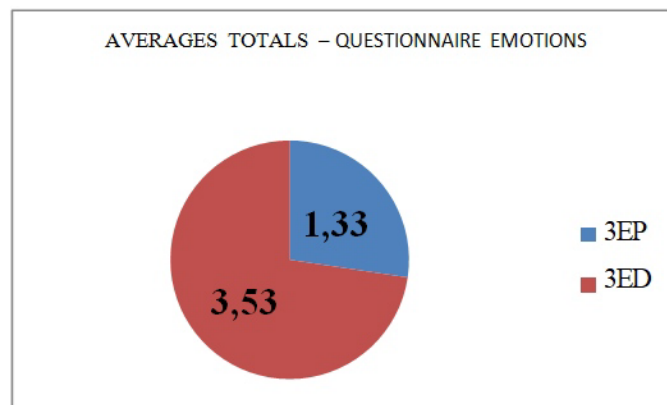


Figure 32. 6—Averages totals—Questionnaire emotions, 3ep and 3ed.

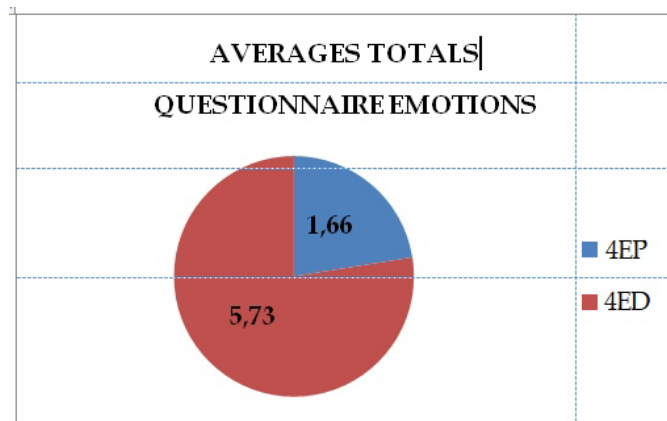
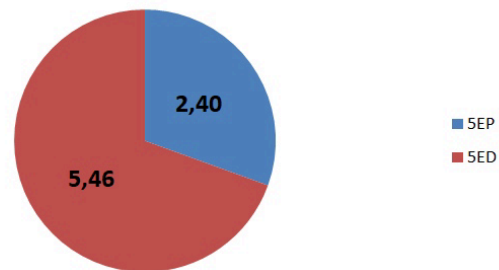


Figure 33. 6—Averages totals—Questionnaire emotions, 4ep and 4ed.

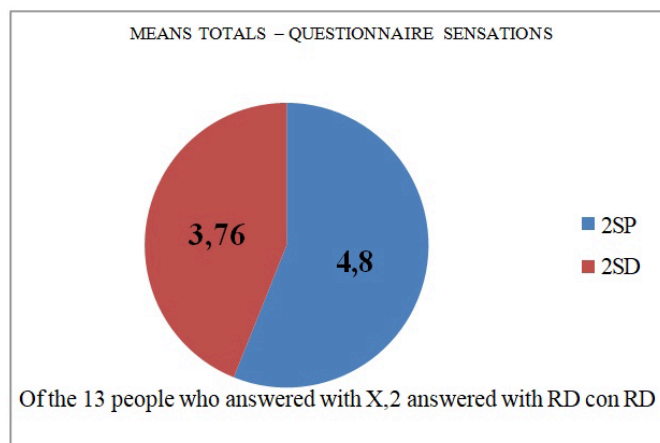
**7—Means totals—Questionnaire sensations**

Regarding sensations before and during the concert, changes in the mean values are less pronounced than those observed for emotions. The mean change in breathing decreased from 4.8% to 3.76% (2SP - 2SD) (Figure 35), a reduction of approximately one percentage point. In particular, as noted above, cold was perceived as less intense than usual (3SP - 3SD) (Figure 36), and the need for movement (5SP - 5SD) also declined, by approximately 1.2 percentage points (Figure 37).

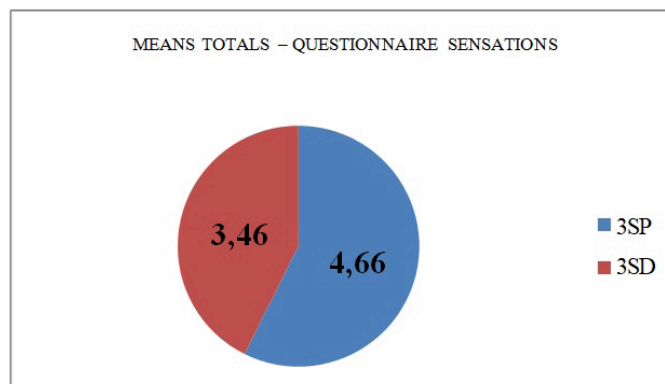
**AVERAGE TOTALS – QUESTIONNAIRE EMOTIONS**



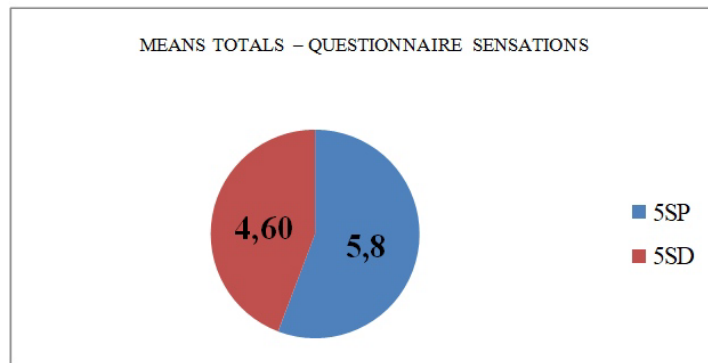
**Figure 34.** 6—Averages totals—Questionnaire emotions, 5ep and 5ed.



**Figure 35.** 7—Means totals—Questionnaire sensations. 2sp and 2sd.



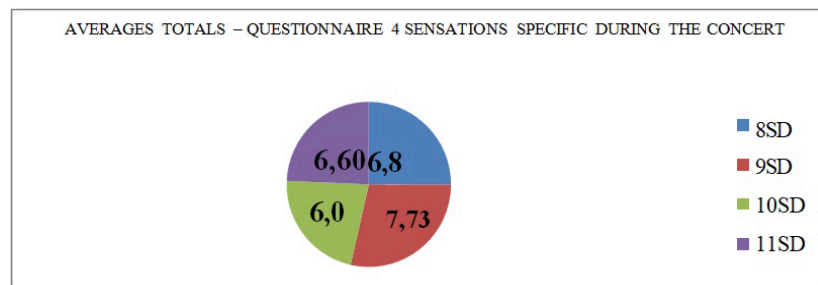
**Figure 36.** 7—Means totals—Questionnaire sensations, 3sp and 3sd.



**Figure 37.** 7—Means totals—Questionnaire sensations, 5sp and 5sd.

### 8—Averages totals—Questionnaire 4 sensations specific during the concert

With regard to the overall mean scores assigned, a fairly high level of engagement in musical performance can nonetheless be observed among both boys and girls (**Figure 38**), demonstrating the strong effect elicited by acousmatic music.



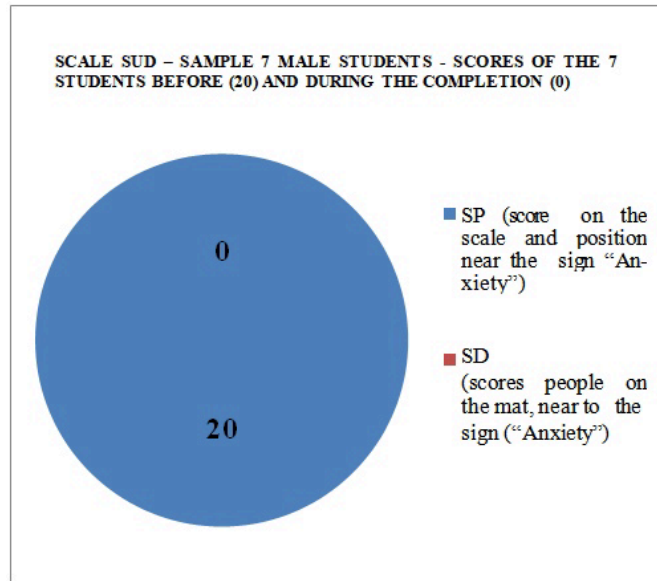
**Figure 38.** 8—Averages totals—Questionnaire 4 sensations specific during the concert.

### 9—Sud scale and well-being scale—Sample 7 male students—Scores of the 7 students before and during the administration

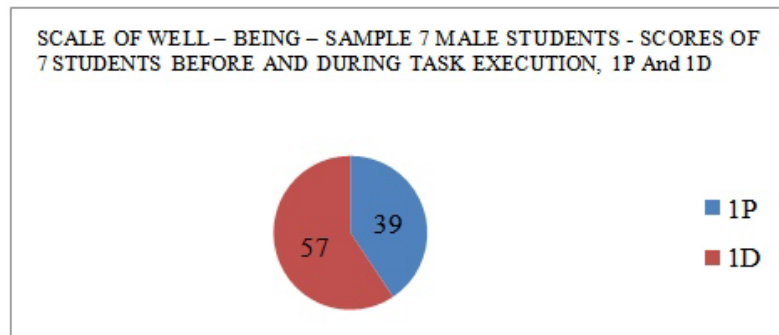
The most critical and interesting point concerns the comparison between males and females. Following the requirement not to overinterpret given the small sample of students involved, the analysis revealed that males used the experience primarily to regulate well-being, while females experienced greater emotional intensity, while maintaining more stable anxiety levels. Although some *d* values were exceptionally high for both males and females (which could suggest a genuine finding), these differences could be trends observed in the specific sample and not as universal laws. Future experimental laboratories on a larger scale are encouraged to test the consistency of findings.

With regard to the SCALA SUD, the change is very evident: the scores dropped to zero after the concert, and the benefit was truly significant (**Figure 39**). With regard to male scores on the WELL-BEING Scale, an overall change during the concert is immediately apparent; moreover, the shift is more pronounced than for relaxation ability (from 39 to 57) (1P - 1D) (**Figure 40**) and for the possibility of feeling calm and relaxed (from 41 to 58) (2P - 2D) (**Figure**

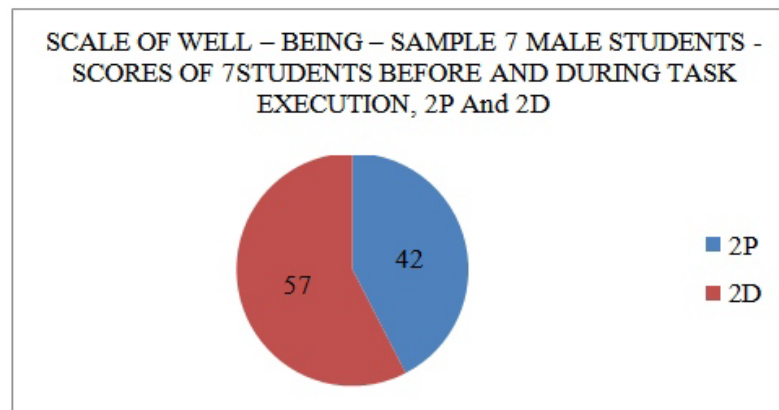
41) e (3P - 3D) (Figure 42).



**Figure 39.** 9—Scale sud—Sample 7 male students—Scores of the 7 students before (20) and during the completion (0).



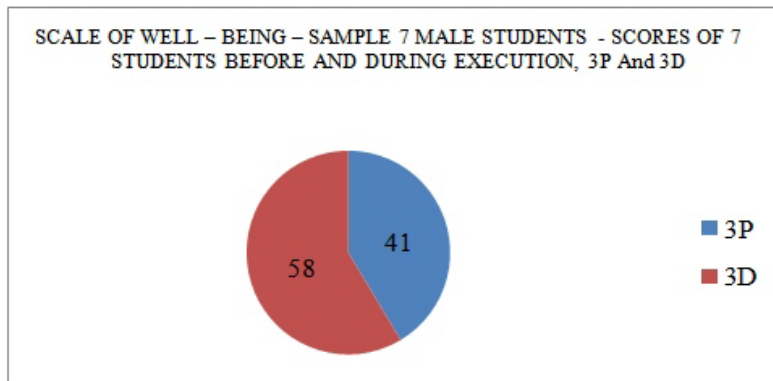
**Figure 40.** 9—Scale of well—Being—Sample 7 male students —Scores of 7 students before and during task execution, 1p and 1d.



