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Article

# Experience of Space in Sound: Perceptions, concepts and methods

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**Abstract**

This article addresses the question of experiential dimensions of space in sound, in electroacoustic music and sound arts practices in particular. We suggest that these practices are limited by the generalised way that spatial audio techniques are communicated, and we attempt to develop a tentative method that would enable discussion and sharing of spatial aspects in sonic environments. These modes of articulation would permit a translation of the experience of space in sound into other modalities. Reporting from a series of workshops, we outline a three-phase method that moves through the stages of listening, describing, recreating and imagining the sonic spaces. In the final stage, a speculative design approach shows that shared sonic spatial experiences are essentially relational. Topics relating to expectations, biases and language – such as memory and imagination – and the methods of mapping and speculative design are addressed in the discussion. Through the explorations presented in this article it becomes evident that different artistic musical practices still show the same need to develop articulations that enable the integration and communication of spatial relationships. The divide between the development of new technologies for spatial audio and the conceptual frameworks for understanding and communicating spatial sonic knowledge can be bridged, and eventually the development of spatial audio should be fuelled by the dynamics between these two poles.

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## 1. Introduction

This article is a position paper that has its focus on the experiential dimensions of space in sound, and tries to expand the conceptual understanding of spatial relations in sound. Stating the fact that audio technology has permeated much of cultural practice, and that spatialised sound is almost ubiquitously present in electronically mediated music, may at this point be unnecessary.

Despite this evident state of things, we are only able to summarily consider some of the related and complex issues of the power relations of spatial sound organisation, institutional politics and the music industry's push to monetise techniques of sound spatialisation. Although the continuous commodification of the use of space in contemporary commercial music productions and sound design in film has had a strong impact on the experience of space in sound, in this article those aspects are left out.

Instead we will discuss one of the core issues in artistic practices involving spatial audio: the difficulty of articulating and conceptualising spatial attributes in sound environments in general, and in electroacoustic, acousmatic music and sound composition processes more specifically. Our main aim is to explore how an understanding of the perception and experience of space in sound can be articulated and communicated; for example, through language use but beyond mere taxonomical categorisations.

Although there is a large body of work in the fields of musical phenomenology (Schaeffer 1966), acoustic ecology (Feld 2003; Gaver 1993), soundscape composition (Schafer 1993) and notational practices for electroacoustic music (Smalley 2007; Sköld 2023) that concerns the terminological aspects of music, this work is only briefly touched upon here. Rather than looking to develop more descriptive approaches to space in sound, our ambition is to focus on its experience and how this experience can be grasped and communicated.

In this article, we outline an experimental approach to thinking about space in sound that enables an emphasis on perceptual and embodied relations to spatial sound, rather than a physics-based and geometrical understanding of it. We go on to describe a model we have explored in three separate workshops in which the research components operate through an approach that generates practical experiences. In the process, we attempt to identify core concepts of the experience of space in sound.

One of the lacunae we implicitly tend to carry with us as musicians working in electroacoustic music and neighbouring practices is that when addressing space, there is a tendency to consider it merely as a parameter added to the sound after the basic steps of sound design or composition have been achieved. This becomes enshrined in the dominance of technical and scientific descriptions of space as an abstract geometric property. These descriptions are commonly the main references when space is approached in artistic sound practices: as a parametrisation of the acoustics of a specific architectural space; or in neat and clean functional categorisations, such as the one described by Macedo (2014). The technical substrate that enables these particular activities of sonic and musical shaping exerts a hidden but fundamental influence on how space in sound is conceptualised, articulated and explored, and has a profound impact on creative processes. This consequently influences how space is experienced and expressed by both musicians and audiences.

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In the practice of spatial music and its conceptual development over the past century – in particular the way it has been developed since the advent of electroacoustic, speaker-borne music – a number of practical approaches have been defined that have served to structure and analyse musical works. However, analytical and holistic approaches – expanded beyond disciplinary boundaries – that were developed to understand space as a fundamental contributing factor to musical experience are still lagging behind. This negatively impacts direct engagement, and the outcome becomes fixated on technical instead of experiential dimensions and domains. This has resulted in a lack or bias in the general and theoretical discourse about musical and sonic space and their experience.

In this paper, we will attempt to focus on this experience of sonic aspects that carry information about space in sound, and on the spatial relationships that listeners develop to sound in the process. Our argument is that a shift away from operations of identifying, describing, classifying and systematising environmental elements, towards the perceptual, situational and experiential dimensions of space in sound, contributes to a more complete understanding and creation of spatial music.

This conceptual expansion was primarily investigated by exploring the following three questions:

1. How do we experience space in natural sound environments?
2. How do we share this experience?
3. How can this experience be articulated and translated?

Shifting away from the pervasive presence of technology necessitates a re-evaluation of the specific expertise and boundary-expanding skills musicians need to develop. In some ways the technologies for spatial audio have taken on the role of the electronic music studio of the 1950s. The owners of large speaker arrays and systems for advanced sound-diffusion technologies are now the gate-keepers of the 2020s, similar to how the studios were 70 years ago. With the significant technological development in the field of spatial audio over the past decades, musicians and artists can not compete with the multinational tech companies anymore. Instead of developing independent and novel technologies, they tend to lean on existing ones provided by these different segments of the industry. Even with experimental approaches to spatial audio, the tools, algorithms and spatial production techniques offered by commercial developers distract artists from its important artistic, social, political and conceptual aspects. This problematic imbalance calls for new ways of understanding and communicating spatial audio.

