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Space in Music: what we call ‘space’ in music and what it really is

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Resumo: Este artigo propõe uma divisão do conceito de *espaço* na música em quatro espaços, nomeadamente os espaços interno, externo, intrínseco e extrínseco. Tendo revisto estes conceitos em textos de numerosos autores e compositores, agregamos uma variedade de conceitos nestas quatro categorias principais de *espaço* na música. Apresentamos também possíveis transgressões dos limites desses conceitos, entendendo que essas transgressões são uma prática comum para compositores contemporâneos. Atualmente, essas práticas de transgressão tendem a ser confundidas pela falta de uma definição clara para os *espaços* em questão.

Palavras-chave: música eletroacústica, música contemporânea, espaço musical, espaço em música, espacialização.

Abstract: This article proposes a division of the concept of *space* in music into four spaces, namely the internal, external, intrinsic and extrinsic spaces. Having reviewed these concepts in texts from numerous authors and composers, we aggregate a variety of concepts into these four main categories of *space* in music. We also present possible transgressions of the boundaries of these concepts, with the understanding that these transgressions are common practice for contemporary composers. Currently, these practices of transgression tend to be confused because of the lack of a clear definition for the *spaces* in question.

Keywords: electroacoustic music, contemporary music, musical space, space in music, spatialization.

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On researching the concept of *space* in music, we observe a huge variety of related concepts and terms. The conflicts, observed mainly between English and French concepts, led us to review those ideas and to propose an organization that can include this wide variety of ideas and terms, minimizing their inconsistencies and divergences. Among the various descriptions of space, we focused on the concepts of intrinsic, extrinsic, internal and external spaces. We believe these terms can be applied to both instrumental and electroacoustic music. These terms are employed frequently in the reviewed literature, but they are used to refer to different things according to the author studied. The need to establish a unity between their usages arises mainly in the context of electroacoustic music, where divergences mean that some discourses have become too difficult to understand.

According to Ligeti (1959, p. 109), we can observe two different types of space in music: one of them is the "real" one, where we can locate the sound waves and the listeners; the second is fictional, imaginary. This second idea of space is provoked by the semblance of movements observed in time from a succession of changes in the frequency domain, in the overall timbre and noise level. An example of this imaginary movement can be observed when a sound moving into the high portion of the frequency spectrum leads the composer or listener to describe it going up "to the skies". A similar observation can be made regarding the sensation that the soloist and the group occupy different spaces due to their different tempi (Dias, 2014, p. 183).

We focus here on music, but this change of paradigm from imaginary space to real space is a phenomenon that was first observed in painting from the middle of the twentieth century. In certain works, we can see a gradual distancing from the mimetic representation of reality, through a process of reduction and abstraction. In this process, the painting ceases to refer to something external to it and starts to constitute itself as pure presence, as an immanence (Alves, 2011, p. 32).

1. Internal and External spaces

According to Vaggione (2000) internal space refers to the piece of music itself. It can also refer to the relation between the sound sources in the composition (Dignart, 2015), the creation of complex timbre (Mary, 2013), or the spatial conflict of sound objects (Smalley, 1991). Inside this same

terminology, we can include the appointments of Chion (1998, p. 31) about the dichotomy between internal space and external space, when referring specifically to concrete music, as well as the definition of spectral space developed by Smalley (1997, p. 122).

We then take as a principle the systematization the term internal space elaborated by the composer Horacio Vaggione (2000, p. 4), who includes in its concept the constituting sounds that have individual characteristics and which are related among themselves and throughout the work. On the other hand, the concept of external space is the one that concerns the place where the work is performed, a place that imprints its own characteristics on the work and modifies it before reaching the listener.

Internal space deals with what is the composer's primary raw material as well as the main subject of the performer's actions. On the other hand, external space can be described as the space where the piece takes place. It is not possible for the performing group or soloist to manipulate it, as it is a piece of architecture. Musicians can only adapt themselves and the playback system to this space, positioning loudspeakers and performers in the best possible orientation and encouraging the audience to listen from the best "sweet spot".

The external space has influence in both electroacoustic works during their performance in the concert hall and in purely instrumental works. This influence is clearly observed when an acousmatic work, detailed by the composer inside his own studio, is transferred to a space with a large-scale diffusion system. In every piece of music heard, the physical space assumes the role of filtering the work, pointing out a certain fragility of the composition, which will transform itself according to the characteristics of the place where it is projected. If the space is more reverberant than the studio used by the composer during the creation process, for example, fewer details of the piece will be audible in performance. Unlike instrumental music played live in concert (where the performer has the possibility of transforming the performance of the work according to the acoustics of the room, making notes shorter for instance) in pre-recorded acousmatic music there is no parallel opportunity. The work becomes captive to the space in which it is performed.

Traditionally the sound diffusion of electroacoustic music in a concert hall is accomplished using multichannel reproduction systems called Acousmoniuns, or "loudspeaker orchestras". In such situations, as proposed by some composers, the electroacoustic performer tries, through the

manipulation of the composition material, to create a dialogue between the internal space and the external space of the work. This can be done through the delicate control of the sound intended for each speaker, in order to better represent the characteristics of the internal space of the work. This artistic exploration of the characteristics of the available physical space allows the performer to get closer to the familiar adaptive possibilities of instrumental interpretation through the manipulation of volume, spatial fullness/density, sound placement, etc.