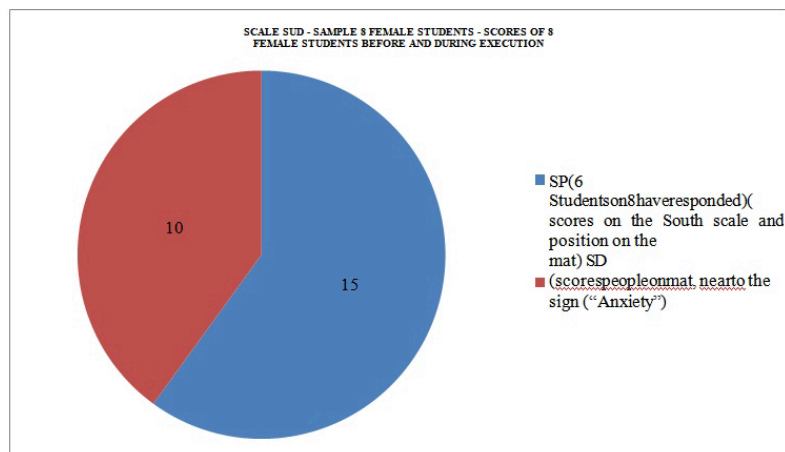
**Figure 41.** 9—Scale of well—Being—Sample 7 male students—Scores of 7 students before and during task execution, 2p and 2d

**10—South E scale of well-being—Sample 8 female students females—Scores of the 8 female students before and after the execution**

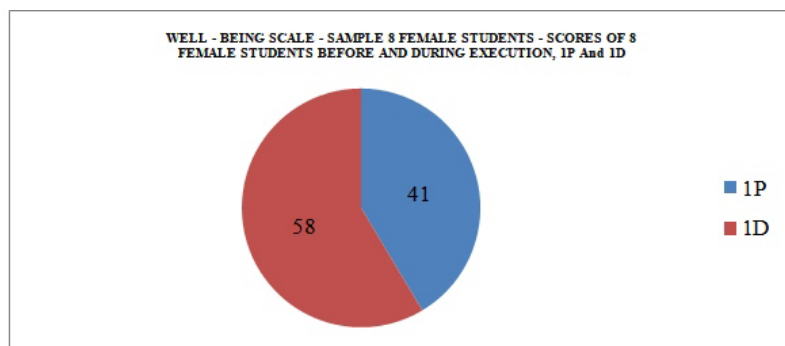
The degree of distress on the SUD SCALE (Figure 43) decreased far less substantially than in males. On the WELL-BEING scale, by contrast, the most evident change concerned the ability to feel relaxed (from 41 to 58) (1P - 1D) (Figure 44).



**Figure 42.** 9—Scale of well—Being—Sample 7 male students—Scores of 7 students before and during execution, 3p and 3d.



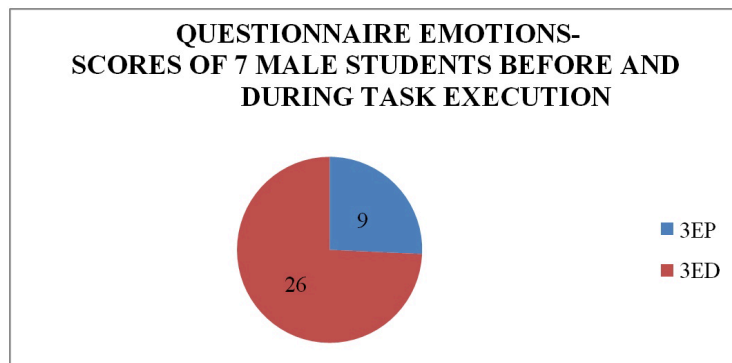
**Figure 43.** 10—Scale sud—Sample 8 female students—Scores of 8 female students before and during execution.



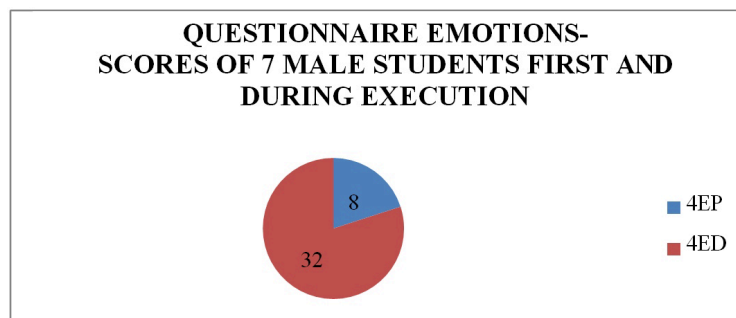
**Figure 44.** 10—Well—Being scale—Sample 8 female students—Scores of 8 female students before and during execution, 1p and 1d.

### 11—Emotions questionnaire—Scores of 7 male students before and during execution

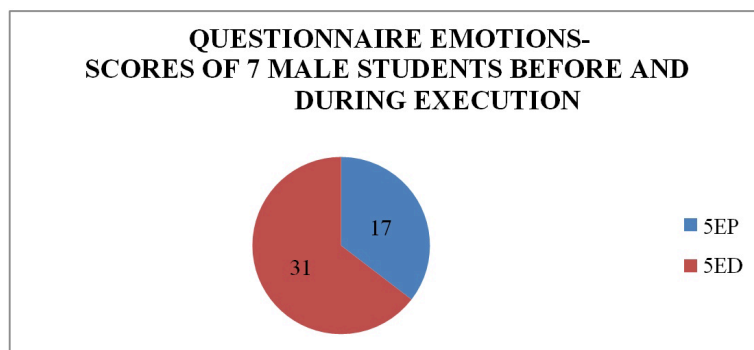
Regarding emotions, anger/rage increased considerably in males after the concert (from 9 to 26) (3EP - 3ED) (**Figure 45**), panic (4EP - 4ED) was more intense during the musical performance (from 8 to 32) (**Figure 46**), while fear increased somewhat less proportionally (from 17 to 31) (5EP - 5ED) (**Figure 47**); consequently, the perceived *agitation without an object increased*, consistent with the effects of certain acousmatic sounds. In addition, sadness increased significantly from 5 to 24 (6EP - 6ED) (**Figure 48**).



**Figure 45.** 11—Questionnaire emotions—Scores of 7 male students before and during execution, 3ep and 3ed.



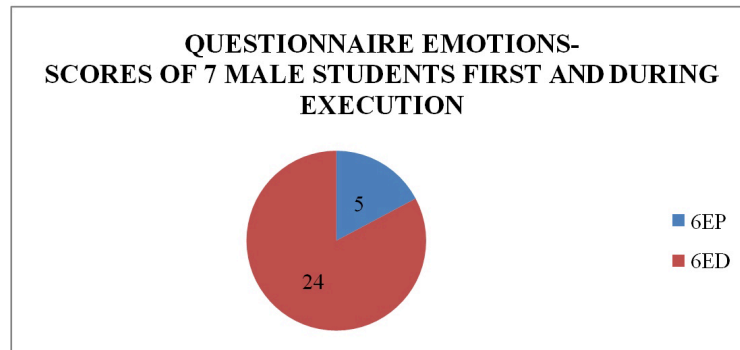
**Figure 46.** 11—Questionnaire emotions—Scores of 7 male students before and during execution, 4ep and 4ed.



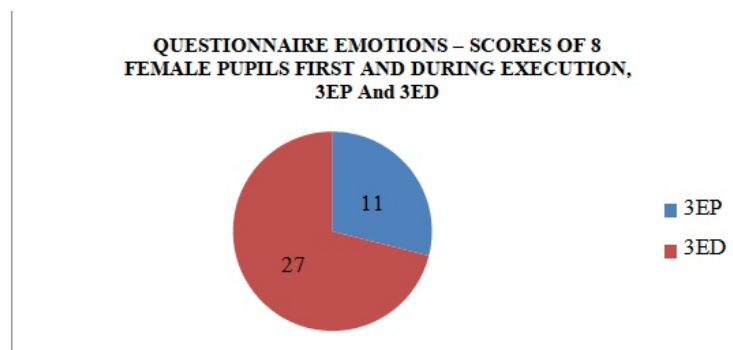
**Figure 47.** 11—Questionnaire emotions—Scores of 7 male students before and during execution, 5ep and 5ed.

### 12—Emotions questionnaire—Scores of 8 female students before and during the execution

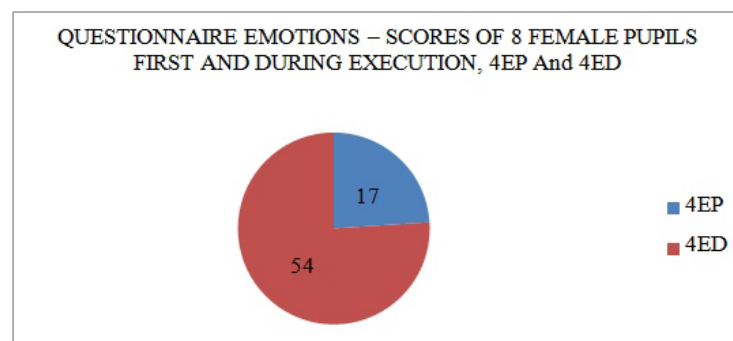
Females reported anger/rage (3EP - 3ED) perception scores very similar to those of males (Figure 49); however, for panic (4EP - 4ED) (17 to 54) (Figure 50) and for fear (19 to 51) (5EP - 5ED) (Figure 51), the scores indicate a more intense perception than that of males in both cases.



**Figure 48.** 11—Questionnaire emotions—Scores of 7 male students before and during execution, 6ep and 6ed.



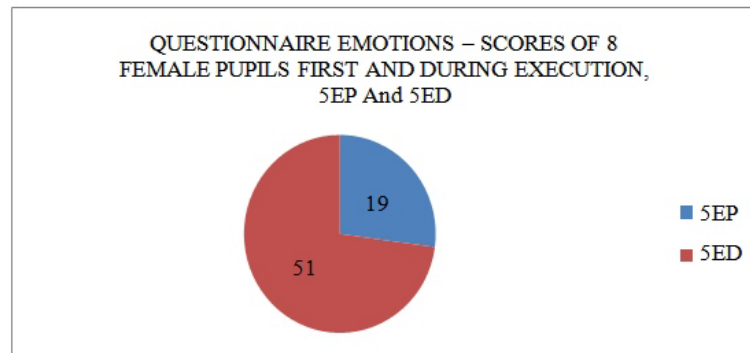
**Figure 49.** 12—Questionnaire emotions—Scores of 8 female pupils first and during execution, 3ep and 3ed.



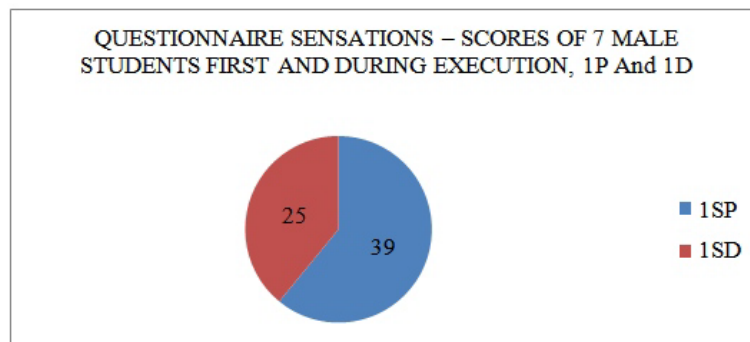
**Figure 50.** 12—Questionnaire emotions—Scores of 8 female pupils first and during execution, 4ep and 4ed.

### 13—Questionnaire sensations—Scores of 7 male students before and during the execution

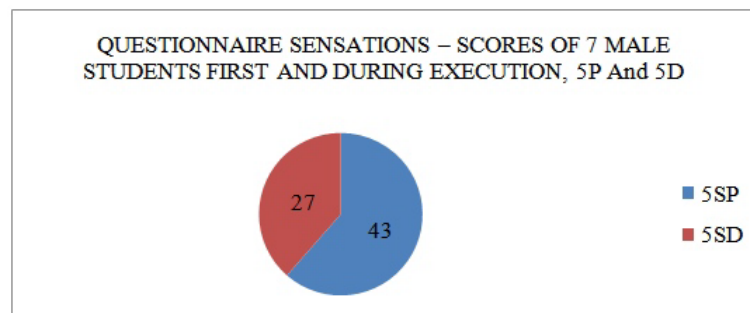
In terms of subjective sensations, males primarily reported a decrease in heart rate (from 39 to 25) (1SP - 1SD) (**Figure 52**) and a reduction in the need to move (from 43 to 27) (5EP - 5ED) (**Figure 53**) in the scores.