The technical parameters for understanding spatial perception can be acquired using a wide array of well-known techniques. Nevertheless, in those spatial music practices that thematise space, the technical and architectural functions, compositional roles and deeper meanings of the spatial components of the sounds are most often not clearly distinguished. This obscures an otherwise comprehensive understanding of the field of spatial audio practices, and leaves the practitioners with the aforementioned standardised tools and techniques. As a consequence, we feel that the approaches to understanding space as a fundamental contributing factor to musical experience, and therefore to a direct engagement with space, are underdeveloped and fixated on the technical rather than the experiential dimensions. Beyond terms like 'envelopment' and 'Cartesian terminology', a limited vocabulary is in use to address the experience of spatiality in music.

## 2. Background

### 2.1. Musical context

During the twentieth century, a notable conceptual expansion occurred in philosophy, and provided the backdrop to some important developments in music, with a particularly strong impact on electroacoustic spatial sound works. Phenomenological investigations into lived experience from a first-person perspective (Merleau-Ponty 1962; Petitmengin 2007) developed methods and vocabularies for conceptually grasping this fleeting dimension.

In the context of musique concrète, these phenomenological perspectives led to the formulation of a notion of musical objects (Schaeffer 1966) in a mode of reduced listening (as related to *epochë* and the consequent suspension of judgement), as well as in deep listening (Oliveros 2005). Following in this lineage, specific focus was given both to listening (Ihde [1976] 2007) and to more particular enquiries into what we hear when we listen to music (Welten 2009). In parallel, and influenced by social anthropology, the notions of atmosphere (Böhme 1995) or ambiance (Thibaud 2020) arose, and the concept of the soundscape was both coined and critiqued (Schafer 1993; Ingold 2007).

These different aspects of sonic spaces influence, and are conditioned by, the ways in which we experience sound. Music, more specifically, 'shapes sound in a great diversity of ways . . . and at the same time shapes the social interactions that take place within those spaces' (Cook 2013: 238). As we shall see later, it is not only these social relations that are affected through the ways in which space is articulated through sound, but also the listener's internal relations to the many different ways that space is articulated are influenced. So there is an obvious interaction between the listener's response to the space experienced, the properties of the sound that gave rise to the experience and the place in which the sound occurred.

Associated with these approaches, a systematisation of sound objects (Chion and Schaeffer 1983; Chion 2009), spatial descriptors (Smalley 2007) and effects of built environments on sound (Augoyard and Torgue 2005) has emerged, and provides useful tools for the analysis of sound-scenes (Bregman 1994) by acousticians (Blauert 1983), urban planners and architects (Böhme et al. 2014), sound designers (Blesser and Salter 2007) and other artistic practitioners in the medium of sound (Kahn 1999). This has led to a discourse in electroacoustic music that favours taxonomies, categorisations and formalised modes of representation, through which these subdivisions into parametric and descriptive systems are gradually becoming prescriptive by virtue of their ubiquity.

Furthermore, the technical tools prevalent in studio practices today operate on principles shaped by science and engineering paradigms rather than artistic ones. They allow the creation and shaping of musical operations in systems of spatial simulation that have become almost transparent on the level of representation. Techniques such as panning (including in full periphonic three dimensions with higher-order spherical decomposition), reverb (both simulated and captured natural spatial imprints) and psycho-acoustic methods of producing acoustic signatures for spatial immersion have been developed to a high degree of sophistication. These already stable tools are becoming more and more standardised and commercialised, and increasingly more sophisticated. They allow for the artificial superimposition of spatial aspects on the music in an environment where the virtual becomes more real than reality: 'Immersive artworks turn into

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experience machines' (Mäcklin 2021).[1] This is consistent with the common notion alluded to earlier that space is something that is added to a sound rather than gathered from it. We argue that the study of spatiality in music has been shaped by this misconception to some degree.

In a survey on compositional practices for spatialisation published in 2011, simulating concert halls by technological means was one of the most sought-after functions (Peters et al. 2011), which points back to the dual nature of compositional practices. It suggests a focus on the performance and experience of the technology, that is, the means for reproducing the composer's intentions, rather than on the experience of the spatiality of the sound. It also points to spatiality as something separate from the music, as an add-on if you wish. As can be deduced from this bias, technology unwittingly appears to have become the primary subject, and the listener's attention is directed to whether or how the technology succeeds in projecting the compositional ambition.

### 2.2. Wider context

Interestingly, in his seminal work *The Production of Space*, Lefebvre (1991) already describes a *science of space* that alludes to what was described earlier as the political aspects of spatial audio, the attempts to conceal them and the simulation that 'embodies at best a technological utopia, a sort of computer simulation of the future, or of the possible, within the framework of the real' (ibid.: 9). Although we do not specifically focus on political aspects in this paper, the proposition by Lefevbre, in the case that his *science of space* holds true, plays well into the research approach that we describe in the next section: 'There is a truth of space, an overall truth generated by analysis-followed-by-exposition ... necessity of reversing the dominant trend towards fragmentation, separation and disintegration' (ibid.). Part of our argument here is that much of the work in spatial audio that we can observe, particularly in the commercial field, lacks the introductory step of 'analysis': how does the spatial property of sound expose itself, and how may we develop means to understand it, both experientially and semantically? As Lefebvre states a few pages later: 'Space considered in isolation is an empty abstraction' (ibid.: 12).