Discussions on the fidelity to the work apart, we can compare the influences of different external spaces on the listener's experience of a work. Some situations could be considered detrimental to the understanding of an acousmatic work, from the point of view of the composer's expectations. On the other hand, we can take advantage of the characteristics of the site itself, as in exhibitions or installations we call "site-specific". Such works approach the exploration of particular characteristics of a determined space as part of the work itself. Works such as "Adsonore", developed by Natasha Barrett (2005), or those mentioned by Klein (2009) are only a sample of the various possibilities envisioned by artists who choose to develop their works for specific spaces.

Still regarding the external space, we observe that some authors and composers frequently point out that a piece of music composed for a specific system or auditorium is often not well suited to other spaces or audio systems. Transferring from one performance space to another is, in fact, a sort of transcription process: it may not be very comfortable, but it is essential in today's dynamic landscape of musical performance. The necessity for detailed tests before the audition, for the composer to adapt parts or even the whole piece to the place it is going to be reproduced, is part of the metier of the electroacoustic music composer. Among the various systems and panning techniques we have at our disposal, we'd like to highlight the ability of the Ambisonic system to adapt well to most loudspeaker arrays, as well as for stereo, binaural and virtual reality applications. This adaptability is precisely why an increasing number of composers and studios are integrating it into their work. Nonetheless, reverberation and room dimensions continue to be pivotal factors when adjusting a musical piece for diverse performance environments.

Within the concept of what we call internal space, we can observe Dignart's ideas of spatial coherence or incoherence, "defined from spatial relationships between sound sources in a compositional context" (Dignart, 2015, p. 92). Also on the internal space, Mary (2013) describes the

composer's intention as a polyphony of space (simultaneous and independent spatial evolution of various elements that make up the work) when performing an electroacoustic orchestration (fusion and spectral fission, that is, sum and dissociation of formative components of sound that can create more or less complex tones).

On the concept of the internal space of a musical work, we also observe the composer's possibility to use the displacement of sound in space to create compositional objects, or movements. These gestures of sound moving in space can be recognizable to the listener and, therefore, have the potential to acquire a semantic meaning, often associated with elements derived from the western analytical and compositional tradition. Some authors name them as spatial tensions (ambiguous presentation of sound sources) or spatial relaxation (coherent, unobstructed and stable spatial articulation); spatial conflict (also called spatial dissonance - Smalley, 1991, p. 123) or spatial consonance (Dignart, 2015, p. 86).

Such terms and concepts (tension and relaxation, conflict and consonance) imbued with a meaning imposed by the tradition of western concert music, have a referential potential, useful for the communication of ideas related to space and its manipulation. Here, however, they are used to describe diverse parameters, more subjective than those from which they were originally created. The freedom and the new possibilities that technology allowed in music production after the mid-20th century offer the composer the potential to expand these concepts to create new relationships, which we will relate to elements on timbre domain or to the mode of diffusion or sound reproduction, for example.

2. Intrinsic and extrinsic spaces

The work of music itself or, as we may say, the internal space of a musical work, can be divided between the intrinsic and extrinsic spaces, and most musical parameters can be observed in this domain. Regarding these terms, we observe many divergences among the authors. These are the main subjects of this study, and we try here to consolidate them in order to unify future usage of this terminology.

Probably systematized for the first time by Schaeffer, the intrinsic space consists on the sound characteristics and has also been called spectromorphology (Smalley, 1997). In Michel Chion's "Guide to Sound Objects" (1983), we observe an appropriate example of the use of the term space within this definition that we have established as intrinsic space in this work. Referring to Schaeffer's work and to what he calls the perceptual fields of height, intensity and time, the author establishes the three dimensions in which sound objects can be manipulated and exemplifies one of them as follows: "Let's hear an object as simple as a violin glissandi. What is the dominant criterion at each instant of that sound? Height. What varies? Height again. In what **space** does this vary? In the domain of height" (Chion, 1983, p. 119, emphasis added).

What Schaeffer calls types and classes of the mass of a sound object in his "Treatise on Musical Objects" also falls within the same classification of intrinsic space. The described "types of mass" (tonic, complex, variable, others) and the "mass classes" (pure tone, tonic, tonic group, corrugated, nodal group, knot, white noise) are the classifications in which this concept of intrinsic space appears more clearly, as they are closely related to the spectral content, or morphology, of the sound object.

An expansion of Schaeffer's concept referring to the domain of frequencies, now applied to acoustic music, can be seen in the descriptions by Henriksen (2002, p. 43) and Smalley (1997) of spectral space, which consists of the set of heights used in the work and in the generation of notions of emptying or filling, among others. In Smalley's words: "the spectral space covers the distance between the lowest and the highest audible sound" (Smalley, 1997, p. 121). Although the majority of studies focus on the pitch aspect of intrinsic space, it is possible to broaden this perspective to include dynamics, timbre, and temporal elements.