**Figure 51.** 12—Questionnaire emotions—Scores of 8 female pupils first and during execution, 5ep and 5ed.



**Figure 52.** 13—Questionnaire sensations—Scores of 7 male students first and during execution, 1p and 1d.

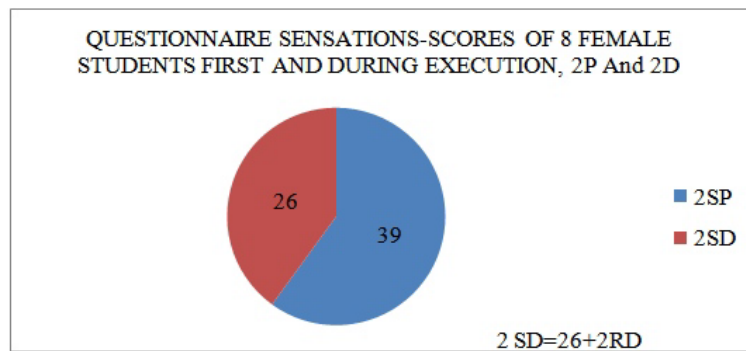


**Figure 53.** 13—Questionnaire sensations—Scores of 7 male students first and during execution, 5p and 5d.

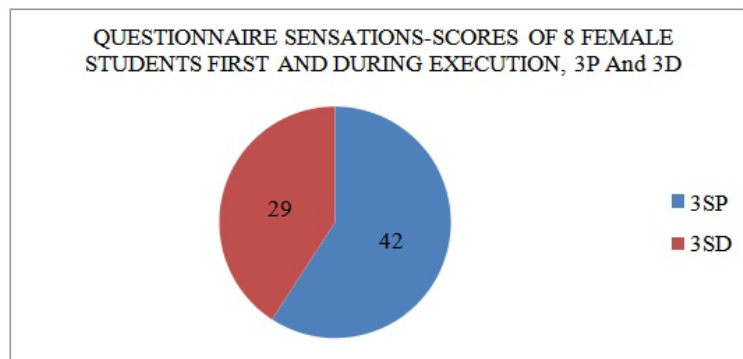
#### **14—Sensations questionnaire—Scores of the 8 female students before and during execution**

With regard to females, the most significant variables are a decrease in breathing variation compared with usual (from 39 to 26) (2SP - 2SD) (**Figure 54**) and a reduction in the sensation of cold (from 42 to 29) (3SP - 3SD) (**Figure 55**), per-

ceived as less intense than usual.



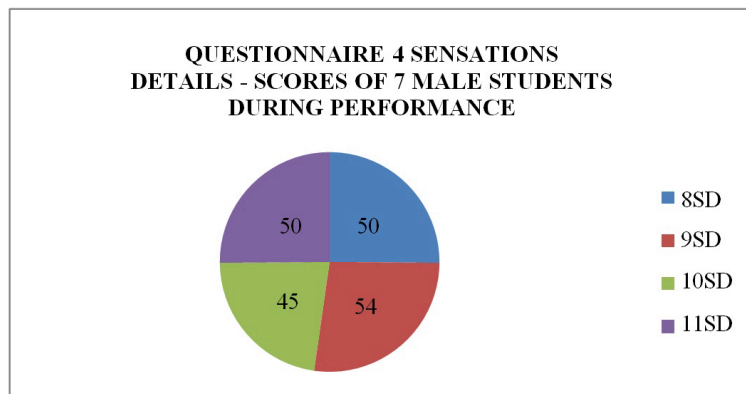
**Figure 54.** 14—Questionnaire sensations-scores of 8 female students first and during execution, 2p and 2d.



**Figure 55.** 14—Questionnaire sensations-scores of 8 female students first and during execution, 3p and 3d.

**15—Questionnaire 4 unusual sensations—Scores of the 7 male students during the performance**

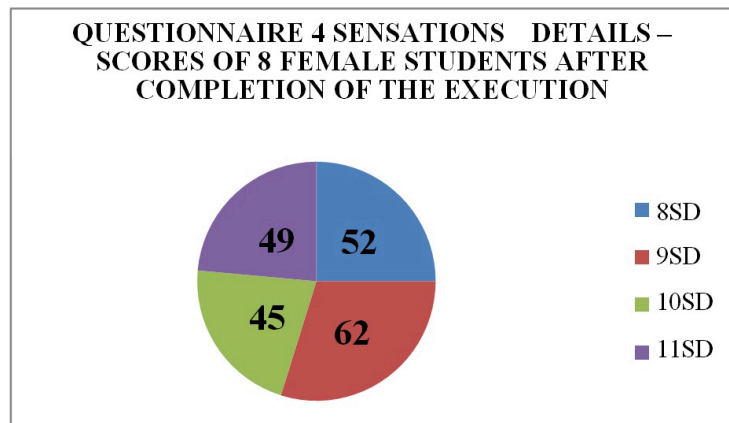
For males, there was an altered perception of the passage of time, in the sense of greater speed, whereas attunement with the external space (10SD) (45) (**Figure 56**) is somewhat less strongly perceived than the assessment of other sensations.



**Figure 56.** 15—Questionnaire 4 sensations details—Scores of 7 male students during performance.

### 16—Questionnaire 4 sensations specific—Scores of 8 female students during performance

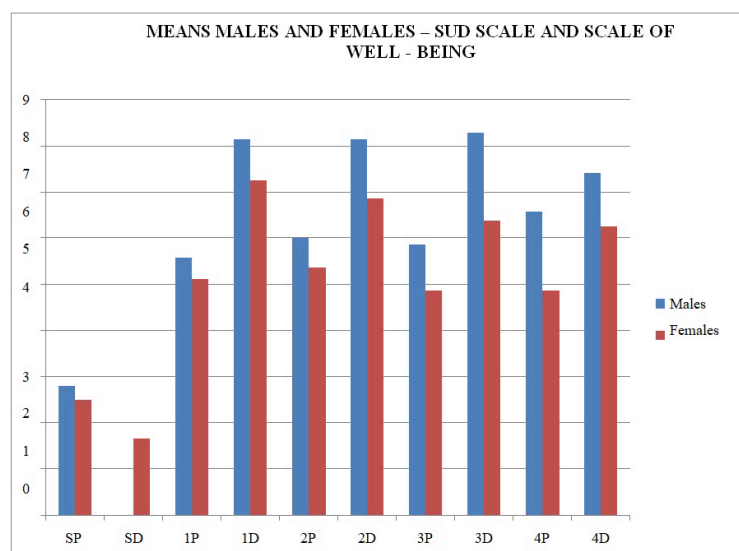
Among females, the sensation of alteration in the passage of time is perceived in a slightly more intense manner (9SD) (62) than among males, followed by an alteration in the perception of space (8SD) (52), experienced as broader than usual (Figure 57).



**Figure 57.** 16—Questionnaire 4 sensations details—Scores of 8 female students during performance.

### 17—Means males and females—Scale sud and scale of well-being

The comparison between males and females is evident in the histogram for the WELL-BEING scale, where males' scores are consistently higher than females' both before and after the concert. Probably, both in terms of expectations and subjective sensations, males experienced a higher level of well-being throughout the entire laboratory experience, whereas for females it was less easy to relax (Figure 58).



**Figure 58.** 17—Means males and females—Sud scale and scale of well—Being.

These results are corroborated by the SUD Scale: distress decreased markedly in males; after listening to the musical pieces, it even dropped to zero, whereas in females it decreased by almost one point.

### 18—Means males and females—Questionnaire emotions

The comparison indicates a heterogeneous pattern between males and females depending on the emotions perceived: the scores for arousal (1EP - 1ED) and joy (2EP - 2ED) are higher in males than in females both before and during the concert, whereas an opposite trend is observed for fear (5EP - 5ED) and panic (4EP - 4ED), which are more intense in females during the musical performance (Figure 59).

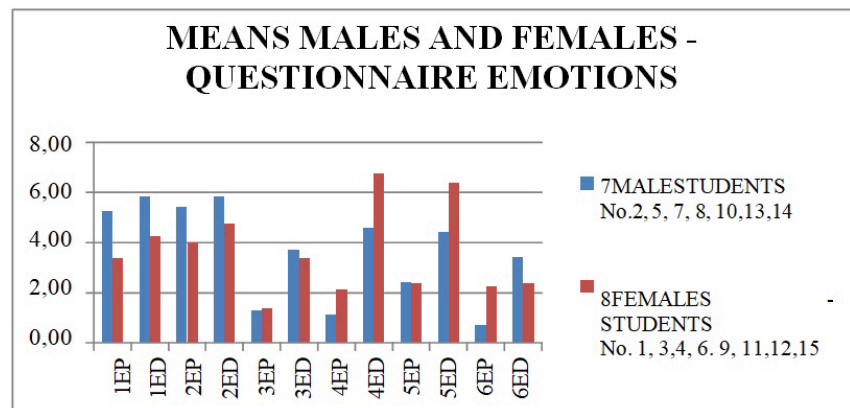


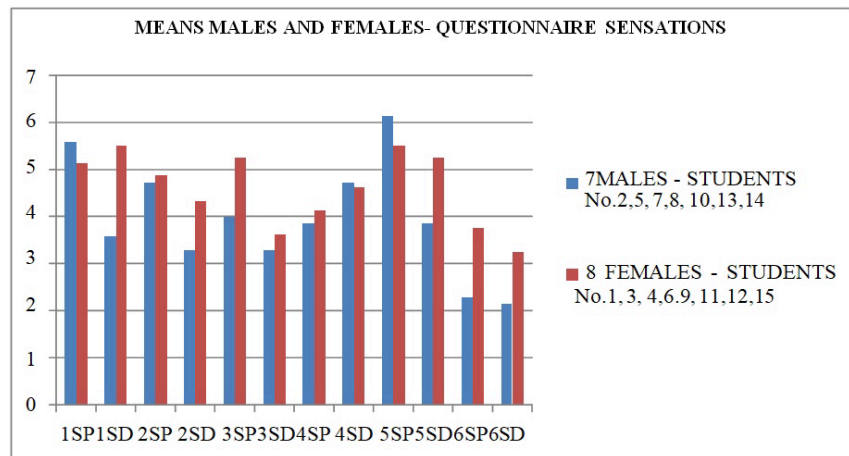
Figure 59. 18—Means males and females—Questionnaire emotions.

### 19—Means males and females—Questionnaire sensations

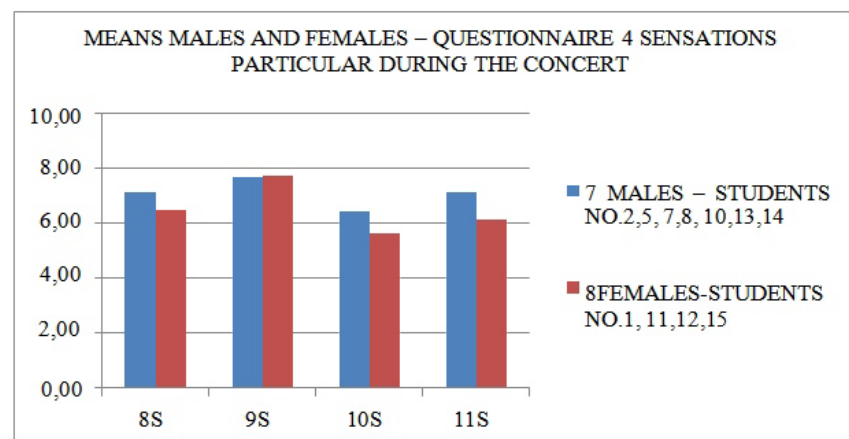
Regarding the different sensations experienced, males showed generally lower somatic engagement than females, with a tendency to perceive bodily sensations less intensely. Only before the concert did they perceive more cold than females, whereas during the concert they perceived the change in breathing variation only slightly more intensely than females. Females, by contrast, reported a strong perception of heartbeat prior to the performance, likely due to anticipatory expectations, and both before and during the concert they felt warmer than males. In females, the need to move and to shout decreased slightly compared with males; in males, only the need to move decreased markedly before and after the performance, whereas the need to shout showed virtually no change (Figure 60).

### 20—Male and female means—Questionnaire 4: Unusual sensations during the concert

As previously noted, there are no substantial gender differences in specific sensations during the concert; the only difference observed is that males show a greater tendency to feel in tune with the gestures performed by Prof. Barlera during the performance of the pieces. Because males also report a slightly higher perception of being in tune with the external environment (Figure 61), we can hypothesize that females are more oriented toward listening to themselves and to their own body, during the performance of the pieces.