Consequently, when considering the capabilities on which spatial sound and audio perception are based, it is useful to also take into account how we dwell in space, how spaces are always a place (rather than an empty abstractions) and that a kind of skill and knowledge of how to negotiate these relationships underpins a musical relationship to space. The cognitive and cultural bases of these principles are well elucidated by Tuan, who states that

> Spatial ability is essential to livelihood, but spatial knowledge at the level of symbolic articulation in words and images is not. For human beings, what is the relationship between spatial ability and knowledge? How does one affect the other? Spatial ability precedes spatial knowledge. Mental worlds are refined out of sensory and kinaesthetic experiences. (Tuan 1977: 74)

Here the interrelationship between kinaesthetic and sensorial ability in the experience of auditory *space* and its mental or articulatory access becomes evident and emphasises that listening provides a necessary dimension of space 'frequently overlooked in the ocularcentric culture of late modernism' (Cook 2013: 225).

In a scope wider than the musical and auditory domain, space and place are always co-constructed and co-felt, and function to bracket direct experience on a pre-personal level. The tension generated by the duality between space and place in *composed* artistic environments (concert halls, studios, galleries) is quite potent. As part of an artistic approach, their superposition may contribute to a specific intensity of experience.

Nevertheless, the fact that space can be abstract but places remain tied to lived experience is also an important distinction for the experience of spatial sound and music. Casey's insight into the agency of places is relevant in this regard:

> The living-moving body is essential to the process of emplacement: lived bodies belong to places and help to constitute them. ... Places gather things in their midst. ... What is kept in place primarily are experiencing bodies ... places also keep such unbodylike entities as thoughts and memories[; they] gather experiences and histories, even languages and thoughts. (Casey 1996: 24)

The place of experience situates us on a bodily level, and also serves as an underlying layer for the inscription of imaginative and remembered affects, sensations and associations; this in addition to the foregrounded experience of sound, music and spatial sound gestures. This raises the question as to whether the shift from space to place also occurs in musically structured environments, and if it does, how does it operate? Norman talks about the connectedness that arises through shared listening situations where place is generated 'in "repositioning" [the] listeners collectively – embodied and emplaced by performance' (Norman 2012). This statement emphasises that places are also central in carrying social relatedness, which extends to the spaces of sounding and listening together, and centrally structures the listener's relations to the sonic environment and its embedded sounds.

## 3. Investigating the experience of space in sound

Between January 2023 and April 2024 the authors carried out three workshops exploring and addressing the experiential perspective on space in sound. These workshops were motivated by an increasing frustration with the lack of articulation and ways of addressing space in sound in the community of electroacoustic musicians and sound-artists, especially when attempting this from a non-technical, experiential perspective. The first workshop, in January 2023, brought together a group of practitioners that included students of electroacoustic composition and senior lecturers and researchers in sound art and music production. The sessions centred on the *aural and oral tradition of spatial music* with a focus on the question: *how widespread is access to the primary experience of* listening *to spatial music?*

The next workshop, in late November 2023, explored the transfer from experience to concepts and words, via a first implementation of the three-phase method that will be discussed in the following subsections. In the April 2024 workshop, the group continued the development of the three-phase method by extending it significantly. As a shared frame of reference and concrete experiences, the workshops included small-group concert presentations in multichannel spatial audio diffusion settings that flowed into the research conversation. The workshop also included field recordings using a surround microphone that were then played back in the concert hall environment.

All workshops were structured in a similar fashion. At each meeting, small groups of participants went to different locations in the respective cities (Stockholm and Helsinki) with the task of carrying out a deep-listening exercise focusing on the experience of space. This was followed up by *in situ* group discussions about the qualities of space that had been perceived by each participant. The full group reunited in the concert hall, where in-depth discussion

[1]This is also related to a whole range of postmodern and poststructuralist philosophy such as Baudrillard (1996) and Deleuze (1988), to only mention two.

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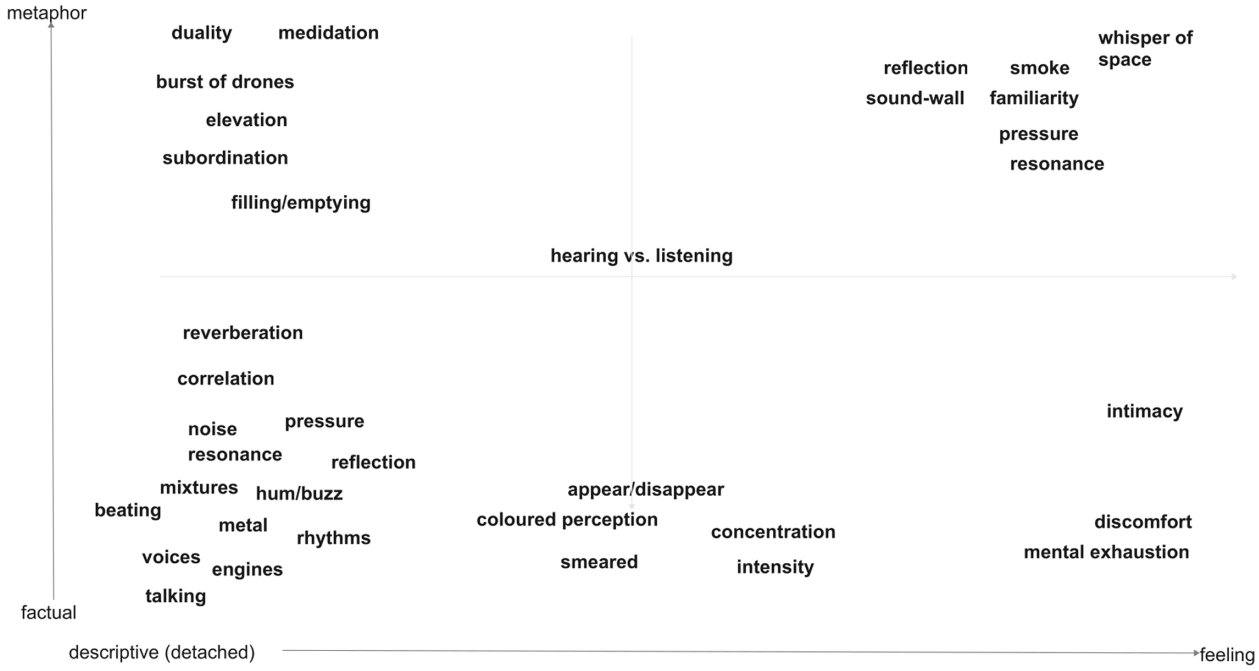



**Figure 1.** Map with participant-provided terms created during the workshop in November 2023 in Helsinki.

and mapping exercises were carried out, revealing relevant discontinuities between how the participants understood the space through listening, and the (conceptual, verbal and practical) tools commonly offered to the user by mainstream electroacoustic spatialisation technologies.