To define what we call extrinsic space we refer to the concept as described by Henriksen (2002). According to Henriksen (2002, p. 33), it is the extrinsic space that allows us to perceive information related to the direction, height, distance and movement of a sound object, assuming that it is heard as part of a constructed sound field and that it can only be observed in relation to a listening point. It then refers to sounds in space, being this the physical space in which we position ourselves to hear something. Although intimately linked to spectromorphological data, the concept of extrinsic space emerges from the interplay between the sound object and its surrounding milieu, including the strategic placement of instruments and the sound reproduction system. This interaction provides

psychoacoustic indicators that guide our perception of sound location. Henriksen (2002) also establishes some categories of sound within the extrinsic space such as directional and non-directional sounds and sounds in motion (depth, lateral, elevation, dispersion and convergence) (Henrikssen, 2002, p. 40-41).

We can track back the exploration of the extrinsic space to the religious antiphons, where this designation refers to the positioning, within an acoustic environment, of a certain sound source or groups of sound sources during the execution of a piece o music. The extrinsic space was especially developed by the composers from the second half of the twentieth century, becoming an important element, or even determinant, in the compositional thinking of this period on. It is important to note that the elaboration of extrinsic space can only exists in relation to the external space where a work is performed.

We take as our starting point, audio spatialization, as treated by acousmatic music, mainly because it was one of the first to develop and explore both, technically and aesthetically, the possibilities of multichannel sound diffusion systems. With the development of this musical genre and the implementation of reproduction through loudspeakers, the exploration of the extrinsic space of a work has become increasingly diverse, often becoming essential for its construction and understanding. It was precisely in this type of music, in which instrumental sound sources are no longer physically connected to the projected sound, that the listener was freed for new forms of listening, so sound diffusion concepts and methods could be expanded.

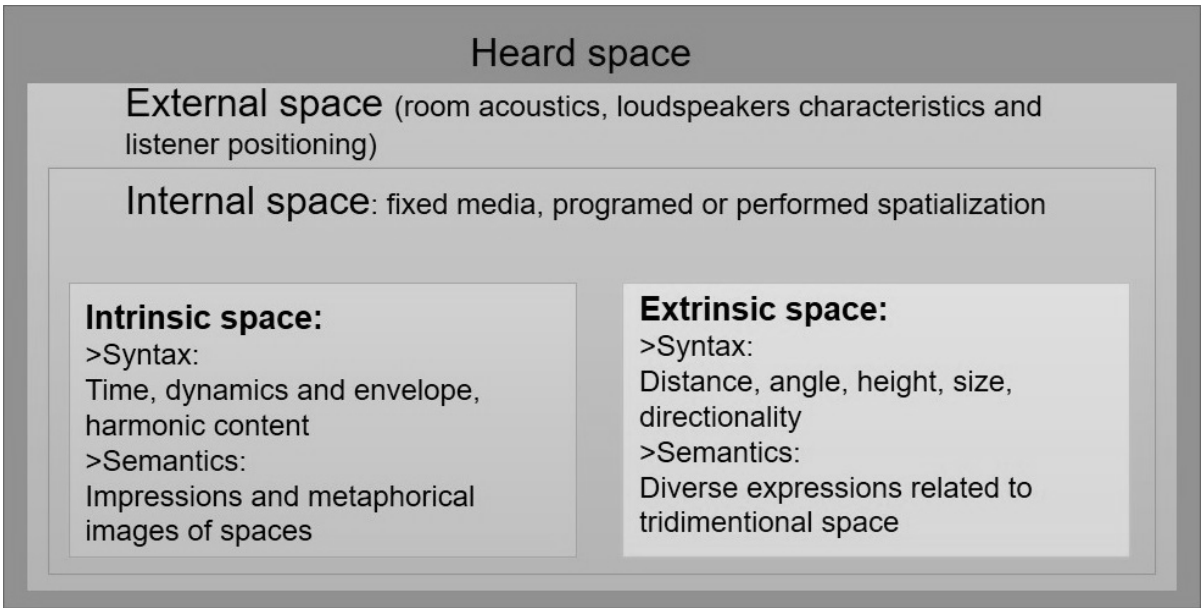
Another important work presenting a concept that can be included within our definition of extrinsic space (although it is directed to the study of acoustic instruments) is that of Koechlin (2006, p. 139). In his work, the author discusses 'volume' in terms of the perceived spatial dimensions of sound projection, rather than its intensity. Acoustic research indicates that low-frequency sounds disperse more uniformly and in all directions, whereas high-frequency sounds from a source become increasingly directional in their projection. Such characteristics are part of what we perceive in relation to the dimensions of a sound source and are valid both for sounds from acoustic sources and for sounds reproduced by loudspeakers. In the context of acousmatic music, this becomes extremely important when choosing the positioning of a sound in the extrinsic space. This parameter also appears in the work of Schaeffer (Chion, 1983, p. 118) and in several other works that deal with

subjective analysis of spatial parameters of recorded audio, and it is also called "caliber". This parameter is then expanded to include volume, or perceived size, of either individual or groups of sound sources, as well as performance rooms (Rumsey, 2002; Bech and Zacharov, 2006).