**Figure 60.** 19—Means males and females—Questionnaire sensations.



**Figure 61.** 20—Means males and females—Questionnaire 4 sensations particular during the concert.

## 7. Performance of Musical Excerpts and Variations in the Perception of Emotions during Listening

It was possible (with the invaluable support of Prof. Villella) to prepare the graphs depicting the continuous modulation of emotions following exposure to Prof. Barlera's acousmatic music, which can generate an extremely rich soundscape characterized by ongoing musical variations. Using the recordings made during the musical/sensory workshop, it was possible to observe the participants' movements: through their repeated transitions from one poster board to another, they indicated changes in their personal emotions (Figure 62), in response to auditory stimuli. Moreover, it was possible to investigate perceptions of anxiety and calmness/harmony that questionnaires alone had not examined in depth.

The graphs highlighting the most significant results are presented and analysed. Each graph shows the number of participants standing at a specific sign indicating the emotion subjectively perceived, depending on the moment in the musical piece. For the purposes of timing, a time interval of approximately 10 seconds prior to the photographic shot is considered as the reaction time required to allow

participants to move to a new sign. This accurate recording makes it possible to identify the most common emotions within the group in relation to specific frequencies of the pieces.



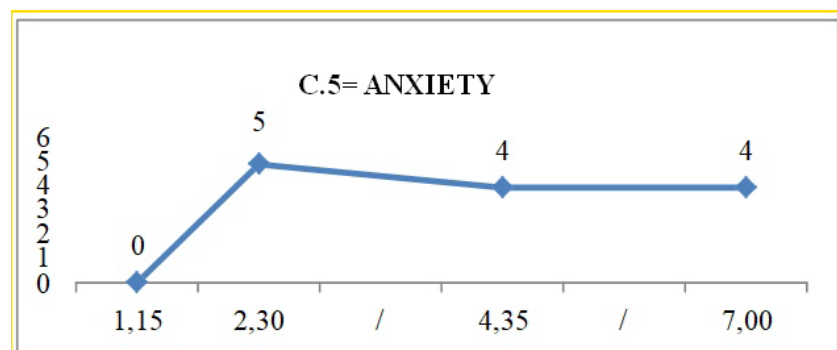
**Figure 62.** Boys and girls on the mats, placed near the signs, in a moment of laboratory.

### 1' passage: *ABYSS*

*ABYSS* unfolds like a wave, drawing the listener into a vortex of layered electronic sounds oscillating between dark textures and moments of sparse suspension. Its sonic architecture relies on the contrast between tension and release, between sounds that expand like distant echoes and pulses that emerge from silence, like fragments of submerged thoughts.

Duration track: 7 minutes and 25"

A rapid escalation (from 0 to 5) and subsequent stabilization (4) are observed for anxiety (**Figure 63**), whereas the calm/harmony curve (**Figure 64**), after a slight dip midway through the composition (from 3 to 1), subsequently rose again toward the end (4). This differentiated pattern, depending on the participants, already indicates that the emotional response is subjective and may also depend (as this is the first piece) on baseline *emotional states* before the concert and on the degree of personal involvement, depending on the characteristics of each composition. The group, with *Abyss*, is beginning to immerse itself in the soundscape and to orient itself among the different acousmatic timbres.



**Figure 63.** C.5 = Anxiety.

## 2' passage: *INTERFERENCE*

*INTERFERENCE* is the sound of doubt, instability, and inner voices overlapping until they create a sonic landscape of colliding fragments. The piece investigates the insecurities of the human mind through an interplay of superimpositions and distortions. Each sound seems to strive to prevail over the others, generating an unstable equilibrium that is perpetually on the verge of breaking.

Duration track: 7 minutes and 10"

The anger/rage (Figure 65) reaches a peak (6) shortly before the midpoint (3 minutes from the beginning) of the piece and is reduced to zero by the end. Panic (Figure 66) peaks (5) after approximately 2 minutes and 30 seconds and then, after a slight decline, stabilizes at 3 before dropping to 1. Anxiety (Figure 67), by contrast, remains fairly constant throughout the composition (from 4 it decreases to 3). Fear (Figure 68) peaks at approximately 1 minute and 30 seconds (5); around the midpoint it declines (2), then returns to a higher level (4) at 4 minutes and 30 seconds, and then progressively decreases until the end (1). Calm/harmony (Figure 69) rapidly rises to 6, then after approximately 1 minute and 30 seconds drops to 1, and within a few seconds to 0; it rises to 2 after 3 minutes and 30 seconds; at 4 minutes and 30 seconds it drops to zero again, and then rises to 6 at the end of the piece. Indeed, in *Interference* the emotions experienced by participants are more variable and diverse.

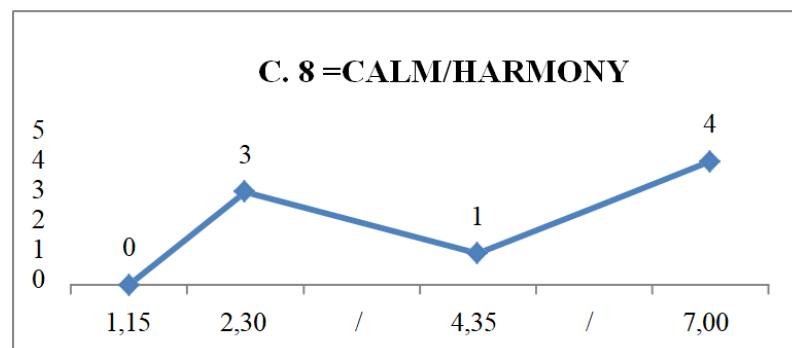


Figure 64. C.8 = Calm/Harmony.

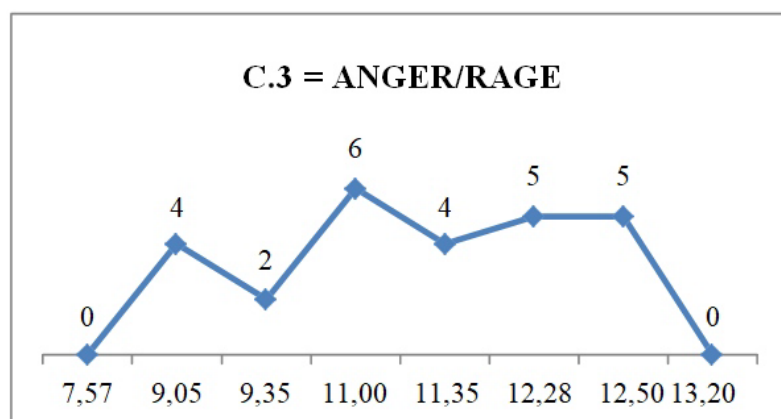


Figure 65. C.3 = Anger/Rage.

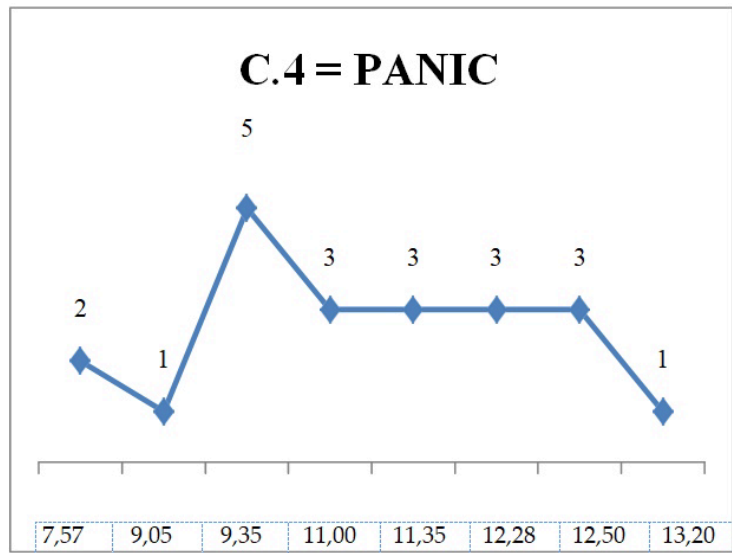


Figure 66. C.4 = Panic.

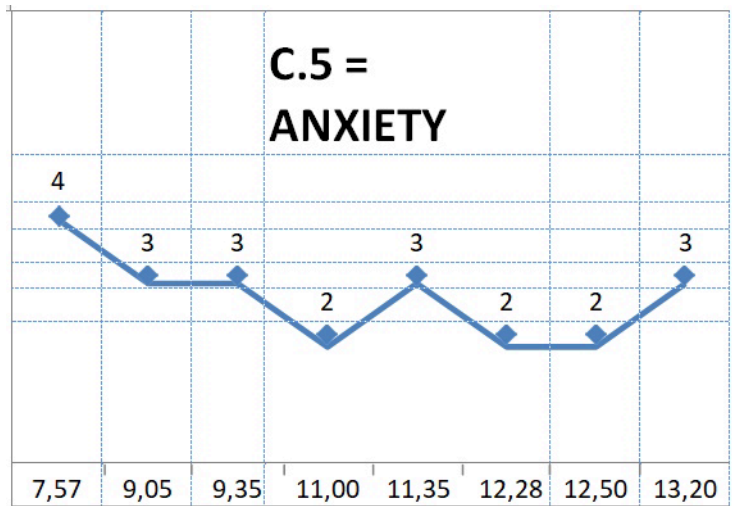


Figure 67. C.5 = Anxiety.

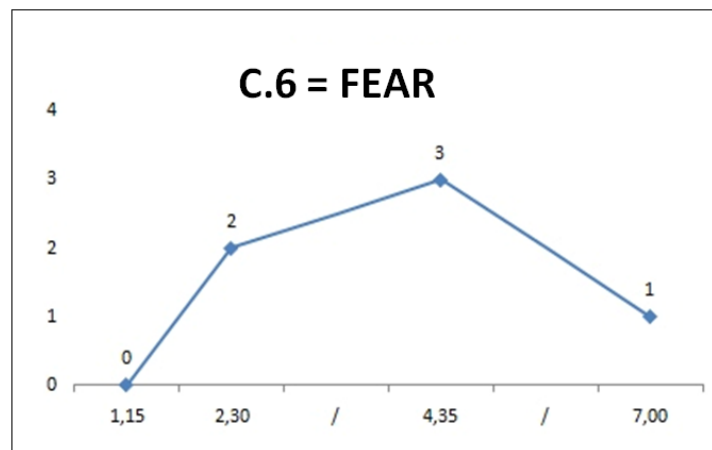


Figure 68. C.6 = Fear.

### 3' passage: *NO CONTROL!*

NO CONTROL! is a piece that challenges the perception of time and space through a fragmented pulse and a constantly evasive, unstable sonic attitude, perpetually in tension. Rather than anchoring to a regular beat, the rhythmic cells seem to elude, dissolve, and reassemble into unpredictable forms, as if the mind were attempting to free itself from the constraints of time and structure in order to explore a more abstract, indefinable dimension.

Duration track: 5 minutes and 21"

Excitation (Figure 70) reaches 7 at 1 minute and 30 seconds into the piece, then drops to 1 at approximately 3 minutes from the start, and subsequently rises progressively to 8 at the end of the composition. Joy (Figure 71) starts strongly (7) and then decreases to 0 at 35 seconds, remaining very low until 3 minutes, then rising at 3 minutes and 15 seconds (4) and reaching 3 at the end. Anger/rage (Figure 72) rises to 7 at 35 seconds, then falls back to 0 at 1 minute from the start of the performance, then rises to 2, at 2 minutes from the start, and then at 2 minutes and 30 seconds drops to 0 and rises at 3 minutes of the piece (3), then decreases to 0 toward the end. For panic (Figure 73) the peak (5) occurs at 35 seconds from the start, after which it decreases and then rises again to 4 at 2 minutes and 30 seconds, before falling again to 0 at the end of the composition. Anxiety (Figure 74) increases progressively to its peak at 3 minutes from the start (6), then declines rapidly to 2 at 3 minutes and 20 seconds, and then reaches 3 at the end of the piece. Finally,

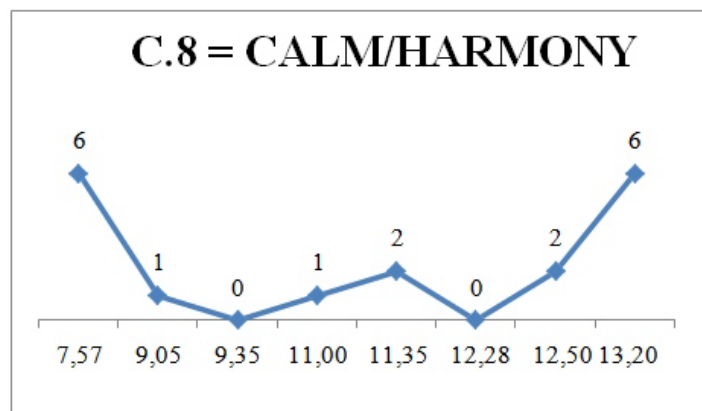


Figure 69. C.8 = Calm/Harmony.