### 3.1. Inquiry procedure

The method developed by the authors for the listening workshops relies on a basic qualitative open-coding method, albeit in a quite free implementation (Auerbach and Silverstein 2003). The main objective was to create a context for listening that allowed the participants to hear and identify the spatial properties of individual sounds in the spaces we had chosen. The workshop method was continually developed over the course of the three iterations, and the general outline consisted of the four steps described in the following subsections.

### 3.2. Listening to the space

In the first workshop phase, two groups were each assigned to two nearby spaces. The instruction to the participants was to visit each place and to listen attentively for key sonic aspects of the place that provided information about it. The chosen places were in public architectural sites or open urban or peri-urban environments that displayed enhanced and layered distances, volumes or super-positions of sources. The tasks included clarifying the point of listening, the place of listening and the way sonic events are able to describe the space to the listener, for example. The instructions to the participants were quite brief: 'Find a location within the space, close you eyes and listen attentively for five minutes, paying attention to spatial aspects of the sonic environment.' Immediately following these listening exercises the group convened *in situ* and discussed the experiences for another five to ten minutes, making direct reference to the key sonic elements while still in the same place.

### 3.3. Describing the space

In the next phase, after the listening excursions, the two groups gathered and each member of the group gave descriptions of their listening experience, either a specific articulation of space, such as 'the hammer hitting the steel bar',[2] or more general impressions, such as the way sound projected in the visited spaces. This discussion gradually turned to a mapping exercise where we attempted to conceptualise the specific experiences of the participants into a collection of terms, which was subsequently ordered in a two-dimensional grid according to a principle negotiated in the group.

The terms surfacing in the first workshop were 'familiarity', 'resonance', 'meditation', 'discomfort', for example (Figure 1). In the discussion, attempting to order the collected terms into coherent categories, the two axes *factual–metaphorical* and *descriptive (detached)–feeling* came to the foreground, allowing an organisation of the terms around the twin processes of *hearing–listening*.[3]

Terms articulated in the most recent workshop included 'representation', 'indexality', 'evidence' and 'disappointment', to name only a few (Figure 2). This time the ordering was done in a 'mind-mapping' manner, by grouping terms according to similarity or thematic and conceptual affinity; the word groups themselves were also distributed in neighbourhoods of meaning, i.e., using these simple diagrammatic processes as sense-making devices (Ljungberg 2012). The three central terms experience, memory, imagination were then also juxtaposed with 'knowledge, understanding and sense-making' on the one hand, and 'past, present and future' on the other.

[2]Quotes come from the authors' field notes collected during the process.

[3]In all transparency, the maps in both Figures 1 and 2 do not contain all the terms proffered by the participants. Some were left out because of lack of time or insight on how to include them in the scheme. As with any classification attempt, the chosen model constrains as much as enables understanding.

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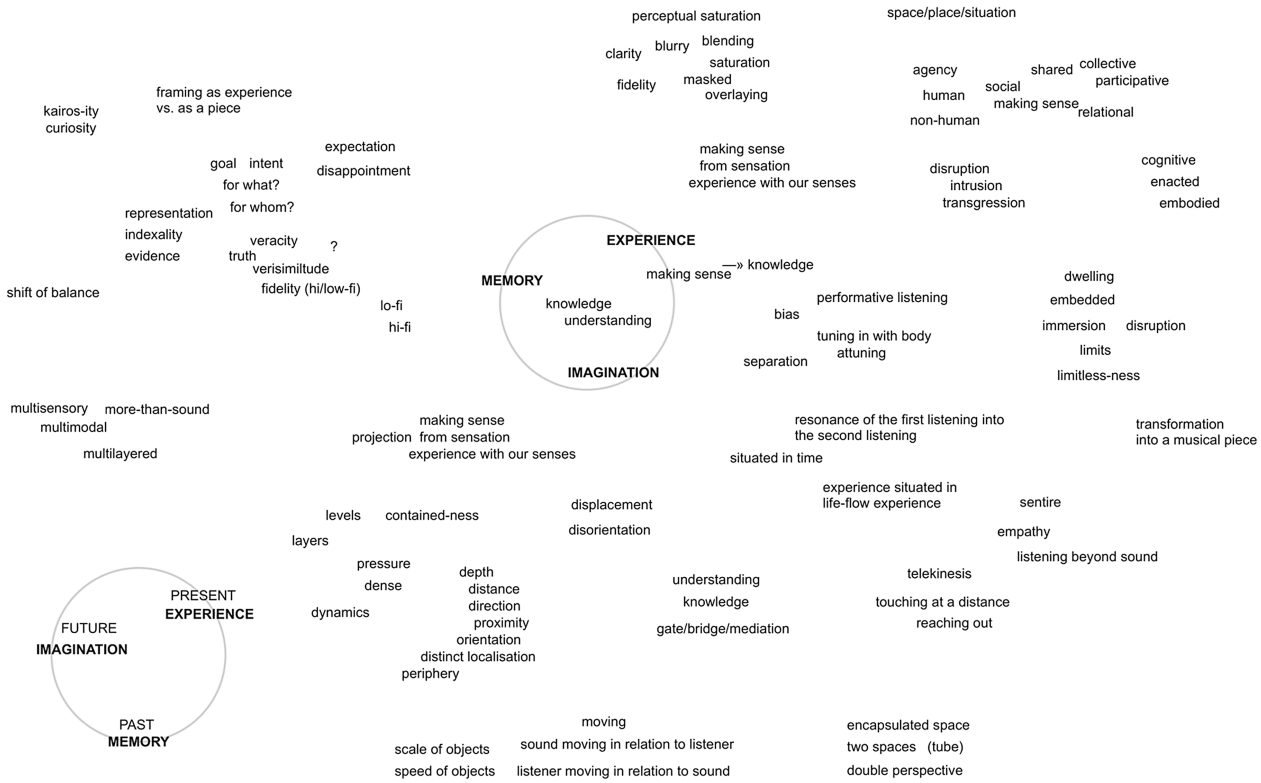