Still referring to the concept of extrinsic space, Merlier (2006, p. 132; apud Dignart, 2015, p. 145) classifies the variety of ways in which it can present itself on what he calls "characteristic parameters of spatial perception". Such classification adheres to the syntactic level of what we define as extrinsic space. Merlier divides such parameters between static ones, which are related to matter (density, texture), shape (width, size, area), position, distance, if interior / exterior, involvement, environment / place; and dynamic ones, which have a close relationship with the movement of the presented sound sources (mobility, trajectory, directionality, growth). These include variation of form, direction, place, density, approach / distance.

Following this succinct conceptual overview, we offer an illustration that synthesizes these diverse spatial concepts in music, categorizing them into four interconnected dimensions: internal and external spaces, as well as intrinsic and extrinsic spaces.

FIGURE 1 – Aggregation of terminologies related to the concept of space in music.



Source: Sousa (2019, p. 97) - adapted

 | https://doi.org/10.33871/vortex.2024.12.8490

3. Syntactic and semantic analysis

In most definitions of space, we found a mixture of concepts that approaches the construction of the space, its syntax, and its semantic values or meanings. Coulter (2007, p. 4) for instance, uses the ways in which our perception can act, arguing that sounds have a double potential: one of them abstract and the other concrete or referential. A similar approach can be observed in Elleström (2017, p. 58), where he deals with the three levels in which his media modalities can permeate: the material, the perceptual and the conceptual. The perceptual is not within the scope of this work, and we take mainly the material and conceptual levels, which can be related also to Coulter's concepts.

Each of the four spatial concepts delineated earlier can be explored separately within syntactic and semantic frameworks. Yet, it's crucial to acknowledge their interconnected nature when practically analysing musical performances and auditory experiences. The spotlight of the following examination is on the realms of intrinsic and extrinsic space, which form the core of the discussion surrounding the concept of internal space.

The main parallel we use in our approach is closely related to the field of linguistics and applies the concepts of syntax and semantics to the possibilities of spatial music. Syntax, or grammar, concerns the relationship of signs to one another: the study of their manipulation in a structural, formal way, at the level of matter. In this domain the sound gesture of the intrinsic space is constituted of timbre, pitch and duration content, conversely, in the extrinsic space it is generated according to our perception of direction, depth and movement. To exemplify this approach we note that authors and composers are referring to extrinsic space when they describe the movement of a sound source, such as a left-right or a front-back movement, a more enveloping sound environment or a point source (Vande Gorne, 2002, 2017; Barrett, 2002, 2005). In the intrinsic space domain we can observe an example when we refer to the organization of pitches (when the sounds goes up), rhythms (when the sound goes faster or slower), dynamics (when the sound goes stronger or weaker), among other parameters of the sound objects themselves.

The domain of semantics describes the relationship between signs and their designates, that is, the gesture of the sound object in space with the interpretation that it stimulates, via the observer's perception. This semantic domain is explored in greater depth by several authors with respect to what

we call intrinsic space, but we believe it can also be explored in the extrinsic domain by developing a rhetoric system (set of rules and conventions related to eloquence) observed in the discourse that can be created by extrinsic spatial gestures.

Historically, the syntactic dimension of extrinsic space and the concept of its manipulation, akin to other musical parameters, were not as accessible or developed as they are in contemporary practice (angle, height, distance, size of the sound source, etc.). According to Begault (2000, p. 192), the manipulation of extrinsic space in the musical context has been as inevitable as the development of the manipulation of pitch, timbre and rhythm. Over the course of its historical evolution, Western music has cultivated three primary techniques for structuring extrinsic space: alternating between different locations, evoking the ambiance of remote environments and sound origins, and orchestrating the actual movement of sound sources.

Currently in electroacoustic music, with the usage of speakers, we have all these strategies at our disposal. We can explore alternating sound sources in the extrinsic space even in a stereophonic system. We can suggest distant environments and sound sources in a number of ways: through the manipulation of the signal intensity of the sound object, the relationship between the direct and the reverberated signal (using reverb processes with extreme fidelity to real spaces), or through the use of the Doppler Effect. We can also move sound sources not only in the horizontal plane but also above or below the listener depending on the multichannel reproduction system that we have at our disposal.

As musical aesthetics have become increasingly complex, the spatial separation of sound sources has become considered a tool of extreme importance in order to maintain the understanding of a work. Let's first take a look at this process of separating sound sources in an example of instrumental music. Henry Brant (1967) was perhaps one of the first composers to try to systematize the exploration of extrinsic space in instrumental works, stating, among other things, that the perception of different layers of musical material could be intensified through the separation of the musicians. It may have been unconscious, but in a way he was already exploring and manipulating extrinsic space based on the four Gestalt principles (Bregman, 1990) in his compositions.

The use of physical space in order to separate sound sources with similar spectromorphologies allows the composer to obtain polyphonies and textures that were previously difficult to achieve. The

distribution of acoustic sound sources or instruments in the physical space was often defined by the composer in the description of the piece or defined by a tradition (such as in the orchestra). This is also an example of the way in which a composer can manipulate extrinsic space in order to determine how a work is presented to the listener.