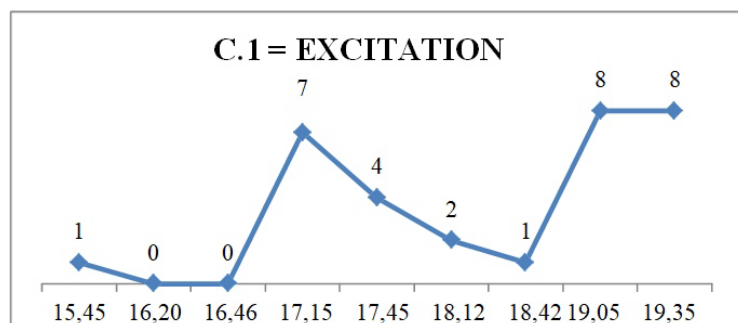


Figure 70. C.1 = Excitation.

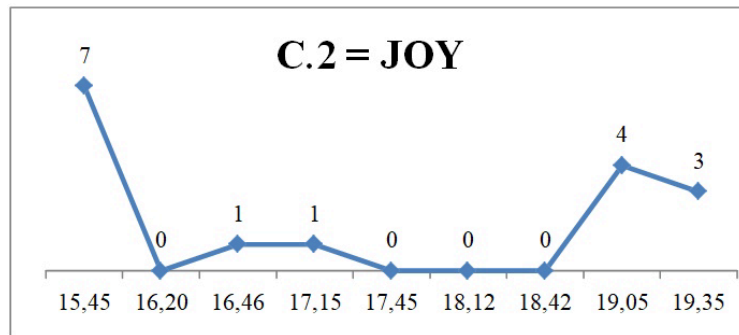


Figure 71. C.2 = Joy.

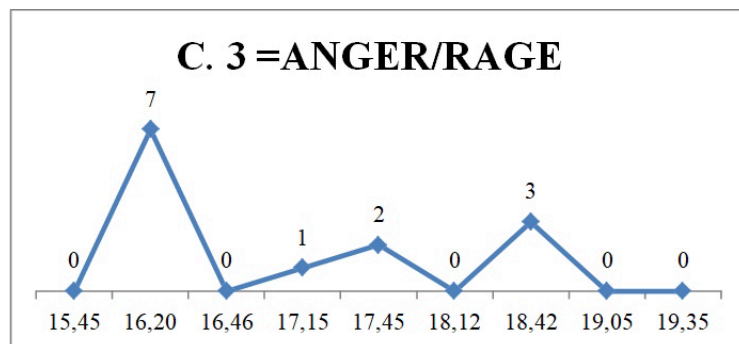


Figure 72. C.3 = Anger/Rage.

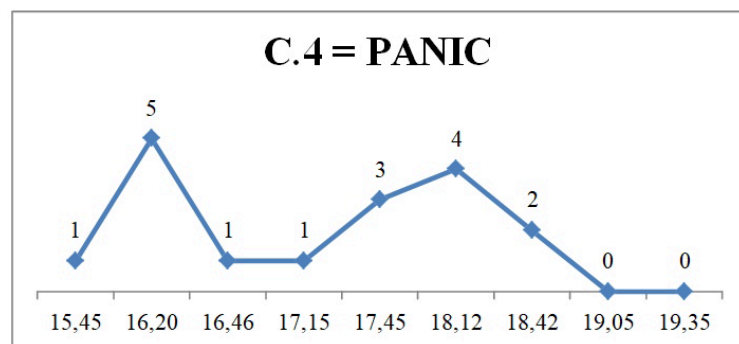


Figure 73. C.4 = Panic.

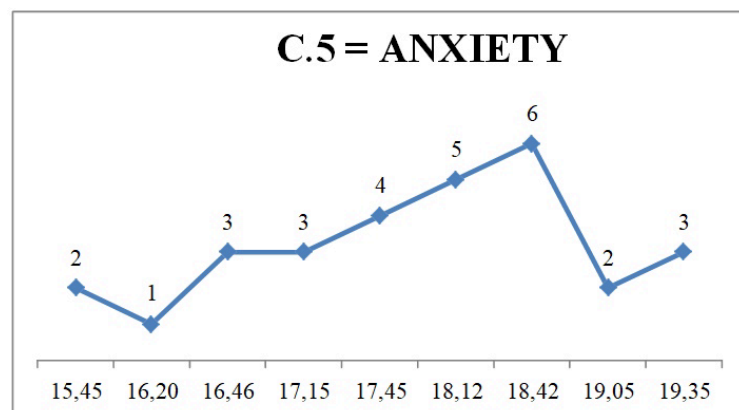


Figure 74. C.5 = Anxiety.

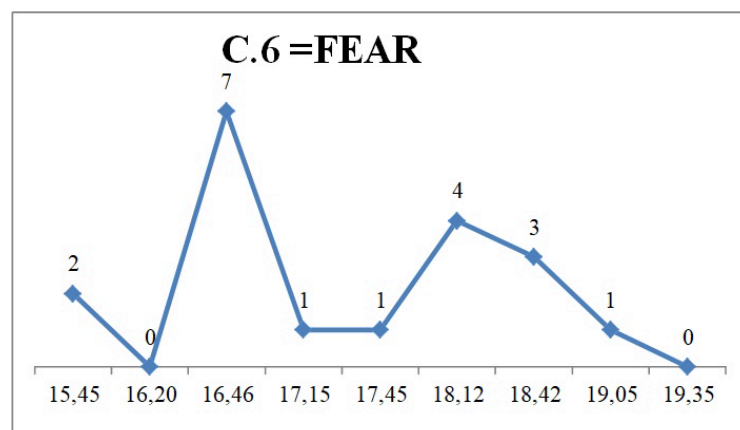
fear (**Figure 75**) reaches the peak (7) at one minute from the start, then decreases to 1 after 1 minute and 30 seconds from the start, rises to 4, at 2 minutes and 30 seconds, and then decreases progressively to 0 at the end of the performance. *No control!*, precisely because of the particular nature of its variations, elicited highly variable and discontinuous emotional responses among participants.

#### 4' passage: *FRAGMENTS*

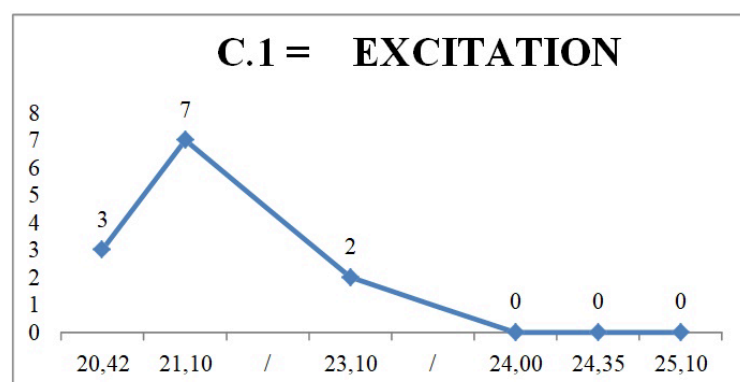
FRAGMENTS is a mosaic of fragmented rhythmic impulses that emerge and dissolve within an ethereal soundscape, a suspended sonic exploration that is simultaneously rarefied and unstable. The piece is shaped by the contrast between motion and stillness: deconstructed, alien rhythmic cells seem to drift without any real point of anchorage, while static textures unfold in the background, as if time were suspended in an eternal present.

Duration excerpt: 5 minutes and 15"

Immediately, excitation arousal (**Figure 76**) begins; at 4 and within 30 seconds it rapidly reaches the peak (7), then declines fairly quickly to 0 at 3 minutes and 20 seconds. Panic (**Figure 77**) also reaches its minimum in about 1 minute and 30 seconds, dropping from 2 to 0, and then, at 3 minutes and 20 seconds, it rises to 4, immediately thereafter to 5, and then decreases again to 2 at the end of the piece. Anxiety (**Figure 78**) in 2 minutes and 30 seconds rises from 2 to 5 and



**Figure 75.** C.6 = Fear.



**Figure 76.** C.1 = Excitation.

tends to remain stable (4) until the end of the composition. Fear (Figure 79) decreases from 4 to 0 within 30 seconds, and then rises again to 2 at the end of the piece. Calm/harmony (Figure 80) is at 2 at the beginning and reaches 7 at 2 minutes and 30 seconds; it drops to 2 at 3 minutes and 20 seconds from the start, and then increases to 5 at the end of the performance. This indicates that *Fragments*, at the beginning, predominantly elicited arousal; midway through the piece, both anxiety and calm/harmony predominate, highlighting the extent to which emotional responses to music are subjective.

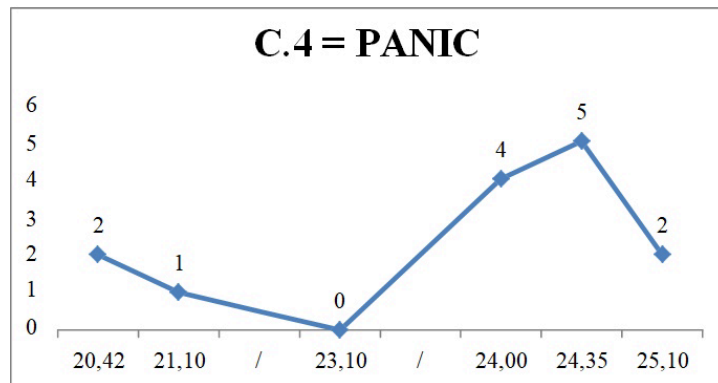


Figure 77. C.4 = Panic.

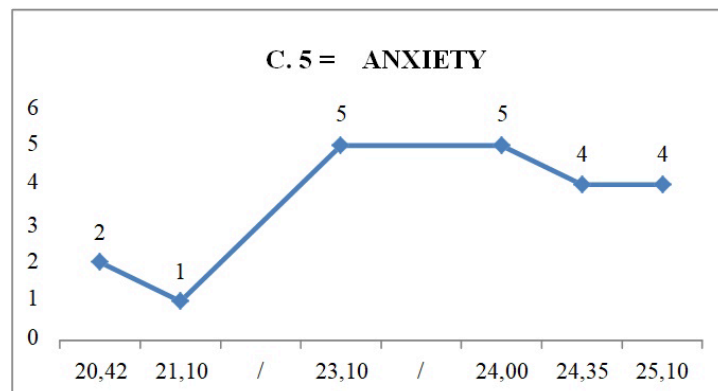


Figure 78. C.5 = Anxiety.

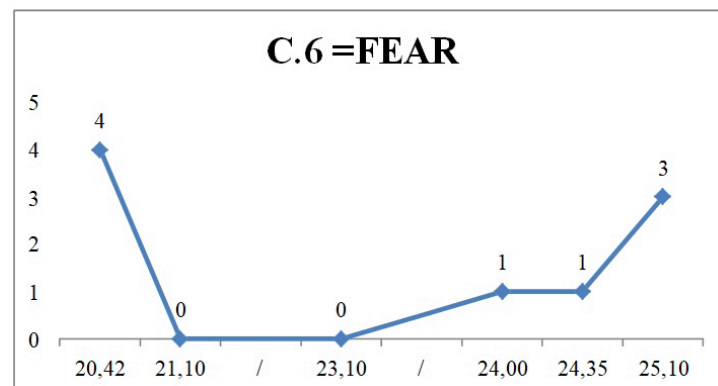


Figure 79. C.6 = Fear.

### 5' passage: *FRAGILE*

FRAGILE is the moment in which the human soul strips itself of all artifice and confronts the unknown. The piece is a suspended sonic universe, an architecture of rarefied sounds that move slowly, allowing the sense of stillness before something unfathomable to emerge. At the center of the sonic gesture, there is a fixed, constant, and impassive frequency, a symbol of an invisible bond between the finite and the infinite, between human fragility and the idea of the divine.

Duration track: 5 minutes

Within 1 minute and 45 seconds, joy (Figure 81) decreases from 5 to 0; after a further 1 minute and 30 seconds, it reaches 1, rises to 3 after 35 seconds, and then drops to 0 at the end of the piece. Fear (Figure 82), within 1 minute and 45 seconds, increases from 3 to 5; at 3 minutes and 10 seconds from the beginning of the composition, it reaches 2; after 35 seconds it drops to 0, and then rises again to 2 at the end of the performance. Calm/harmony (Figure 83) follows a curve: from 0 it reaches 4 within 1 minute and 45 seconds; at 3 minutes and 45 seconds from the beginning of the piece, it reaches 5, then 6 (4 minutes and 30 seconds), and then gradually decreases to 2 at the end of the composition. Joy and fear exhibit continuous oscillation in *Fragile*, thus, these emotions are highly unstable, whereas the perception of calm/harmony follows a gradual upward trajectory and then declines in an equally gradual manner.

