#11
EXPLORING POLYPHONY IN SPATIAL PATTERNS IN ACOUSMATIC MUSIC

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11.1 Introduction

The multiplicity of musical practices in Western art music that arose from the technological developments involving the use of electricity applied to music were particularly expressive after the Second World War. Their associated terminologies are varied: *musique concrète, Elektronische Musik, acousmatique, cinéma pour l'oreille, sonic art*, among others. For the purpose of this text, their differences will not be tackled, but some of their underlying common characteristics, particularly the use of spatial concepts in *acousmatic listening* will be discussed. The decision to focus on acousmatic music concepts derives from the fact that most of the mentioned literature and musical concepts are grounded in musical traditions where space is a key element to understand this practice.

The focus on many of Annette Vande Gorne's conceptualizations is not merely for the allusion to her work in the present volume, but rather for her centrality to and legacy within literature and music creation in the acousmatic music world.

This text is organized as follows: A theoretical short introduction to the use of space as a parameter in acousmatic music and some of the main perceptive features involved in such practice, followed by a brief description of acousmatic music techniques, such as those presented by Annette Vande Gorne, and their relations to gestures. The final section describes how I have been able in my own music compositions to enhance spatial polyphony through various techniques.

https:/doi.org/10.34727/2022/isbn.978-3-85448-047-1_11.

11.2 Space

The study of spatial features in sound in general is a very complex task, but it can be handled by perspectives that are focused on *perception* and *reception*, framed within distinct sciences and associated methodologies. The study of Western art music may often involve understanding an increasingly differentiated socio-communicative system generated by a multiplicity of included musical practices within its frame. Here, rupture and novelty take on an important role, often creating a gap between what one can perceive, pay attention to or focus on when encountering such musical practices, and what the *music-makers* would think that should have been perceived (Reis, 2015).

The exploration and development of techniques that tackle spatialization in electroacoustic music has been a part of the associated musical practices since its origins with Pierre Schaeffer, Karlheinz Stockhausen, Varèse and other pioneers. However, the literature greatly excels the fields around the practices of Western art music history.

A brief review of some of this literature will be mentioned here, accompanied by some personal considerations concerning my own perception and musical practice.

The study of spatial sound features has been addressed in the frame of different scientific fields such as physics, acoustics, psychoacoustics, psychology, biological basis, technological approaches (Blauert, 2001; Opstal, 2016; Rumsey, 2001; Suzuki et al., 2009; Wöllner, 2018), and in other perspectives. While the importance of such standpoints is of substantial significance to the study of spatial sound features in music, other perspectives based on creativity are nonetheless key to providing new paths for research that are based on artistic practices.

When trying to understand the conceptualizations and practices of the use of spatial features in music, one can find many specialized texts, articles, journal issues, etc. that describe a personal practice in general or in a specific work that may include technical, conceptual and methodological considerations, often deriving from personal research and artistic experiences.

Many of the personal perspectives that derive from a personal compositional practice, such as in the works of Chowning (1971) or Stockhausen (1988) among others, can often be extrapolated into other practices. Other texts can be considered from the beginning as more comprehensive perspectives:

- from Western music history that will include both instrumental and acousmatic music within different time scopes (Harley, 1994; Zvonar, 2005);
- in the systematization of spatialization conceptions in acousmatic music (Smalley, 2007; Vande Gorne, 2018);
- in the field of soundscape[1] (Schafer, 1977, 2008; Truax, 1978);
- within the spheres of technology applied to electroacoustic music: such as Brümmer's comprehensive article that covers diffusion methods[2] and systems and their appli-

[1]Terms such as soundscape, acoustic ecology and bioacoustics seem to have convergent meanings. This practice alludes to the study of the effects of the acoustic environment on the physical responses or behavioural characteristics of those living within it (Truax, 1978).

[2]Such as vector base amplitude panning (VBAP), distance-based amplitude panning (DBAP), Wave-Field Synthesis (WFS).

cations (2017); terminologies, technologies and compositional approaches within spatialization techniques (Lynch & Sazdov, 2017); the use of peculiar technologies such as the ultra-directional sound that one can obtain with a parametric loudspeaker array (Reis, 2016); immersive explorations of virtual performance spaces (Wöllner, 2018, among others).