Natasha Barrett (2002, p. 318) describes her electroacoustic works and notes the importance of spatialization regarding the possibility of increasing the number of identifiable sound sources simultaneously. Like Brant, she describes the use of spatial separation in order to avoid spectral masking and to create a temporal texture that allows richer counterpoints. Just as we can separate two sound sources, we can explore the same principle to join them. This was observed by Smalley (1997, p. 122), when he states that in the acousmatic music composers have in their hands the ability to unite two distinct sound objects, or two spectromorphologies, by placing them at the same point in space (extrinsic space) and time.

Bates (2009, p. 119) also mentions Charles Ives' work "The Unanswered Question" as an example of the manipulation of extrinsic space to clarify and define the various overlapping musical layers. According to Bates, in some works spatial separation is used to create the feeling of distance and perspective; in others, to facilitate the performance of dissonant passages or with slightly similar musical material, in order to benefit both musicians and listeners.

Regarding the semantic domain, we already have a certain diversity of works related to the semantics of intrinsic space (Hautbois, 2010), but the semantics of extrinsic space are yet to be systematized. We can observe the meaning that certain musical gestures evoke in the extrinsic space, by observing Gestalts generated by the directionality or movement of sound objects. This directionality or movement can be related to more primitive instincts as we observed that sounds in motion as well as sounds coming from behind attract the attention of the listener best, since in these situations the auditory information overlaps the visual information to give clues related to possible hazards. Whenever a sound source begins to move, regardless of its nature or the previous stillness of its internal components, it became the central element, capturing and holding the listener's attention.

One of the few authors to describe the relations the composer can create between syntax and semantic content of the extrinsic space is Vande Gorne (2002). Her description of the possibilities of creating illusions of real spaces, the generation of surrounding or pointillist spaces, the types of spaces,

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as well as the structuring of spatial gestures such as those proposed by her fifteen figures of space, seem to be the closest we can get to a semantic study of this domain up to now.

In general, it is extremely difficult to propose a semantic analysis separately from the syntax of a work, since all aesthetic options performed on a syntactic level (related to the form and structure of a work) inevitably went through a semantic observation, even if subjective, by the composer. We observe a similar difficultly in separating analyses of extrinsic and intrinsic space. As previously seen, they will coexist and interact with each other within the conception of the work and will have a joint impact on the listener's perception of musical gesture.

In this next section, we aim to clarify the distinctions made by various authors regarding spatial concepts, focusing on both their structural, syntactic roles and their semantic implications. We will begin with an examination of the semantic perspective on intrinsic space as presented in the works of Natasha Barrett (2002) and Denis Smalley (1997), commonly known as the spectromorphology of the sound object.

Barrett (2002, p. 314) describes our capabilities to relate specific sounds to the space to which it alludes. That is, we identify relationships with known real spaces according to our perception of them and our knowledge of the world. According to her, the sound has this ability to be associated with something beyond what we can perceive in the spectrum, it plays with our memory and diverse associations. Barrett`s concepts of spatial consonance and spatial conflict[1] are based on the listener's expectation of what would be observed, whether or not the reproduction of real spaces is convincing or not. These observations occurs at a semantic level of intrinsic space, as well as does the systematic studies of Smalley (1997, p. 110), which defines and discusses spatial forms based on the concept of "source-bonding". "Smalley uses the term source-bonding to describe this natural tendency to relate sounds to supposed sources and causes, or to relate sounds to each other due to a shared origin" (Bates, 2009, p. 154).

Smalley (1997) supports his approach on the fact that the image or the recognition of a space comes to the surface even without being presented by a multichannel system. This "spatialization" that presents itself firstly at a semantic level is what he called "source bonding". This image originated

[1] Spatial consonance: when a real sound presents itself in the illusion as expected. / Spatial conflict: when the spatial information inherent in the object is in conflict with its spatial disposition (Barrett, 2002: 319).

 | https://doi.org/10.33871/vortex.2024.12.8490

from the identification of sound sources and the spaces to which they allude is not the exclusive heritage of the receiver, but rather one of the main tools of the composer who "brings into play meaningful combinations and musical ideas, allegorical, metaphorical and even figurative"[2] (Justel, 2011, p. 112).

Regarding the phenomena of perspective, we will borrow some studies from the visual arts, where it is relatively well described, and where we observed that there are few authors who developed some theoretical studies on it. We take for instance the perspective phenomena in visual arts. At the same time that it does not offer us a materiality at the level of depth of a pictorial art, it is recognized by anyone as containing such spatial information. Concerning the relationship between the figure and the background of a visual work, Arnheim reports that due to our knowledge of the world, we can conclude, by observing an image and the size of its elements, which are in the front and which are in the background (Arnheim, 2005, p. 226).

The sense of Depth in music, created by our differentiation between foreground, background and middle ground, can be perceived as a parallel to visual perspective, and can be either real or illusional. It can be analysed as being intimately connected to the syntax of extrinsic space—such as the deliberate placement of sound reflections in a multichannel system to emulate expansive environments—as well as to the semantics of intrinsic space, which involves managing the pre-delay and decay times in a reverb processor. We can obtain such effects, both the perspective and this perception of figure and background, in the sound domain, by using the intensity manipulation of the sound sources or its timbre (semantics of the intrinsic space), or by using some reverberation, manipulating reflections and sound source positioning (syntax of extrinsic space). Extrinsic space manipulation can be observed on sound materials, even when monophonic, which carries spatial information indicative of either small or large spaces, characterized by a reverberation that is readily identifiable as emanating from such environments.