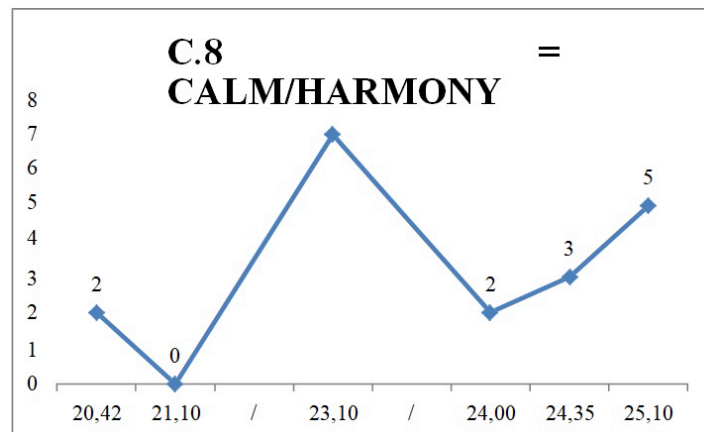


Figure 80. C.8 = Calm/Harmony.

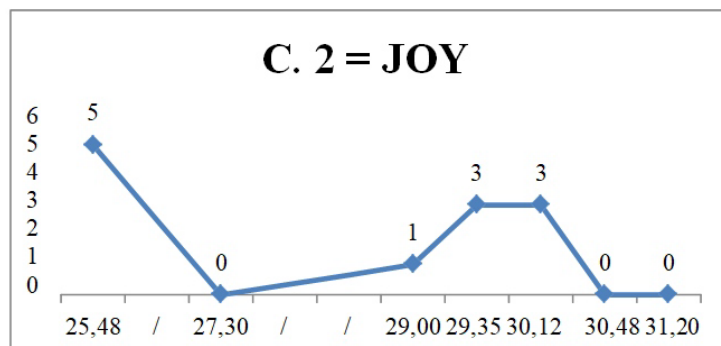


Figure 81. C.2 = Joy.

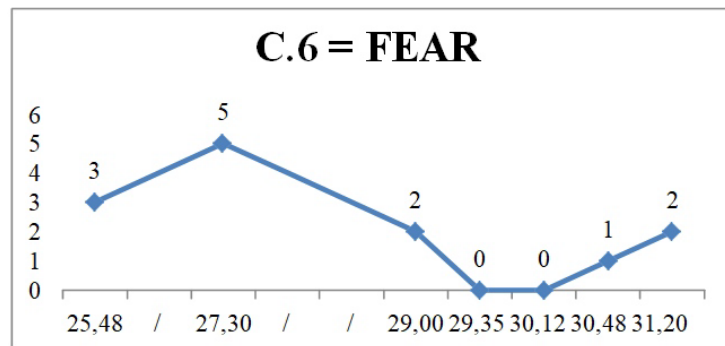


Figure 82. C.6 = Fear.

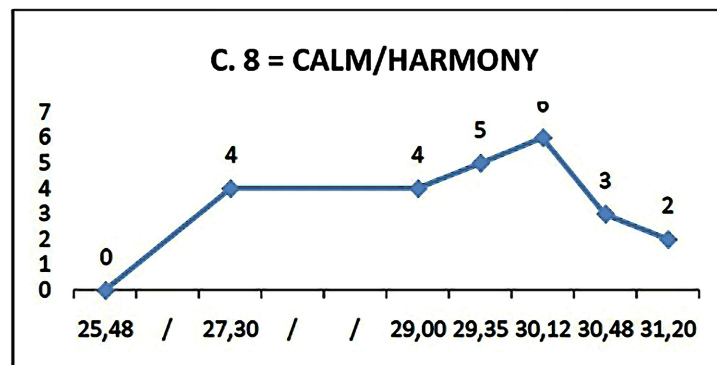


Figure 83. C.8 = Calma/Armonia.

### 6' passage: *ETHEREAL*

ETHEREAL represents the culmination of an inner journey, the moment when the soul rises and detaches itself from the uncertainties that have accompanied it. The piece opens onto a suspended soundscape, composed of rarefied harmonies and ethereal timbres that evoke abstract spaces of peace and relaxation. A central element of the composition is a percussive sound—almost a bell—small and distant, which resonates with disarming gentleness, granting the listener a sense of meditative depth and profound sacredness. The journey concludes, but this is not an ending; rather, it is an opening, instilling a sense of belonging to something greater and intangible.

Duration track: 9 Minutes and 18"

Regarding anxiety (Figure 84), the perceived level reached a maximum of 3 at the beginning, and then again at 2 minutes and 55 seconds from the beginning, subsequently oscillating between 2 and 3 for almost the entire duration, before stabilizing at 1 at the end. Sadness (Figure 85) was perceived in a slightly more intense manner, with a peak of 4 at 6 minutes and 30 seconds from the beginning, and decreased slightly (to 3), persisting until the end of the composition. In the final excerpt, calm/harmony (Figure 86) was experienced profoundly by most participants, peaking at 10 at 3 minutes and 30 seconds from the beginning. *Ethereal* primarily elicited calm/harmony (Figure 87) that, in several participants, persisted even after the concert, as indicated by the images and by the group discussion.

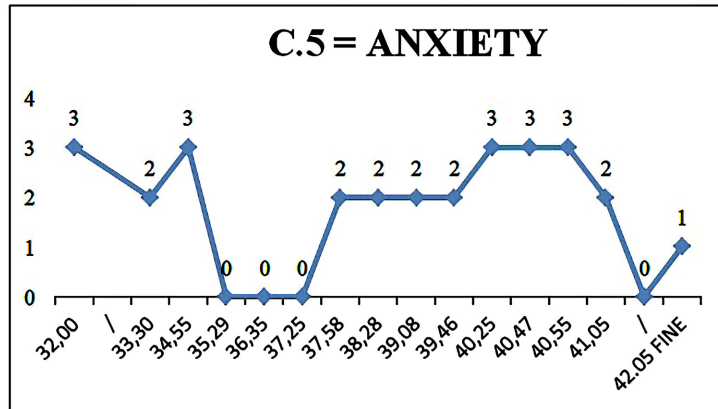


Figure 84. C.5 = Anxiety.

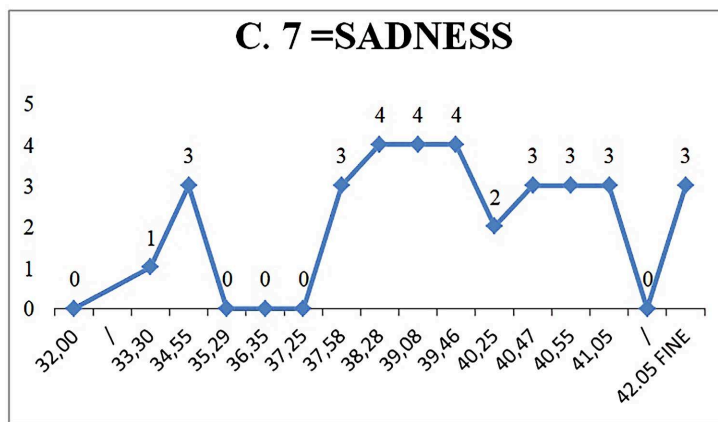


Figure 85. C.7 = Sadness.

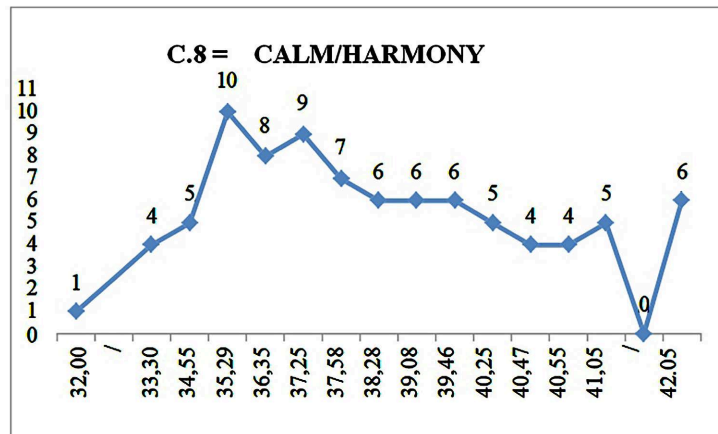


Figure 86. C.8 = Calm/Harmony.

### 8. Analysis of the Spectrogram of the Tracks of the Laboratory

The acoustic spectrogram is a frequency-time plot showing the frequencies that constitute the sound wave as a function of time: the horizontal axis reports the temporal progression of the performance, expressed in minutes and seconds,

whereas the vertical axis represents frequency values.



**Figure 87.** Boys and girls on the mats, placed near the signs, while listening to ethereal, at the end of laboratory.

Whereas frequency depends on the number of vibrations per second, sound intensity depends on vibration amplitude: the greater the sound wave amplitude, the more the sound perceived is loud, whereas a vibration at the same frequency but with lower amplitude produces a weaker sound. Spectrograms provide information about wave amplitude (and thus sound intensity), represented through a color code: sound intensity is shown with warmer colors (such as yellow and red), which indicate greater amplitudes, whereas cooler colors (such as blue and purple) indicate lower amplitudes.

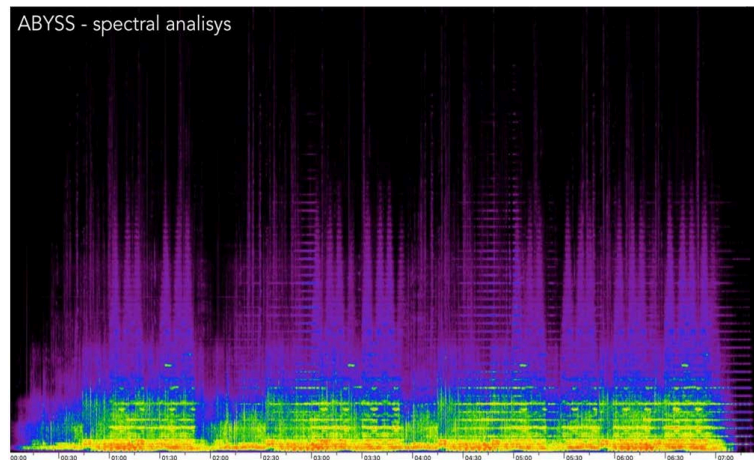
In a spectrogram, light purple denotes low sound intensity relative to a specific high frequency at a given time point. Red, by contrast, indicates the opposite. Moreover, when interpreting the spectrogram, it is necessary to assess whether the combination of simultaneously very low and very high frequencies is associated with specific compensations and the resulting cancellation of the emotional effect (+1 and  $-1 = 0$ ). Indeed, the emotional impact derives primarily from the relationships between the different frequency bands and from the way in which these support the content of a piece.

Spectral analysis was therefore used not only descriptively, but also to identify relationships between acoustic structure and perceptual response. For each track, a high-resolution spectral analysis was performed using the short-time Fourier transform (STFT) method, using the professional audio editing and mastering software WaveLab PRO 12, developed by the German company Steinberg Media Technologies GmbH, based in Hamburg. This analysis allowed us to observe the temporal evolution of sound energy across different regions of the spectrum. The spectrogram was then segmented into constant, short-duration time windows, transforming the continuous flow of sound into analyzable intervals in which to measure the distribution of energy across different frequency bands.

In each time segment, several spectral quantities, relevant to affective perception, were extracted: first, the energy distribution in three macro-bands—low frequencies (approximately below 200 - 250 Hz), medium frequencies (approximately 250 - 2000 Hz), and high frequencies (above 2000 Hz). This subdivision allows us to distinguish regions of the spectrum with different perceptual effects: low frequencies tend to produce a direct bodily impact, often associated with pressure or tension; medium frequencies are central to intelligibility and sound presence; high frequencies are more often perceived as bright, light, or airy. In addition to energy distribution, the spectral centroid, an indicator of sound brightness—high values correspond to brighter sounds, low values to darker sounds—and spectral density, understood as the degree of band filling over time and a possible correlate of perceived timbral complexity, were also analyzed.

A spectrogram was created for each of the six acousmatic compositions for live electronics by Prof. Barlera, and the frequencies of the pieces were correlated with specific reactions and psychosomatic experiences. The results for *anxiety and calmness* are reported below. These mood states were found to be significantly modulated by specific sound frequencies.

1) **ABYSS—Duration track: 7 minutes and 25" (Figure 88)**



**Figure 88.** Spectrogram of abyss.

### Anxiety

The frequencies progressively increase to 2500 Hz at around 1 minute; at 1 minute and 50 seconds there is a slight interruption in the low frequencies, with a sudden decline. Subsequently there is a steady recovery until reaching 2 minutes and 30 seconds: at that exact moment anxiety is observed at 5. From that point onward, the frequencies remain compact and constant, at approximately 2500 Hz, for the entire duration of the piece: anxiety remains fairly stable (from 5 to 4) until the conclusion. Some intermittent frequencies also appear and remain stable at around 3000 Hz (lines with green-yellow coloration) up to 7 minutes (end of the piece).