Many specialized journals have dedicated issues to related issues, gathering perspectives from a significant number of authors, such as Barrière & Bennett (1997), Chouvel & Solomos (1998), Dhomont (2008), Keislar (2016), (2017), Szendy (1994), and Vande Gorne (2011) among others, where one can find seminal texts from authors such as Anderson, Barrett, Barlow, Bayle, Boulez, Chion, Couprie, Dhomont, Dufour, Emmerson, Ferreyra, Justel, Lotis, Mandolini, Mary, Menezes, Nattiez, Normandeau, Parmegiani, Risset, Roads, Schaeffer, Smalley, Teruggi, Truax, Vaggione, Vande Gorne, and so many others who have largely contributed to the discussions of the use of *space* in acousmatic music.

Within the large topics that arose in literature, very often the topic of spatial conceptions that are focused on ideas of tridimensionality, or conceiving beyond the horizontal plane (Kendall, 2010), and other terminologies that have been systematized (Lynch & Sazdov, 2017). Groundbreaking works and research can be read about the specificities of terms such as dome, cupola, spherical, semi-spherical, immersive, 3D, among others, such as Barrett (2016), Brümmer (2017), Kupper (2008), Normandeau (2009), and Stockhausen (1971). I find this literature to be particularly important when it comes to the domain of *spatial polyphony*, for the new possibilities that are opened up by such systems in comparison to systems that are based in the horizontal plane only.

11.3 Spatial polyphony

The development of acousmatic music practice often relates ideas of musical gesture to the perception of movements in space. But where can one draw the line between a mass of sounds and movements that are perceived as a texture, and the independence of voices and spatial patterns?

The answer to that question may rely on a large number of studies previously mentioned here. However, for the present text, I intend to explain how I view the concept of spatial polyphony as presented in the literature connected to acousmatic music, before attempting to respond to the question myself based on my own perception and current experience as a composer.

11.3.1 As a concept and in practice

Even in the realms of acousmatic music, the concept of *spatial polyphony* has been used with slightly different meanings according to the context in which they were being used.

Mary explains the importance of polyphonic materials and space referring to presenting a precise role in electroacoustic orchestration for each element (timbre partial) and therefore arriving at a polyphonic conception of space that is coherent with the polyphonic conception of the music materials and their inner connections to the position/ movement/ panoramic and to the volume/ mass/ depth (2006).

Menard discusses his ideas of a *(super) polyphony* of space through complex diffusion systems designed by the composer (2008).

Ascione (2008) describes his first experiences in 1985 with the creations of 16 track realized in G.R.M. mainly confronting differences between conceiving a spatial work for stereo or for larger multi-channel pieces. He mentions what is enabled by what he dubbed *polyphonic spatial composition*: more effective adaptation of the space to the musical subject thanks to the permanent control of the affectation of sounds in the aerial sphere (when compared to the *real time spatial diffusion* of a stereo piece); the possibility of a better evaluation of the plasticity of the work; the ability to make spatial paths within the composition, to give more perspectives, to better distribute the masses and forms which oppose and respond to each other, and to specify the locations for the listener.

Merlier (2011) distinguishes the ideas of *spatial polyphony* and *depth of the [sound] field*, mentioning that both characterize the superposition or spatial obstruction of several objects. The depth of the [sound] field is linked to the geometric occupation of space (in the sense of depth): a single sound object with a large spatial mass or several distinct sound objects distributed in space. As spatial polyphony underlies something more conceptual—such as the simultaneous perception of several spaces, or of several spatialities, or of several discourses of space—we can see that the two terms overlap in part, but are not synonymous.

I here refer to the latest concept of *spatial polyphony* as presented by Merlier. Having my ear and personal perspective as a reference, sound spatialization acts as a central musical parameter, where the distribution of sound within the loudspeakers is related not only to different kinds of movements and spatial shapes and paths, but related and associated to *energy models*; or, to put it in a different way, associated to spectral changes, different speeds and other parameters that make the spatial movements (paths) more or less recognizable—and even *un*recognizable in given moments. My overall goal in *spatial polyphony*, is to enable focus in order to distinguish and be able to describe each particular sound spatial movement, in the sense of a recognizable pattern or distinct feature that one would group as a single entity, inspired in the way described by the *Gestalt* theorists and the perspectives of perceptual psychology as Deutsch elucidates (1980).

11.3.2 Limits in the perception of spatial polyphony

One central question when creating and listening to works involving spatial polyphony is: How many independence *spatial patterns* can one listen to simultaneously?