The perspective phenomena is explored in Vande Gorne's (2017) work, when she superimposed two different sound plans at listener's appreciation. Her approach has parallels in describing a similar phenomenon in sound manipulation in acousmatic works, possible both in

[2] Original: "Ce-la n'implique pas, pour autant, que l'imaginaire soit du patrimoine exclusif du récepteur. Le compositeur, lui aussi travail avec l'imagination, puisqu'il met en jeu des combinatoires et des idées musicales porteuses de sens, allégoriques, métaphoriques et même figuratives."

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intrinsic space, mainly through intensity manipulation, and in extrinsic space, in what she calls the manipulation of space on an ornamental level.

Bachelard (1993), despite having his work directed to concepts observed in literature, brings us observations that can be valid in the construction of a semantics of the extrinsic space in the sound domain. Bachelard's work is focused on the development of a phenomenology of poetic image and, according to him, this image of a space exists even before thinking, reasoning about the perceived, presenting itself almost as a Gestalt. Nothing is capable of preparing this poetic image, "neither culture, in literary mode nor perception in psychological mode", it "is not subject to an impulse. It is not the echo of the past. It is rather the reverse: by the explosion of an image, the distant past resounds in echoes and it is no longer possible to see in what depth these echoes will reverberate and cease" (Bachelard, 1993, p. 183).

Bachelard's concept of a poetic image, that is, an image imagined by the reader and caused by a set of words, verses or paragraphs, is useful to us because several composers of electroacoustic music refer to space on a semantic level from images caused by the sound objects themselves. The evoked image isn't always linked to what we name 'extrinsic space'; rather, it's connected to the traits of 'intrinsic space' (semantic domain), which are discerned by the listener in each auditory element utilized in the composition.

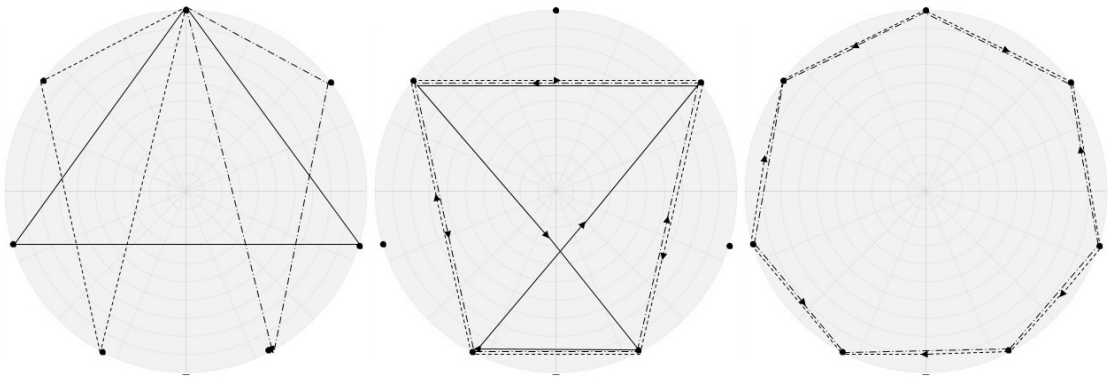
Lucena (2007), in her work on the phenomenology presented in Bachelard's book, states that "everything is human value; space cannot be exclusively external because it is lived, imagined, remembered internally." (Lucena, 2007, p. 9). This assertion echoes our observations in Bachelard's oeuvre: a semantics of extrinsic space is extremely difficult to define since it is inseparable from the constitutional elements of the sound object itself, the semantics of intrinsic space.

When comparing signs of the miniature and the immensity of imagined spaces, Bachelard points to a certain relativity that can also be observed in music. How slightly larger spaces, when presented right after smaller spaces, can be interpreted as larger than they really are. This is because our perception is not accurate but it always explores comparisons, also having a limited memory in relation to stimuli presented in the short term. The manipulation of the size of the sound source, or groups of sound sources, takes place in a similar way to that described by Bachelard in extrinsic space, in which the reproduction system is the tool through which the composer manipulates it. We can

take as an example the sound of a bunch of keys that, when reproduced by a large multi-channel system, can change in size depending on the composer's proposition.

As an example of a possible semantic analysis of external space, I would like to revisit a work, which I composed by in 2011 at the University of York. "The Seven Sins" can also be used an example closer to the serial approach of what Vande Gorne (2002) calls "geometric space". In this piece, the intentional use of a series of points in space intends to evoke meanings from the rhetoric of Western culture. The work, with its algorithmic format, includes a random factor for each performance, and is divided into seven sections that are developed with the exploration of 14 samples recorded by a group of gamelans, divided into two sets. Their organization is considered serial in the sense that no sample is repeated until all seven samples have been played once, as it is the sets of three time intervals between the samples. The seven points in space were chosen in such a way that three different triangles, a square, a circle and a seven-pointed star can be drawn between them; this set of positions is defined by the shapes with which each section is related.

