AUDIBLE (ART): AN INTRODUCTION TO THE INVISIBLE SONIC CONNECTIONS

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ABSTRACT

This is an introduction to a special edition of JSTA dedicated to the myriad forms of sonic connections and audible expressions. We approach three dimensions of sound in an artistic context: auditory specificities, performance dimensions, and computational listening. Sound is a complex phenomenon present in everyday life and dwelling between conscious and unconscious processes. A universe contained within itself, where every sound event has the potential to be considered aesthetic material, contributing to the proliferation of creative approaches. These specific conditions have potentiated an outbreak of sonic art genres and expressions. Listening as an epistemic process has been subjected to successive changes pushed by computation and the breeding of computational media. The intertwining of computation with environments leads to a state of permanent re-articulation, and supports the development of new relations in meta-environments, turning listening into a hybrid process of human and computational operations. This essay points to visions and approaches to sound as a specific field of knowledge that can arise from, lead to, or be used as a tool of world-building.
Keywords: Audio cultures; Sonic arts; Sound and performance; Auditory perception; Computational listening.

THE INVISIBLE MATERIALITY
José Alberto Gomes

What is Sound? Sound is a complete phenomenon made up of several worlds and layers and described and analysed by different perspectives, occupying different roles in our lives. The musical and aesthetic point of view monopolized most of the research on sound in Western History. Only in the 20th century the physical and the physiological properties took an important place in sound research (Olson, 1967). It is quite clear to all, including the scientific community, that the significance that each individual give to sounds is different and goes beyond its physical and perceptual properties. In other words, for example, a Mozart Minuet does not provoke the same sensation to people from different parts of the globe. This is a consequence of an intrinsic part of the listening activity, a cognitive part. So, along the musical and aesthetic fields, the physical and the physiological aspects, that deals with the auditory system behaviour and the process from the pressure waves to the electric impulses into the brain, are fundamental to extend our reflection to other areas like anthropology, psychology and cognition. Thus, not only due to the air vibrations and the auditory system, a musical piece, as is common knowledge, has different meanings and different impacts in distinct listeners. And the reason is quite complex. The cultural and musical background, the state of mind and body, a personal and emotional experience with a particular music passage, etc., are all reasons that influence and affect the act of listening. This complexity applies not only to musical contact but also to all of the listening experience. As an extreme example, an ambulance siren has completely different impacts on an inhabitant of an urban space compared to someonewho lives in a remote area (McAdams & Bigand, 1993).

The auditory system tends to be put at a different perspective than vision, commonly at a lower level of importance mostly because the act of listening is processed effortlessly and unnoticed. At the same time, the auditory sense has a different function than vision. It is a different world containing a unique reality. It is a permanently-on sense; it never shuts off. Naturally this characteristic has a survival function, providing us with the ability of permanent three-dimensional awareness, with the capacity to identify the location of a sound source, being our main door to what surrounds us outside of the view angle. This characteristic strongly defines our relationship with the sonic world: that permanent act of listening forced humans to develop different levels of listening or conscience about it.

Most of the time a person relates to the sound around them in a casual listening mode, that is listening to identify the source of a sound. Through causal listening we can identify the source of a sound simply by listening, without having the visual reference. Another common way of listening is to be aware of the language or code, using the semantic listening state in order to interpret the implied meaning like in a conversation or decoding morse. We can also listen in a way our focus is primarily on the traits of the sound itself: being aware of all sonic characteristics like

pitch, intensity, timbre, specialization, spectral qualities and how all these elements evolve in time (Chion, 1994). This involves a lot of effort. A great amount of people go on an entire life without being conscious of this ability. (Everyone can recognize the sonic beauty or ugliness and so everyone has the aptitude to apply a reduced listening.) But it will be impossible to be always in this level of awareness. We become crazy with all the continuous information, even with common sounds like a gentle hum of an AC, the sound of your neighbour's shuffling footsteps or the murmurs of conversations around us. In a way to save our sanity the listening process has to be placed at a passive level, because sound is always there. However, the auditory system is always working. Against a disruptive sound our listening process shifts to the active mode. If we are in a conversation in the middle of a crowd, even a very loud one, we know that the sound is there, but we are in a very low awareness mode, we are not following any conversation or words beside our interlocutor. However, if a child starts to cry, someone asks for help, someone says our name, automatically we change to an active mode. This means that we are always listening to everything. These aspects in the nature of perceiving sound have an impact on the relation that we have with our sonic surroundings and more importantly how we shape it and how we let it evolve.

But how do we relate to the surrounding sound in a world where all kinds of sound are permanent and effortless? Where access to music is automatic or trivialized, through a concert hall, our smartphones and in the supermarket's columns, or where the soundscape is invaded by sounds of engines in a spiral phenomenon of ecosystems permanent mutation. Do we recognize the sound that surrounds us as a conscious sound identity? Due to the characteristics of the aural perception, the soundscape is not an external and hermetic system formed by biotic communities that inhabit and interact in a region and by the abiotic factors that influence them. We are an intrinsic part of that ecosystem. The soundscape is more than a sum of sounds from a specific geographical space, the soundscape is sound as a form of collective identity. It does not only involve intensities and timbres but all other aural worlds such as Acoustic Ecologic, Socio-cultural, Emotional, Temporal, Romance and Phobia, Musical, Environmental, Communicational, Immersion... As Barry Traux said, "After all, the soundscape is not an alien force but a reflection of ourselves" (Truax, 2001, p. 117). Although sound plays a fundamental role in our survival and in the relation to what surrounds us since always, the musical sound started to be studied in ancient Greece; the sound as a physical and perceptual phenomenon in the last two centuries; and the soundscapes studies only deserved real attention since the 1970s. The word *soundscape* did not exist until it was introduced to the world in 1977 by Murray Schaefer (1993). And it's hard to give attention to a concept that doesn't have a name. The fact that the term Soundscape was only "discovered" in the 1970s, elucidates the type of relationship with our collective aural identity. As such, the work of rediscovering the world through sound, or even discovering a new reality through sound, becomes

as pertinent now as ever, not as opposed to a visual world, but as a new and independent philosophy of knowing.