**Figure 2.** Map with participant-provided terms from the workshop in April 2024 in Stockholm.

These collections of terms that in and of themselves conceptualise an experience of space in sound should obviously not be considered general and exhaustive listings, but rather as an intermediate stage from which a more universal understanding may emerge. As we gather more data from upcoming workshops, a wider range of methods may be used to connect existing conceptual frameworks to experience. A further discussion on the terms explored in these workshop discussions will follow in the next subsection.

### 3.4. Recreating and imagining the space

The third phase of the workshops focused on the attempt to imagine how the sensations of the space just experienced might be recreated. Questions posed to the participants included *What kind of tools would be needed and did they already exist?* and *Is there a need for new technologies for spatialisation?* This was carried out in a speculative design (Houlden and Veletsianos 2023) exercise, where the participants were asked to come up with imaginative scenarios that could contribute to novel approaches to working with and in spatial audio.

Design fictions appears to be a useful method for this task in that they 'create a speculative space in which to raise questions about whether a particular technology is desirable' (Cox 2021). For the third research question stated previously, on how the experience of space may be articulated and translated, these design fictions turned out to be useful. Resulting fictions were 'a magical device that produces a map' and 'a device that can turn memory into sound', for example. Some of these results are discussed in more detail later.

The imaginative transformation of perceived, remembered and shared listening situations immediately after the original listening experience was an important method step. It enabled the activation of listening and musicianship skills, while at the same time allowing participants to stay attuned to the question of spatiality in sound. It also enabled the identification of a spatial foundation of sonic experience through amplified and transformed sensations by actively imagining their recreation.

### 3.5. Methodological development

In parallel to the phases carried out during the workshop, the authors were engaged in intense discussions on methodological development. As with any experimental process, the goals and the ways to achieve them remained in flux throughout the process of enquiry. Goals shift due to new insights and how work phases fail or can successfully be carried out, and contribute to a gradual clarification of the insights that may be achieved.

In this enquiry, the methodological development task was to organise the listening and articulation processes in order to enable a focus on access to the experience of space in the three different approaches and modalities: listening, articulation and imagination. In other words, the three phases of the model had to be tested and re-implemented throughout the three workshops in order to sharpen the focus on knowledge about spatial qualities in sound. These three phases are directly connected to the three research questions defined earlier. We believe that using this structure would also improve strategies for accessing perceptual qualities in spatial sound.

As of this writing, however, a comprehensive understanding of the outcomes of these enquiries is still emerging. Their value has become most apparent in exchanges with practitioners struggling to organise their musical spaces with a sensitive weighting of audio techniques and perceptual organisation in

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the 'sound scenes' they create. It is clear that the different steps in these workshops have resulted in a few concrete and related insights:

- Listening with an explicit focus on spatial cues in different environments reveals information about the way sounds project, define and characterise a space that can appear surprising or novel to the participants.
- Discussing and conceptualizing the listening experience can give rise to useful terms outlining and sharpening said experience, albeit not terms that provide a general understanding.
- A close linking of direct experiential access to coherent sonic environments with almost embedded propositional articulation processes shifts any terminological categorisation away from abstract, high-level descriptions towards articulation that builds a bridge between immediate, embodied, elemental sensations and their possible crystallisation in language.
- Thinking about how to recreate the previously experienced and heard spaces makes it evident that most available tools are insufficient to do justice to the multidimensional phenomena at play in sonic environments, that is, it shows that re-reproduction or simulation of the spatial aspects of these environments is almost impossible.
- The use of a design-fiction exercise shows that new approaches to creating musical works are possible, leaving the question open as to how to fold them back into concrete artistic workflows.
- Speculative or imagination-based approaches give priority to experience in spatial sound, and alleviate some of the dominance of the purely technical, parametric treatment of space in musical creation.

The exploratory development of this method is still ongoing. It needs to be further extended to include procedures for evaluation, analysis and interpretation in a more systematic operationalisation of the experience-first framework. Continuing this research work through a range of analytical and interpretative approaches will enable a more detailed integration of perspectives related to our theoretical framework.

## 4. Discussion

The last and crucial step of the proposed method is a reflection about the various processes and their outcomes. To open this reflection we provide an anecdote from the third workshop that illuminates an unexpected and extremely salient point relevant to the approach chosen for this enquiry.