FIGURE 2 – The locations defined for "musicians" 1 (_ _ _), 2 (_ . _ . _) and 3 (____) that are reproduced in extrinsic space, according to the sections established by the music - top view.



Source: Sousa (2019, p. 122) – adapted

The first section has no particular shape and conveys the idea of chaos, with which all creation started (described in the creation of the world of the Christian Bible and other ancient writings). The second and third sections are based on three different sets of positions that create triangular shapes (ternary geometric shape with expressive divine meaning in different cultures) in the listening space.

 | https://doi.org/10.33871/vortex.2024.12.8490

The fourth and fifth sections are based on three sets of four positions that create square shapes (representative form of the arts and sciences developed by mankind). The sixth and seventh sections, exploring all seven points chosen in space, create circular shapes (referring to the infinite) and, in a way, at least perceptually, returning to the chaotic environment of the first section.

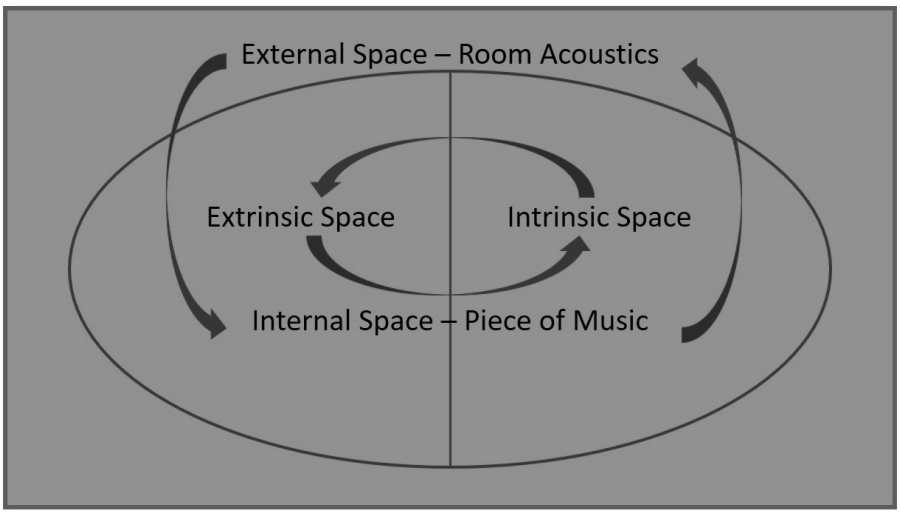
This geometric space, which considers points in the extrinsic space as a structure, can be presented as lines, planes, surfaces and volumes. It is one of the four types of space, or categories of space, described by Vande Gorne (2002), the other three being ambiophonic space, source space and the illusion of space[3].

4. **The relation and the transgression between spaces**

All the four spaces mentioned above are inherent and simultaneous to any piece of instrumental or electroacoustic music. Despite being segregated in this representation, the different concepts of space communicate, interfere and suffer interference with each other. The internal space of a work is influenced by the external space when being reproduced in concert room, or performed through a reproduction system, open area or any other space than that used in the compositional process. In a reverse way, the composer can think of manipulating the internal space of his work by adapting its reproduction to a certain external space, taking advantage of its characteristics, as can be observed in site-specific works. The graph below briefly illustrates the possibilities of relationship between the different concepts of space: from internal to external space, and vice versa, as well as, within the work, the intrinsic and extrinsic spaces relating to each other.

[3] According to Vande Gorne (2002), the Ambiophonic space would be the space in which we cannot determine where the sounds come from, where the listener is bathed in a diffuse atmosphere; the source space is opposed to the previous one, in this type of space we can precisely locate the source of the sound; the illusion of space is related to a spatial depth recreated by the loudspeakers in a stereo system, where sound transcends its physical form to become an auditory image, a mere representation.

FIGURE 3 – Relationships between the concepts of space in music.



Source: Sousa (2019, p. 99) - adapted

In this synthesis, we can also observe that few approaches observed in the literature fall outside our proposed system of conceptualization, although they may combine two or more of these main concepts. An interesting combination, for example, between two of these conceptual spaces (intrinsic space and extrinsic space) can be observed in the work of Normandeau (2009), a renowned Canadian electroacoustic music composer. Instead of distributing the sounds of the piece throughout the loudspeakers after the composition, he distribute the spectral components of the sound in points at the extrinsic space, so each point represents part of the whole. According to him, this "timbre spatialization" is exclusive to acousmatic music (Normandeau, 2009, p. 3). This same strategy of filtering the sound of the work and distributing its different regions in different pairs or group of speakers was previously described and implemented by Christian Clozier (1998, p. 56), at the Gmebaphone de Bourges, France, one of the first Acousmoniuns implemented.

As we venture into the potential of transgressing the established spatial concepts, we encounter a spectrum of liminal opportunities within the spatialization process of sound materials which consists of the transitions from one category of space to another. These shifts hold aesthetic intrigue, though they may occasionally be unintended.