Ludger Brümmer (2017) establishes a proper link to polyphony in a common sense, referring to the examples of listening to a fugue, where up to and including three or four voices it is possible to listen to and follow each voice, whereas five or six voices can scarcely be perceived in detail. He does, however, mention that polyphonic listening is a skill that can be improved through training. Emmanuel Nunes' (1994) work *Lichtung I* features up to six simultaneous spatial paths distributed totally independently between eight loudspeakers. Karlheinz Stockhausen would often talk about the importance of perception, referring to *Cosmic Pulses*, from *Klang*, as the first of his works where he couldn't follow each of the individual (also spatial) lines during the whole piece (Siano, 2013). While in many of Annette Vande Gorne's writings (2008), in which she alludes

to other composers perspectives, and to her lectures[3], she professes her perceptual experience at the time as being limited to four movements or four differentiated geometric spaces. Over the years, personal conversations with Brümmer, Nunes, Stockhausen, Vande Gorne and many other composers, scientists and audiences inspired me to consider what my personal limit might be for the maximum number of simultaneous spatial paths, and furthermore, to contemplate how I could construct a first musical work that would directly address this issue. I realized that if I wish to surpass the three / four distinguishable *spaces*, I would need an immersive space in a dome shape, since I believe that the addition of the dimension of height could provide a more accurate perception in the multiplicity of *spaces*. The work *Magistri Mei - Bruckner* (2020)[4] intended to have up to seven simultaneous perceivable spaces. The perceptive result has yet to be tested in more than one studio or concert; nor has it either been discussed with colleagues and audiences, or subjected to further testing from other perspectives.

11.4 Spatial polyphony in my music

I have previously materialized my interest in aspects of spatial polyphony as a composer in previous acousmatic works such as:

- *Omniscience is a Collective – part I* (2009), where space is used to enhance semantic aspects of what I term *multi linguistic polyphony* (Reis, 2011). This work was inspired by an idea from Schaeffer's famous 1966 *Treatise*, where he mentions spatial localization as a cue for what could be a *polyphony of chains of objects* (Schaeffer, 2017). The multiple different languages that one can hear simultaneously could only be perceived semantically through space location.
- *Jeux de l'Espace* (2015), for eight regular loudspeakers, equidistant around the audience and one directional parametric loudspeaker array to be operated during performance, requiring an operator to play it following specific instructions on a score demonstrating at each moment where to point, what kind of surfaces to point at, or 'swipe' in the direction of the entire audience, or just parts of it, where the gesture in each moment is determinant for the spatial perception of the audience (Reis, 2016).
- *Fluxus, pas trop haut dans le ciel* (2017), for 16 channels in a dome distribution, where sound spatialization acts as a central feature; the distribution of sound relates not only to different sorts of movements and spatial shapes, but to spectral changes, varying speeds and other features that render the spatial movements (paths) to be more or less noticeable, or even unrecognizable. that I've called spirals, rotations, spectral explosions, points, geometrical shapes, lissajous curves, sound suctions, walls of sound, sound swarms, etc. The intention is not to have them being perceived as a taxonomy of movements relating to formal features of the macro structure, but rather as the *energy flows* present in the world and in the work (Reis, 2020).

[3]On several occasions, in particular while organizing concerts and related activities in Portugal (2015 and 2019) and while we were giving lectures together in places such as Kyiv (2018), Ohain/Brussels (2019) and Vienna (2019).

[4]Work commissioned by the Embodied Gestures artistic research project, funded by the Austrian PEEK programme.

I recently composed a new acousmatic work that features a strong personal interdependence between *gesture* and *spatial polyphony*. Inspired by Anton Bruckner's methodology in conveying traditional polyphony, I have recently been developing ideas of spatial polyphony that I try to explore not only through traditional polyphonic development, but mainly through sound spatialization connected to musical gestures expressed in spatial patterns that travel through a dome-shaped sound system, namely in the piece *Magistri Mei – Bruckner* (2020), for 16 channels in a dome distribution, composed within the frame of the project *Embodied Gestures*, using new musical interfaces[5] developed within this research project that were used in the conception and creation of this piece, alongside algorithms, regular patterns and gestures that were materialized in sound objects as a counterpoint to spatial polyphony.