### 4.1. Mismatched expectations

During the listening workshop in Stockholm in April 2024 we made an interesting observation regarding the relation between a recent listening excursion and its documentation and playback. We brought first- and third-order Ambisonics microphones[4] to some of the sites, and recorded the sonic environment while we were listening. It should be noted that we did not spend much time optimising the conditions for the recordings, and this obviously had an effect on the result. We merely set up the microphones and recorded onto a laptop or portable recorder. Later, in the group discussions, towards the end of the step labelled *describing the space* (see section 3.3), the idea was raised to playback the recordings as a means of reinforcing the memory of the experienced spaces and places. The recordings were decoded and played back into a 29.4 dome-like configuration of speakers already present in the concert hall that served as the venue for the workshop. Despite the lack of care taken with the recordings, the playback conditions were technically not far from optimal and the system appeared to be relevant for the reproduction of spatial audio surround recordings with relatively high fidelity. The universal rejection of the recording by the group as something that had at most only a very vague resemblance to the collective memory of the experienced sonic environments was rather dramatic and unanimous. As a preliminary analysis, the rejection and demonstrated mismatch does not necessarily say much about the quality of the recordings, nor about the equipment and infrastructure used for playing them back. Nevertheless, before any conclusions can be drawn from this insight, more work needs to be done experimenting with better recordings, better equipment, more preparation and production time. Another possibility is to explore different moments at which the recording is introduced back into the various phases of the method.

[4]The Sennheiser Ambeo and the Zylia Pro.

### 4.2. Space versus place, and spatial relationality

Apart from the obvious difference between natural listening and a technically captured sound environment, this mismatch is indicative of the fact that the experience of a place's sonic space consists of more than the distributed sound events and their associated acoustic effects. One may claim that the engagement with sound, space and experiential place that these listening exercises elicit is not entirely compatible with the affordances of spatial audio technologies. The experience of a sonic relation is embedded and situated in the encounter with a *place* containing multiple layers of perceptions, sensations and stories. Hence one of the first experiential aspects is that of how the listener is situated, in both their personal trajectory and the immediate environment of the place. The mismatch between the experienced and recorded place that we observed may also have something to do with the concentrated listening exercises, through which attentive listening to the spatial properties of a place and the subsequent discussions and attempts to conceptualise the experiences of space create a particularly heightened involvement with the place and its sonic identity. This intense experience of the place, with its dense and layered experiential dimensions, was obviously not matched by listening to the recordings, which serves as a clear example of *the difference between primary versus mediated experience*. Another way to consider this discrepancy is between production and re-production. At any rate this insight resonates with both the first and the third research questions. 'Production' of space is what Lefebvre (1991) identifies as a social act, as perceived, conceived and lived space – from a phenomenological position it is seen as the 'bringing forth of the world' (Varela et al. 1991) through an enacted, inextricable relation to each place. 'Re-production' of a spatial scene or place is a mediated process that is transported in time and space through technical means. It is premised on the viability of its interpretation as the simile of an actual experience – a cultural technique (Mauss 1973; Winthrop-Young 2013). Thus the relation to space cannot only be a 're-presentation', but requires an active 'material encounter' (Nelson 2015), whose resistance entails that we leverage our habitual practices and ways of relating. Nelson's insight 'that space and body are intertwined through proprioception, and . . . allow us to encounter space as a material' (ibid.: 10) points to one of the reasons for the mismatch in the

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technically mediated synthetisation of sonic spaces: proprioception, the sense of being there, as located in the body, is not transported by the recording and diffusion technology. However, in the case of presenting spatial sound as a musical performance, space is both *created* and *re-created*, generating a new experience that may not mimic another one, but that builds on the techniques and abilities to work with and understand artificially constructed sonic and musical environments.

### 4.3. Biases and silent assumptions

The enquiry, as it was designed, carried out and refined across the three iterations, is based on a few assumptions that were implicit from the outset, but have become more evident through the process. Listening to the spatial aspects of sounds in architectural or outdoor spaces is more common and therefore more accessible than doing the same thing in the optimised and highly artificial architectural venues such as the concert hall, the studio, the black box, or the white cube. Part of what this investigation aims to achieve is to bring to the foreground spatial aspects that are more prominent in 'natural' sonic environments and establish (terminological, procedural, perceptual and experiential) approaches to working with them in artistic projects and processes. The necessity for these clarifications and new conceptual and procedural tools arises mostly from our frustration with the discrepancy between the promises of technological advances and the failure of these tools to deliver a coherent multidimensional sensorial experience beyond conventional sound projection in concerts or sound installations. In addition, as creators of sonic experiences in mediated formats and constructed places, a deeper understanding of the experiential dimension of spatiality can enhance our chances of achieving the desired artistic and aesthetic outcomes.

As also touched on earlier, the reliance on language as a working medium in describing spatial properties in sound is by no means trivial. Habituated as we are to naming things, the descriptive mode provides a well-known and useful way of exchanging the elements and aspects of an experience. Musicians, and particularly the academically trained artists who took part in these investigations, already possess a vocabulary that originates from the various forms and types of academic musical training they have gone through. However, even before collecting the language elements and establishing some kind of descriptive system, the limitations in language use, or rather the variability in articulation ability between different participants, needs to be considered. Levels of experience and the individual mixture of different types of expertise in the participants, as well as the specific ease of use of the idiomatic language prevalent in the latter phases of the method, also play a central role. The level of language proficiency is often silently assumed not to matter.[5] Consequently, it is important to acknowledge that this well-established mode of language use does not necessarily fulfil the need for exploration and synthesis of insights in relation to a sonic spatial experience.