The observed level of anxiety, indicated by the low frequencies, is partially mit-

igated by very high and brief frequencies (light purple) that, at certain moments, rise sparsely to 18,500/19,000 Hz and overlap across almost the entire track.

#### Calmness/harmony

The highest frequencies, corresponding to very high-pitched sounds, were probably detected within a range of very brief and sparse acoustic stimuli that rises and falls from 2500 Hz to 19,500 Hz (light purple shading), mirroring the oscillation of calmness. The rise is consistently alternated with drops between 1' and the end of the track, that is, at 7 minutes and 25 seconds, and this result corresponds to what is shown in graph C 8 (calmness/harmony).

#### 2) *INTERFERENCE*—Duration track: 7 minutes and 10" (Figure 89)

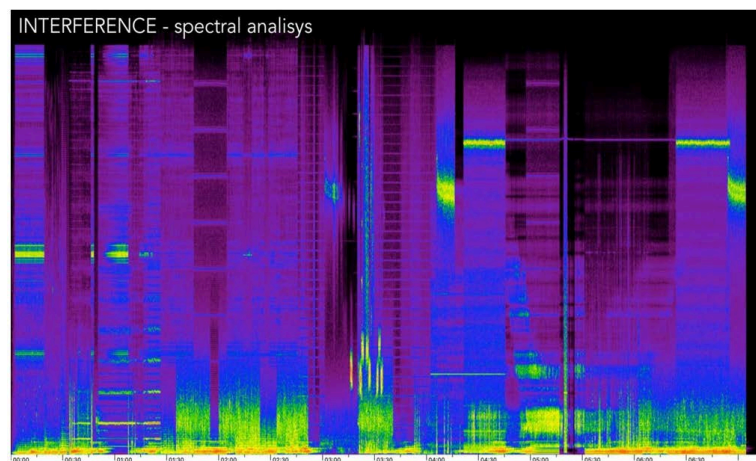


Figure 89. Spectrogram of interference.

#### Anxiety

Frequencies reaching up to 2500/3000 Hz (yellow-green coloration) remain stable in blocks starting at 0'35" and throughout the entire track (and anxiety decreases from 4 to 3). Some interruptions are observed, with a decrease marked in frequencies, in particular between 2'58" and 3'20" (and anxiety from 3 drops to 2 at that moment). Frequencies decrease slightly at 2000 Hz and become more sparse only at the end of the track (and anxiety also increases from 2 to 3).

#### Calm/harmony

Calmness/harmony rises rapidly to 6 because high frequencies persist—up to 18,500 Hz—from the beginning of the piece; starting at approximately 1'40", there is a sudden and progressive disappearance of the high sounds of light purple: from here the rapid drop to 0 in calmness, in order to then rise slightly to 2, at approximately 3' and 35". Then, at 4'30", there is another brief disappearance of the light-purple high sounds, which brings calmness again from 2 to 0; subsequently, the frequencies become more perceptible and distributed across differentiated bands starting at 5'20" (and calmness rises to 6), with frequencies dropping to 13,500 Hz and appearing more sparse, more rarefied and in vertically parallel lines, in order to then return to 18,000 [ph 43] [ph 44] and above, from 6'25" until the end of the piece.

### 3) *NO CONTROL!*—Duration excerpt: 5 minutes and 21" (Figure 90)

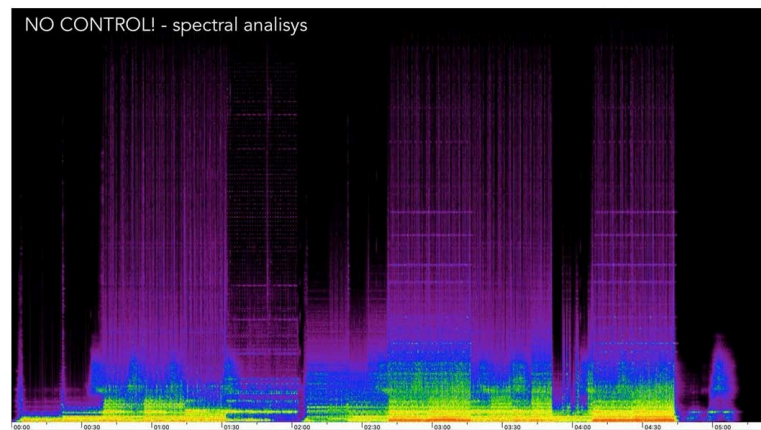


Figure 90. Spectrogram of no controll.

#### Anxiety

At 3 minutes anxiety reaches 6 (and the yellow/green frequency bands rise slightly to 2500/3000 Hz and become more intense). In particular, from 2' and 40" to 3' and 15", the lower band (up to 250 Hz) turns red. Shortly thereafter, at 3' and 20", anxiety decreases to 2 (and the red frequency bands nearly disappear). From 4' and 10" to 4' and at 45", the frequencies shown in red increase slightly. Subsequently, at 4'45" and until the end of the piece, the low frequencies highlighted in yellow/green and red are almost completely interrupted (and anxiety increases slightly to 3). The high frequencies, represented by extremely thin light-purple lines, do not compensate for the numerous emotions elicited by the piece.

### 4) *FRAGMENTS*—Duration track: 5 minutes and 15" (Figure 91)

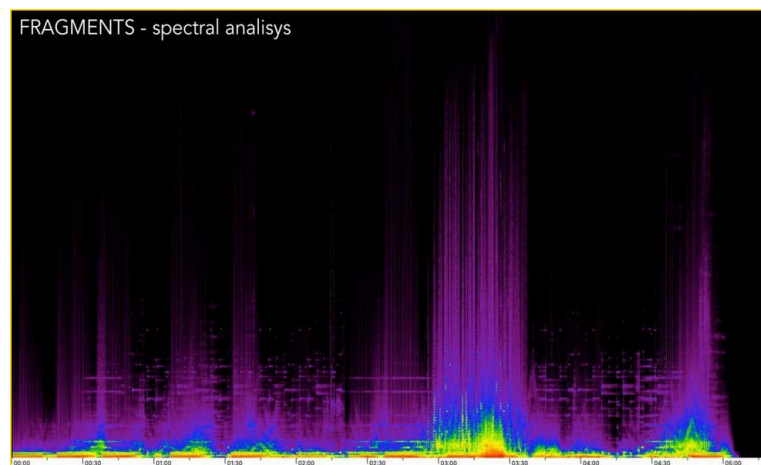


Figure 91. Spectrogram of fragments.

#### Anxiety

Very low frequencies up to 250 Hz, shown in red and constantly present, promote a progressive increase in anxiety, which from 2 minutes and 30 (5) tends to

remain fairly stable until the end of the piece (4). From 3'15" to 3'30", no anxiety peak is observed because the low frequencies in red and yellow/green, which at this point reach a peak at 1500 Hz, are strongly counterbalanced by the thin, more compact high frequencies that reach 18,500/19,000 Hz.

#### Calmness/harmony

Calm emerges to some extent from the beginning (2) and in intermittent bursts, because low frequencies (shown in violet) are continuously present and only rarely reach around 7000 Hz; from 2'20" the frequencies drop to 2000 Hz and then rise rapidly at 2'30" up to 10,500 Hz (calm at 7), subsequently reaching 18,500/19,000 Hz, with a peak from 2'55" to 3'40" that should have facilitated calm. However, these frequencies are strongly counteracted by low frequencies (highlighted in yellow/green, but especially red) precisely from 2'55" to 3'35", and calm thus drops to 2. Subsequently, the low frequencies become barely perceptible, giving way at 4'50" to still high frequencies up to 15,000 Hz, which bring calm back to 5 at the end of the performance.

#### 5) *FRAGILE*—Duration track: 5 minutes (Figure 92)

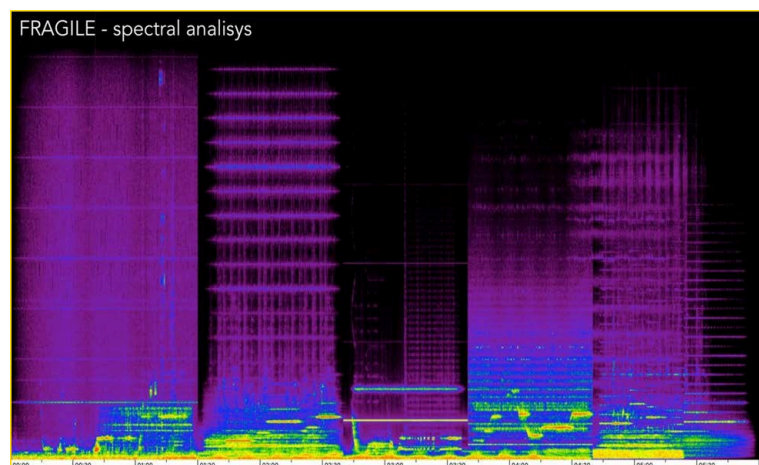


Figure 92. Spectrogram of fragile.

#### Calmness/harmony

By examining the frequencies marked in light purple, it can be observed that, starting at 1'30", the frequencies, which had previously been continuous (up to 18,500 Hz), undergo a brief interruption, for then resuming at 1'40" with block-like parallel frequencies that span different bands (and calmness reaches 4). After a drop at 2'40", subsequently, at 3'40", the frequencies decrease and remain constant at 8000 Hz (and calmness reaches 5). At 4'30" the frequencies across different bands, horizontally parallel, resume up to 17,000 Hz (and calmness at that moment rises to 6). At 5'30" the distribution of light-purple frequencies is barely perceptible; for a few more seconds it still covers different bands, and it becomes increasingly less distinguishable until the end of the piece (and calmness drops to 2). Low frequencies (highlighted mainly in yellow/green) are present, but in a truly intermittent manner. It is also interesting to note that the high frequencies, con-

sistently indicated throughout the piece by sparse, horizontally parallel line blocks in light purple, kept anxiety at imperceptible levels.

6) *ETHEREAL*—Duration track: 9 minutes and 18" (Figure 93)

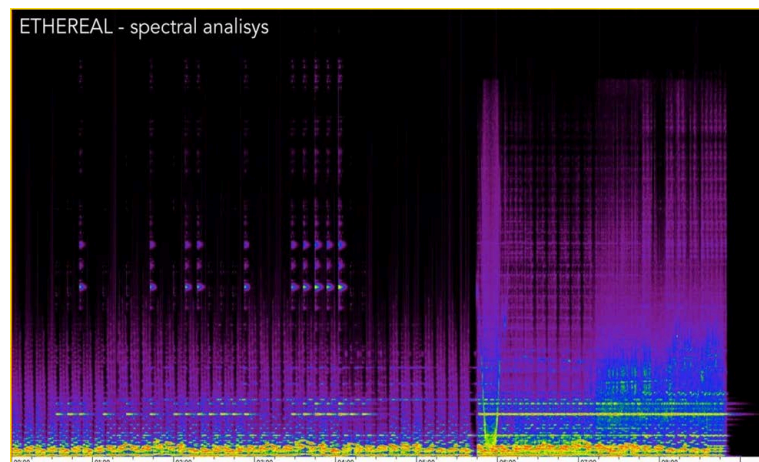


Figure 93. Spectrogram of ethereal.

#### Calmness/harmony

At the beginning of the excerpt, high frequencies are already present, with light purple lines forming small blocks arranged in vertically and horizontally parallel patterns. The light purple frequencies are constant and sparse, becoming more perceptible and distinguishable up to 9000 Hz. Extremely faint frequencies around 18,000 Hz begin to appear approximately 40 seconds after the start of the excerpt, but they are more detectable from 3' and 25" from the beginning of the composition because they become more continuous and frequent. At that moment, calmness reaches a peak of 10, then drops to 0 at the end of the excerpt and subsequently returns to 6 when the composition ends and participants remain silent.

#### Anxiety

A very low level of anxiety emerges during listening, fluctuating between 2 and 3 for almost the entire piece. However, there is a time window between 4' and 5'40" during which no anxiety emerges (0); at that moment, the green-colored frequencies, highlighted intermittently, which previously extended up to 2500 Hz, disappear from 4'30" until 5'40", with a background tone below 500 Hz. Then, after rising again to 3 at approximately 8'30", anxiety drops to zero at the end of the piece. Moreover, the very low and constant frequencies below 500 Hz, with very slight superimpositions of yellow/green lines extending up to 2500/3000 Hz, were frequently offset by the high frequencies present in the piece, up to 18,000 Hz.