Bruckner's sovereign mastery of counterpoint can be observed both in the predominantly polyphonic textures of the first three movements and in the massive fugue with chorale which forms the bulk of interrelatedness of the breakthrough provided by the Finale of his *Fifth Symphony* (1876), where the chorale theme 'breaks through' at the end of the exposition space (Hawkshaw & Jackson, 2001; MacDonald, 2010). The idea of *space polyphonic breakthroughs* in the organization of the layers was decisive in achieving the desired result of multiple layers that are here briefly describe in eight procedures that were conceived in connection to specific *energy models*[6], leading to what I consider to be audibly distinct spatial patterns:

1. *False polyphony*[7] in patterns (through changes in amplitude, timbre and so forth);
2. rotations in the lower ring of loudspeakers;
3. opposite direction rotations in the medium ring of loudspeakers;
4. internal geometries (triangular and other shapes, mainly in front);
5. spectral *suctions / explosions*, usually from the lower to the upper loudspeakers;
6. simultaneous interpolated actions in the three rings of loudspeakers;
7. *points/localized* actions;
8. *spirals*, usually from the lower to the upper loudspeakers.

[5]Created by Enrique Tomás and Thomas Gorbach.

[6]I use the term *energy model* as taken from Vande Gorne's work, which in turn draws from the work of Pierre Schaeffer (descriptive vocabulary of listening), François Bayle (certain concepts defining acousmatic sound), and Guy Reibel (*play-sequence* and the importance of gesture), and that connects to a specific musical universe, usually a physical model, working as an *archetype* (a fundamental concept in conducting acousmatic listening) consisting of creating a sequence by applying a musical idea in relationship with the model (Vande Gorne, 2018).

[7]It is an analogy to the homonymous term that refers to the connection one can make in the frequency range giving the illusion of multiple voices when listening to a single melodic instrument, such as in a Telemann fantasia. Here the term is used in the sense of having a recognizable spatial pattern with a sub-pattern that can either create a localized action or a construct of, for instance, a sub-pattern of a distinct geometry that enables us to hear both the original pattern as well as the new one.

Although the perceptual features are less accurate when it comes to the discrimination of a sound source within height, when compared to our acute sense of space in a horizontal plane, particularly in front of us, the possibility of having sound patterns that travel above the audience allows an important feature of distinction between patterns.

When the polyphonic density is increased, the enhancement of a layer is usually achieved by a *gesture*. Almost all the sound material was made by the new musical interfaces developed for the aforementioned *Embodied Gestures* project. I mainly took short samples from works by Anton Bruckner and thereby created hundreds of *play-sequences* having in mind *energy-movements* using the new instruments and thinking about them as *sound bodies*[8]. I subsequently ruled out[9] from the work the majority of the created *play-sequences*, as is usual for me when composing However, one of the most notable perceptive features that allowed me to create distinguishable layers was the contrast between such *play-sequences* made with these *sound bodies*, in contrast to others created by algorithms or using other simple programable interfaces.[10] This contrast made *by the hand* created peculiar gestural spaces[11], to use Smalley's (2007) terminology, that would emerge back on the surface and play a role in the memory, connecting a layer that was previously presented, which had started to dive into textural sound masses, but would again rise up and be more easily distinguishable to the ear in comparison with the other *play-sequences*. The importance of the physicality of the gesture in the sound result and its perception has also been tackled by Brümmer (2017) and Vande Gorne (2018) in the context of acousmatic music.

This latest compositional experience allowed me to give light to two personal questions:

- Is the perception of layers related to a musical gesture?
- Is there a relationship between such musical gesture and a physical gesture?

The answer for both questions when considering this work is *yes*. Although there are many ways to convey space polyphony, the composition of *Magistri Mei - Bruckner* allowed me to test new personal limits regarding the perception of the simultaneity of spatial patterns in conjunction with new interfaces that acted as *sound bodies* for the creation of my own *play-sequences* and their interweaving connection to their associated *energy models*, with their idiosyncratic perceptual characteristics that allowed for the nourishment of a rich space polyphony.

[8]To better understand the concepts play-sequences, energy-movements and sound bodies, I highly recommend reading Thomas Gorbach's interview with Annette Vande Gorne, as well as reading her trailblazing work (Vande Gorne, 2018).

[9]In the sense that I created many more sounds than the ones used in the final work.

[10]Many of the algorithms were created in SuperCollider, both in ways that allowed a sound sequence to be triggered by command lines, or in lines that were, for instance, controlled by the MouseX / MouseY.

[11]*Gestural space*—The intimate or personal, source-bonded zone, produced by the energy of causal gesture moving through space, as with performer and instrument, or agent and sound-making apparatus (Smalley, 2007).

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