Returning to the concept of external space and putting some thought on the transformations that it imposes on a piece of work when observed through headphones, we observe that we managed,

to a certain extent, to transform the external space into internal space. In this process, we avoid several problems reported by composers when listening to their works in larger spaces or being broadcast to large audiences. By limiting reproduction to headphones and binaural systems, we almost completely exempt the piece from the interference of external space. Some interference will occur since the sound of each brand and model of headset has a certain colour, among other features, so the listener will observe differences in a work as perceived using different headphones. However, the composer may consider, for practical purposes, that such colourations are minimal or, at least less prejudicial than other possible external spaces.

The processes as described above (spatialization of timbre), may therefore become part of the internal space of the work itself, independent of a filtering system, hardware or specific physical speakers. In this context, the sound manipulations are now the responsibility of the composer, who must establish the necessary filtering in software as well as the spatialization of the resulting signals at the infinite points around the listener, who will receive the final result through a single pair of headphones.

Still regarding the manipulation of what we call external space, we can add the acoustic response of a given room to the intrinsic space of a sound object. When a given sound source propagates in an acoustic space, it creates not only primary and secondary reflections, but also the reinforcement and attenuation of certain regions of the spectrum over time. The response of a room's acoustics to an impulse or noise, or more commonly a continuous frequency sweep, can be recorded and transformed into what we call impulse responses. Such impulse responses, or IRS, can be applied to any other audio material and make it sound as if that sound object had been recorded in such an acoustic space. This is the basic principle of most convolution-based reverb processors (Deruty, 2010; Adriaensen, 2006), but exploring this process creatively, the response from the room can become part of the timbre itself, thus creating a new sound object that includes the room sound as part of it, transformed into intrinsic space.

Composers of acousmatic music commonly apply such procedures to sound objects with two distinct objectives: that of representing a recognized or desirable external space on a semantic level (a church for example), and that of altering the timbre and envelope of sound objects within the composition. When Natasha Barrett (2002, p. 320) discusses the creation of an illusion of space, the

first of the space approaches described by the author, she gives an example of the transformation of a reverberation that simulates a small space and can be interpreted as part of the sound object itself, part of what we call intrinsic space.

The reverse process can also be proposed if we consider that the perception of extrinsic space (angle, height and distance) in binaural systems is obtained through the incorporation of HRTFs (IRs created from recordings with Dummy Heads of sound sources positioned in a point in the listening space) to the sound objects being spatialized. Such HRTFs can be represented as dynamic filters, which act in the frequency domain and which are addressed to each of the two ears of the listener. In this case, a manipulation in the domain of the intrinsic space of a sound object serves us to add information regarding the extrinsic space of a given sound object.

Probably the most common example of a transformation in extrinsic space is that of transforming extrinsic space itself into intrinsic space. When a particular sound object performs trajectories faster and faster, that comes to a point when we no longer distinguish its location changing, but we perceive a change, or modulation instead, in the timbre of the sound. Several composers explored this transformation in their compositions; Stockhausen, notably, uses a series of spatial movements in his work Kontakte. According to him, such movements would be able to articulate durations, a parameter naturally belonging to what we call intrinsic space (Bates, 2009, p. 138). Felder, describing the work "Sirius", also by Stockhausen, states that "the sound moves so fast in rotations and slopes and all sorts of spatial movements that it seems to stand still, but it vibrates" (Felder, 1977, apud Bates, 2009, p. 143).

In Blackburn's description of her piece "Origami, miniature IV", the author describes a visual representation of spectro-morphologies, more specifically the manipulation of what she calls spectral space. When willing to create a swirling water effect, visually represented by circles around themselves, she calls upon "repeatedly panning an iterative loop" (Blackburn, 2011, p. 10). This manipulation of the extrinsic space is another example of those descriptions and processes that touch the thresholds between intrinsic and extrinsic spaces.

This specific transformation (the manipulation of extrinsic space until it is perceived as intrinsic) is also observed by Barrett (2002, p. 320) and developed by Robusté (2014). Unlike Smalley, who states that "spatial perception is inextricably bound up with spectromorphological content, and

most listeners cannot easily appreciate space as an experience in itself" (Smalley, 1997, p. 122), Robusté develops his thesis, explaining that his approach is to use spatialization to change the perception of the sound attributes, creating personalized musical events (Robusté, 2014, p. 13). The author elaborates works based on sinusoidal and noise sounds in order to test such approach, and concludes that the variations when using such sounds are very subtle. He deduces that these variations would be masked when using more complex sounds, illustrating that these two domains, intrinsic space and extrinsic space, are interdependent.

5. Conclusions

In this work we present four definitions of space in music that can summarize most the terminology used by other authors and composers to describe the subject. The proposal of separating intrinsic and extrinsic spaces into their syntactic and semantic levels is useful in order to illustrate and endorse many ideas presented by the literature. It is extremely important to observe that none of these space concepts in music are isolated. While space is perceived as a single aspect of a musical work, its elements can be dismembered only for the purposes of analysis and manipulation during the compositional processes and conception. The transgression of such concepts of space is also discussed and observed as a powerful tool for composers to aggregate interest in their musical discourse.

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