### 4.4. Mapping

The workshop phase following the communicative exchange about the listening experience, either in small groups *in situ* or in the larger group, prepared the participants for the collection of terms, though no other instructions or rules were given. The open-coding processes that arose were mainly embedded in the mapping processes. As part of the articulation phase, the maps evolved from an unstructured collection and discussion of terms into a negotiation about classification or grouping according to the (sometimes associative) connections between the terms. By no means a linear process, the mapping exercises took on different intensities and orientations, depending on the focus of each group, but the descriptive and personal reporting of the experience gave rise to an axial organisation (Figure 1). The more detailed and better instructed later workshop process produced a more complex and interwoven organisation of terms, as seen in the second map (Figure 2).

From a methodological development perspective it is noteworthy that the additional time dedicated to the second mapping process is clearly reflected in the density of the outcome, but not necessarily in its clarity. The legibility of the maps in terms of terminological categories and their logical structure benefits from a simpler organisation model, such as a coordinate system with two dimensions.

The terms pivotal to the first map were *hearing–listening*. They provided the anchor points in a terminological space between the objective–subjective poles of *description* and *feeling*, as well as *facts* and *metaphors*. The first hurdle in finding articulations about spatial aspects of sonic environments is to balance literal description and abstraction or emotion/affect. Since one of the central aims of this investigation is to gain access to subjective experience of space in sound, clarifying what the articulation refers to becomes essential. When asking about experience, the question should be 'What is it like to experience . . . ?' rather than 'What is it you hear/listen to?' (Petitmengin 2007). Concentrating on *familiarity*, *resonance*, *meditation* and *discomfort* as detailed elements of the map, it is clear that these terms demonstrate how reflection and higher-level ordering already form part of the terms offered by the participants. Each of these terms speaks of experiential impacts while listening and activating the state or sensation described.

The terms central to the second map were *experience*, *memory* and *imagination*, and they reflect the structure of the workshop to some extent. They also represent the outcome of an ordering and analytical process that was already occurring during the term-finding discussions in the first workshop. But more directly reported items can be associated to each of these three core terms, to experience *situated in flow*, *situated in time*, *more-than-sound*, *contained-ness*, *pressure*, *dense*, *dynamics*; to memory *indexality*, *representation*, *evidence*, *truth*, *making sense and separation*; and to imagination *transformation into a musical piece*, *gate/bridge/mediation*, *expectation/disappointment*. And overall, the already mentioned triples *knowledge*, *understanding*, *sense-making* on the one hand and *past*, *present*, *future* on the other indicated a strong conceptual framing imposed from a higher level. Overall, the encapsulating nature of these key words, standing in for insights by individual members of the group, then shared through explanations and finally captured as placeholders in a vast constellation of meanings, gives this map a somewhat cryptic or encoded character. Re-reading the map, or navigating it without reference to the conversations that occurred during the process is more than an act of interpretation, it is one of speculation, of associating meanings to terminological nodes that may not have been present during the group's initial engagement with the task of articulating terms.

The value of these maps should therefore not be overestimated. They represent the outcomes of situated processes with distinct groups of participants. As such, their form is contingent to the time, persons and locations that framed the precise moment of

[5]Almost none of the participants were actually using their native tongue. The electroacoustic lingua franca of English was used by default and for practical reasons.

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their making. They represent to some extent a singular constellation of people, dialogues, conversations and experiences; a typical configuration found in qualitative research approaches that address subjective, experiential and social dimensions. And realistically, from this perspective, the maps cannot provide universally applicable structures and terminological organisations.

Nevertheless, the second-level ordering that occurred during the mapping processes, in the first case finding a coordinate system, and in the second finding three core concepts as an ordering principle, speaks to the utility of collective thought and articulation processes. Serving as a basis for further iterations of the investigation, the principles active during the processes, rather than the specifics present in their traces, form the core insights of this process.

### 4.5. Speculative design processes

The third workshop phase had as its central principle *imagination not bound by convention*, which was an exercise loosely based on the method of design fiction (Cox 2021; Holzer et al. 2021). As a principle more time-consuming and complicated to carry out, but also more rewarding on different levels, this approach created an opening onto the problems and frustrations at the source of this investigation.

In this phase, while working in pairs, the participants' task was to develop an approach allowing the re-creation of the experience of space in sound, or the spatial experience lived in the sonic environment. Although few of the groups managed to stay within the parameters of the task (many using their imagination to completely escape the constraints of either urban listening situations or cultural production spaces), the scenarios, imagined apparatuses or processes that were presented offered valuable insights into novel elements or ways of integrating space into musical, sonic or social creation processes.

In the first example already mentioned, the group imagined 'a magical device that produces a map' and 'a device that can turn memory into sound', thus creating 'a liminal space, [while] remaining flexible' (Mills 2019).[6] It bent sonic experience back into its representation – making it temporally displaced, entirely based on memory – and changed the medium of representation into a map, albeit in an abstract form. This speculative design attached itself to the elements of the preceding process, and tried to re-imagine them in a 'magical' mode. Taking a big step away from any concrete processes, the model nevertheless tried to address the investigation at hand directly.

The next group expanded the task and came back to propose 'music-making as a utopian activity that translates subjective experience', a cultural role that music has always fulfilled to some extent. This group's interpretation of the speculative task refers back to 'a new technology: music', without specific instructions or alterations to the notion of what this means. The emphasis on the ways this role is newly defined makes this speculative proposal reach beyond given conventions and boundaries. Its application in actual creative processes becomes highly contingent on engaging with an extensive interpretation process, thus reassigning listening and music-making as principally experiential in themselves.