### Analysis of Results of the Spectrogram

It was possible to observe that, in the laboratory, low frequencies induced an anxiogenic effect, whereas the rapid, closely spaced oscillations of high frequencies, by contrast, produced a calming effect in participants who were particularly focused on those frequencies, as we had assumed.

Moreover, the constant oscillations of closely spaced high frequencies (18,000 Hz) (in light purple) appear to positively influence calmness, as is particularly evident in track 6, *Ethereal*.

Anxiety, by contrast, appears to emerge more strongly when sudden occurrences of red (from 250 Hz up to 500 Hz) and/or yellow/green (up to 2500 - 3000 Hz, although in some compositions and occasionally they extend beyond this range) then persist constantly, without being attenuated by high frequencies. An instructive example is track 1, *Abyss*, which exhibits high anxiety and a low degree of calm. Indeed, the high frequencies, which continue to rise and fall from 2500 to 19,500 Hz, do not effectively counteract anxiety.

By contrast, it's difficult to find a correlation between frequencies of sounds and other types of emotion, perhaps because, in such cases, the specific subjective reactions to acoustic stimuli and the capacity to modulate emotions themselves are more relevant than the frequencies.

The emotional ratings were then temporally aligned with the analytical windows of the spectrogram, allowing us to compare the trend of the acoustic variables with the changes in affective perceptions reported by the students. The goal was not to demonstrate a direct causality between spectral configurations and emotional states, but rather to identify convergences or recurring patterns. For example, sections characterized by strong low-frequency energy and greater timbral density tended to be associated with more tense or disturbing perceptions, while sections with reduced spectral density and a progressive rise in the spectral center of gravity were more frequently linked to feelings of lightness or relaxation. Interpreting these correlations, however, requires caution, as several acoustic factors can act simultaneously. The analysis therefore considered several potential confounding variables. The first concerns sound intensity: although the power of the amplification system was kept constant, the perception of intensity can vary, due to the effect of spectral density or the presence of low frequencies, making the sound perceived as greater "strength" regardless of the frequency distribution alone. A second variable is timbral density: sounds with numerous simultaneous spectral components can generate perceptual saturation and influence emotional evaluations regardless of the predominant frequency bands. A further factor is the sharpness or rapidity of sound transitions: sudden changes between spectral regions or different density levels can produce emotional reactions related to surprise or perceptual discontinuity rather than to the spectral content itself. The rhythmic component also represents a possible interfering variable, since marked pulsations or rhythmic patterns can induce motor or physiological synchronization phenomena that influence emotional perception; in the laboratory, however, this component was integrated into the compositional model and considered part of the overall system of sound parameters.

Given these interactions, the results of the comparison between the spectrogram and affective ratings must be interpreted as exploratory.

The analysis highlighted some plausible trends between spectral configurations

and perceived emotional states, but was not accompanied by formal statistical modeling or multivariate regressions capable of isolating the contribution of individual acoustic parameters. The results are therefore presented as preliminary indications useful for guiding subsequent research. The laboratory experience suggests that spectral analysis can represent a promising tool for studying the relationship between acoustic structure and affective dimension in acousmatic listening, especially when integrated with more rigorous analytical models and physiological or behavioral measures alongside listeners' subjective ratings. From this perspective, the laboratory represents a first attempt to connect the spectral landscape of sound with the emotional and bodily dynamics of listening, paving the way for further methodological developments in musical and perceptual research.

## 9. Discussion

Sadness, among all the emotions elicited by acousmatic music, was generally the least perceived by the group during the concert, except in the final piece, in which it nevertheless did not exceed 4. Anger/rage peaked in the 2nd (6) and 3rd piece (6), whereas in the other compositions, its perception was extremely limited (2). Joy was also perceived in a very intense manner at the beginning of the 3rd (7) and of the 5th piece (5), only then to decrease rapidly over the remainder of the duration of the compositions and shift toward other emotions. Except for the penultimate piece, anxiety was consistently reported as a constant element, with peaks of 5 in the 1st and 4th piece and 6 in the 3rd. However, in the final composition, *Ethereal*, this emotion proved rather moderate: indeed, the peak reaches only 3. Excitement was perceived very intensely in the 3rd (8) and in the 4th piece (7), whereas in the remaining pieces it was not particularly significant. Fear was perceived in particular in the 2nd and 5th (5), while in the 3rd piece (7) it reached its peak. Panic in the 2nd, 3rd, and 4th piece was the emotion that maintained stable peaks at 5, reaching 6 in the 6th, whereas calm/harmony reached as high as 10 in the final composition, and had already reached 6 in the 4th and 5th piece. The last three compositions were probably perceived as more relaxing and, in any case, in the final minutes *the emotional outburst* previously experienced underwent a positive dissolution into *tranquillity* and *reconciliation with oneself and with the group*, as shown in the images. Toward the end of the concert, the boys and girls gathered almost entirely around the final poster, such that the physical distances between participants were markedly reduced, to the benefit of greater proximity and a stronger shared experience of emotions.

During the discussion, following Prof. Barlera's performance, the participants expressed their enthusiasm for the compositions performed in live electronics and highlighted their surprise at the wide variability of emotions and sensations perceived during the performance of the six pieces. The students also experienced an altered perception of the passage of time and did not believe that 40 minutes had already elapsed.

Thus, thanks to the line of organic synthesizers of SOMA Laboratory, it was

possible to experiment with the extremely diverse and discontinuous range of arousal, joy, anger/rage, panic, anxiety, fear, sadness, calm/harmony, a key objective of our music laboratory.

As we had assumed, gender reaction to acousmatic music should show significant differences, such as great relaxation, calmness, and ability to unwind, at the end of the concert, in males; great panic, fear and anger/rage during the concert and, consequently, less relaxation at the end of the musical performance, in females.

The study's primary conclusion was identified as the change in Psychophysical Well-Being, measured using a validated 5-item scale (SUD scale) that demonstrated excellent internal consistency ( $\alpha = 0.94$ ). Pre-post changes were analyzed using Student's t-tests for paired samples. For secondary comparisons, given the exploratory nature of the research (considering a small sample), we have reported the  $d$  coefficients in full in the attached file, in **Appendix**. Although these data reveal robust results (e.g.,  $d = 1.76$  for emotion 4) (panic) that appear to largely overcome random fluctuations, regardless of the sample size, we avoided generalizing the conclusions, believing them to be related to the particular sample chosen.

The results from both the SUD and WELL-BEING scales and the questionnaires confirmed that acousmatic music, in addition to fostering the development of *introspective capacities* and *feelings of emotions* in adolescents, can also bring about significant improvements in peer relationships, as it promotes *group cohesion* and *intense nonverbal communication* during the sharing of this distinctive experience, and leads to greater *mentalization of bodily experiences*.

## 10. Conclusion

The results obtained from the exploratory associations between frequencies and moods experienced by participants are important because they allow for an interesting initial exploration of perceived emotions, using measurable and quantifiable acoustic parameters. The gender-specific results attempt to offer an initial exploration of the different ways in which males and females react to musical stimuli, based on their sensitivity and musical enjoyment. However, it should be noted that this is an initial experiment on a small sample of young adolescents from a single class, without a control group that would have provided truly meaningful validation of the results obtained. Furthermore, the results of the scales and questionnaires relating to perceived emotions and sensations are based on self-assessment.

It is necessary to trust subjective responses, which were analyzed by Prof. Vilella using the t-test. Although significant divergent patterns emerged (for example, a greater reduction in anxiety in males with  $d = 2.28$ ), it is not possible to draw general conclusions because, as mentioned, the nature of the study presents limitations. Furthermore, reliance on subjective measures could be influenced by social desirability, although the high internal consistency of the data ( $\alpha = 0.94$ ) supports their reliability.

It is hoped that these laboratories, based on listening to acousmatic music, will become more widely adopted in schools, given the *psychosomatic benefits* they may provide and their potential contribution to the development of *emotional intelligence* in this new experimental direction. Moreover, it would be appropriate to investigate additional aspects of the influence of acousmatic music on listeners' psychological state, particularly among *adult or elderly individuals, in order to understand the potential therapeutic implications*.

## Ethical Considerations

There is no ethics committee in Italian schools. The study related to this article was conducted in accordance with the ethical principles established in the "World Medical Association. Declaration of Helsinki: Ethical Principles for Biomedical Research Involving Human Beings" (Declaration of Helsinki) and the "Convention on Human Rights and Biomedicine" (Oviedo Convention).

## Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

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## Conflicts of Interest

The authors declare no conflict of interest.

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## Sitography

For Kazakh Research (2023): <https://somasynths.com/psychosomatic/>

## Appendix

To address the need for reliability, we used two distinct approaches:

- **Internal Consistency Analysis:** To analyze the internal consistency of the “Distress Rating Scale (SUD)” and the emotions questionnaires, we calculated Cronbach’s Alpha indices. In particular, the “Distress Rating Scale (SUD)” questionnaire (composed of 5 items, all related to well-being except the first, which we negativized) showed excellent internal consistency, with a Cronbach’s Alpha of 0.94.

This value confirms that the items used constitute a set of highly reliable and consistent indicators for measuring the construction under examination. Regarding the emotions section of the questionnaire (anxiety and calm, which are already covered by the SUD Scale, are not included), we divided them into two groups:

Positive emotions: Excitement, Joy.

Negative emotions: Anger, Panic, Fear, Sadness.

This allowed us to group the items into homogeneous dimensions, obtaining excellent Cronbach’s Alpha indices (up to 0.89). This demonstrates that the instrument did not collect random responses, but rather measured solid psychological constructs.

- **Sensory Specificity Analysis:** For the Sensations questionnaire, it was not possible to obtain a Cronbach’s Alpha index, given the diversity of the sensations investigated. This demonstrates the multidimensionality of the experience. Therefore, we proceeded with an analysis of individual items (before and after listening) to respect the subjective and physiological nature of each sensation (heartbeat, breathing, thermal perception, etc.).

We report the reference tables in this link:

[https://docs.google.com/spreadsheets/d/e/2PACX-1vR4sY8KzFWrX6zI98EnI4dy1Gemz3a2DNjiPal0kesUo4-2Meyg-tEfXD6jwA3X7Ipe6NCMtI5pmhf\\_A/pubhtml](https://docs.google.com/spreadsheets/d/e/2PACX-1vR4sY8KzFWrX6zI98EnI4dy1Gemz3a2DNjiPal0kesUo4-2Meyg-tEfXD6jwA3X7Ipe6NCMtI5pmhf_A/pubhtml)

## Emotions and Sensations Questionnaires

Name: Surname: Class:

Date:

Questionnaire for the evaluation of *emotions* felt before the concert:

*1EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how excited you feel*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

*2EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much joy you feel*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

*3EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much anger/rage you feel*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

*4EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much you feel panic*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

*5EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much fear you feel*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

*6EP referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how sad you feel*

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

Questionnaire for the evaluation of *sensations* felt before the concert:  
Referring to your personal experience, *right now you are feeling*:

**1SP heartbeat variation**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

*Discontinuous heartbeat*

**2SP breath variation**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

*Discontinuous breathing*

**3SP feeling cold**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

**4SP feeling warm**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

*Alternating perceptions of hot/cold*

**5SP need to move**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

**6SP need to shout**

*Less intense than usual*

*More intense than usual*

0 1 2 3 4 5 6 7 8 9 10

**7SP other sensations:**

Name: Surname: Class:

Date:

Questionnaire for the Evaluation of *Emotions Felt During the Concert*

**1ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how excited you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

**2ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much joy you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

**3ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much anger/rage you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

**4ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much panic you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

**5ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much fear you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

**6ED referring to your personal experience, indicate on the scale from 0 (minimum) to 10 (maximum) how much sadness you felt**

---

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

---

Questionnaire for the Evaluation of sensations **during the concert**  
*Referring to your personal experience, DURING the performance of the concert you heard:*

**1SD heartbeat variation***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

 *Discontinuous heartbeat***2SD breath variation***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

 *Discontinuous breathing***3SD feeling cold***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**4SD warm feeling***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

 *Alternating perceptions of hot/cold***5SD need to move***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**6SD need to shout***Less intense than usual**More intense than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**7SD Other sensations experienced during the concert:***During the Concert How Did You Feel in:***8SD space perception***Narrower than usual**Wider than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**9SD perception of the passage of time***Slower than usual**Faster than usual*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**10SD perception of being in tune with the external environment***Not very in tune**Very in tune*

0	1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	---	----

**11SD perception of being in tune with the gestures performed by Prof. Barlera in the execution of the pieces**

<i>Not very in tune</i>						<i>Very in tune</i>				
0	1	2	3	4	5	6	7	8	9	10

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