Another group proposed to 'engineer' a social situation of listening, where an immersed listener who is exposed to an actual sonic environment is interrupted by an accompanying person. This disruption forces the listener to 'snap out of it', which for a short moment permits other agents to alter the environment, by adding sonic or spatial elements, and present a newly layered experience of sonic space to the listener. While oscillating between deep immersion, disruption and re-immersion with an increasingly layered sonic space, this proposal centres on the listener's ability to remember and reconstitute the experience in an intensified manner, thus 'filling the gradual puzzle of time'.

Finally, one group proposed a musical instrument with 800 speakers and three symphony orchestras present in a place permeated by outside sounds originating from nature in a transparent manner. With this instrument the proponents would then 'transcribe the soundscape' as a 'recreation of a recreation of a recreation'. This speculative maximalism maintains the creative act of composition at its core, while again creating layers of experience through transcription into a so-called 'score'.

The ensuing discussion with the larger group revealed important ways in which the participants were thinking about the spatial and sonic aspect of the experienced places. Core statements included the observation that 'non-visual space doesn't reveal itself, except over time', and that 'space grows' – possibly referring to an insight about spatial sound when stating that 'in a built space, everything is present at the same time, imprisoned by the architectural space', and that the processes of spatial sound operate through an 'unveiling over time [that] reveals space, sounds reveal space'.

Concerning the method of speculation, participants' opinions fluctuated between seeing the 'limits of speculation [and staying] pragmatic in the realm of the possible' and the 'ease of collective speculation – [to] trace a line between things' as a mode of developing a joint understanding of the field under speculation. They also noted the necessity to 'frame in order to create experiences', and to consider speculation as an essential tool that may serve as a starting point for deeply human ways of operating such as 'absurdity, humour, storytelling' – all of these also considered cultural 'survival tools'.

To the authors, one of the successful outcomes of this last phase was the deliberate shift away from imagining any sort of digital audio processes: scenarios detached from conventional spatial organisations were proposed, as well as the interchangeability of sound and space. The outcomes therefore also disproved the expectation that tools and instruments of current electronic music production would play a role in the imagined processes.

### 4.6. Language, verbal definitions, memory, relations

There are a few critical steps that may need further evaluation, but we believe that the method developed here may still lead to interesting results. The most obvious aspect is perhaps the relation between language and first-person experience. What is the relation between an individual sensation of spatial properties in sound and the rendering of this sensation in language? Can there be a meaningful linguistic description of the experience of space that promotes the communication of said experience? Although there is not a traditional opposition between a musical experience and its verbal description, there is at least a conflict. Consciously developing terminology for the experience of spatial aspects of sonic events through discussion appears to deliver concepts with some relevance, at least locally.

The second challenging aspect, clearly connected to the first, is how to identify core ideas and effects in spatial sound. This identification undoubtedly happened in the workshops, and there were several examples of how everyday, almost mundane sounds propagated the experience of interesting spatial effects. It is equally

[6]Again, the quotes originate from the field notes.

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evident that these led to verbal definitions and concepts that could be critically discussed in the group. This discussion was not just limited to the validity of the descriptors, but also included comparison between different kinds of events and the emergence of new descriptors.

Third, the impact of memory was revealed not only through the feedback loop of experience, activated memory *in situ* and re-activated but also referential experience, for example through recordings or speculative design; in the discussion too, references were often made to related experiences of spatiality in sound, the verbalisation of which provided the participants with tools to both describe and understand. The frequent mention of memory clearly indicates that it plays a central role in all the reports about the three phases of listening, articulating and speculating about spatial sonic experiences by the participants. In the first map this is mainly discussed in terms of *reflection*, whereas in the second, memory is a central aspect through which other aspects were understood. Finally, a core element of the experience of space in sound is the spatial relationship of the listener with the environment, the sound events and their evocations, the sense of place and of being present. How a sound event is positioned with regard to the listener carries no semantic meaning but forms part of the sensation of place. The sense of proximity and distance, the presence of a sound event in the frontal field – 'facing the listener' – are all aspects that constitute a relationship, diffuse perhaps, but as an intrinsic part of the experience.

## 5. Conclusion

Starting with the question of how we may access, articulate and transmit the experience of space in sound and sonic environments, we have shown the progression and some collected outcomes of an exploratory process and methodological development that attempts to engage in multiple ways with this complex issue. The experience gathered from the workshops presented here clearly shows that more attention and conceptual development work is needed to develop musical practices that investigate the possibilities of spatial audio beyond what mainstream tools and hardware systems can offer. Through our exploration it has become evident that the different practices situated between sound art and art music show the same need to develop a notion of spatial relationships. Although we present a dichotomy between instrumental approaches using technology and perceptual approaches based on subjective experience, the central tenet remains that we are looking for ways to link these two domains.

Acknowledging the technology fatigue mentioned in the beginning of this paper does not, however, discredit the fact that there is a social need to explore new technologies through art. As musicians and sonic artists, we oscillate between these two perspectives out of necessity, and the fatigue should rather be interpreted as a wish to regain control over technological development. Given that this pendulum movement is not necessarily a controlled and intentional shift of perceptual attention and conceptual focus, the gap it unveils represents a large and unexplored blind spot. Ultimately, the overarching question remains of how to do justice to the incredible perceptual sensitivity to space in sound offered by human cognition, whether working with virtual spaces in audio or compositional processes in built or 'natural' environments. In other words, how can our embodied experience of spaces and places in real life be conceptualised in ways that make the knowledge useful in the context of composition or sound art? Framed like this, the question is primarily epistemological in nature: how may spatial knowledge be explored, understood and communicated in ways that contribute to the development of new technologies and their practices, as well as to a reflective attitude that enables the development of conceptual frameworks? Currently the answer eludes us, but we believe we have begun an exploration that may lead to a firmer understanding of the experience of space in sound.

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