Sound was seen as an expression, as art, as a physical, cognitive, ecological and social phenomenon but rarely as a universe contained within itself. Only the sound characteristics of being permanent and omnipresent, adding the passive, automatic and unconscious relationship can point out to the surprising negligence of this universe (Gomes, 2020). Sound remains as an active element capable to modulate and infect. It is a permanently open and involuntary external signal sensed through an auditory system that receives it effortlessly, providing a constant three–dimensional perception and navigation abilities. It is precisely in this internal oscillation that sound finds its validation as an epistemological instrument, expanding its operational capabilities into speculative and knowledge, testing of social, cultural, environmental and artistic connections, establishing invisible worlds (Tudela & Gomes, 2021). "(…) the world is not for the beholding. It is for hearing. It is not legible, but audible" (Attali, 1985, p. 3).

SOUND BEYOND MUSICAL PERFORMANCE
Henrique Portovedo

Taking into consideration the audio culture that emerged in the late 20th century, calling attention to the potential of all sounds to be musical material, the phenomenon in interaction between instrumental and electroacoustic sounds became a fundamental point of interest of contemporary music, while the changing paradigm of performance practice is creating, not only new modes of virtuosity, but leading performance to a creative element (Portovedo, 2020).

Since the close of the 20th century, there has been an outbreak of musical genres and musical expressions according to two principles: the integration of tradition and technological means; and the rupture of all the contexts that cannot be seen as directly deriving from the computer and digital technology. This means that the creation process trajectory goes from the concrete realities towards an external space, based upon an understanding of the adaptation of the technical and technological realities to the needs of creation, while the creation process relies on an awareness of the technological potentialities as a means to attain an artistic result. The Electroacoustic Resource Site (EARS) has a list of 81 genres and categories of electroacoustic music, clustered into two categorisations which are in no way exclusive: genre as musical or artistic grouping; category as grouped into performance situation, a technological aspect or an approach (Emmerson & Landy 2016).

A plethora of innovative musical instruments – Actuated Instruments – has recently been developed, and their principles are based on the use of acoustic instruments controlled by feedback with processing of the sound synthesis, with the goal of extending the sound possibilities of instruments (Ângelo et al., 2018). The terms extended, augmented

along with prefixes such as hyper-, meta-, infra- and event mutant-, were coined to emphasise different conceptual approaches. The sound output is therefore hybrid; it comes from the overlapping of the acoustic or mechanic vibration and its digital processing. Actuated Instruments keep the interface of the acoustic instrument while including the possibilities of sound synthesis, however there is no unified methodology for the design and creation of these new instruments, or how augmentation processes are applied physically or digitally within a piece. In mixed music, the interactions mediated by such new interfaces of musical expression have direct influence on the structure, on the internal development of the sound output, and on the very object of composition (Hamman, 1999). Composed interactions are audible experiences as a music of sound (timbre composition), more than music of notes (especially when instrumentalists are involved). This has been justified by musicologists such as Erickson (1975) and Kvifte (2011) that have argued that music has shifted from musical notes to timbral composition of sonic spectra, yielding into a sonic art that both transcends and collapses traditional dichotomy of sound material and musical form, allowing timbre to be truly experienced as form (Di Scipio, 2003).

The 21st century presents a bifurcation in the conception of what music is, after's Varese *Liberation of Sound* (Roads, 2015), with some composers directing their attention to the investigation of sound under acousmatic conditions, others seeking to reassert the central importance of the performing body. One might even regard these as different ontologies of music: music as identical to its sound; music which cannot be separated from the physical conditions of its production. This last aspect seems to underline the notion that the instrumentalist's body is a vehicle for the realisation of cognised musical intentions (Laws, 2014). Musical instruments are key to understanding mimetic activity and they serve as surfaces of musical inscription. The music theory of each culture is written into the functional body of the instrument itself: it is concretised music theory. The instrument becomes a "techno-logic" (Magnusson, 2019), which then becomes our external memory: "A tool is, before anything else, memory; if this were not the case, it could never function as a reference of significance" (Stiegler, 1998).

For example, on the one hand, Lachenmann's music – *musique concrète instrumentale* –, in which the approach emphasizes the concrete nature of the instruments, re-thinks their potential as sound sources, and congruously presents a musical notation that describes performance actions and extended techniques, in the composer's words: "this means a music in which sound events are chosen and organised in such a way that the nature of their origin is considered at least as important as the resulting acoustic properties themselves" (Lachenmann in Craenen, 2014, p. 84). On the other hand, the music of Verrando or Meyerhof in which building new instruments inspires sonic imagination, an imagination that builds on the 20th century focus on timbre, yet emphasises the 21st century focus on material objects, instruments, and new notations. The

move is one from quantitative to qualitative compositional approaches, or from thinking with symbols to operating at the level of the signal.

The idea of virtuosity has changed, shifting from the focus on the instrumentalist to the instrument itself, i.e., the instrument "lands on the operational table" (Craenen, 2014). There is a spectrum of organological analysis available that ranges from the musical object and its affordances through to the inactive and embodied potential of the instrument to aesthetic and music-theoretical considerations. Multiple dimensions of instrumentality, including instrumental qualities, compositional ideas, performance skill, and auditory reception cannot be reduced, constituting a network of unified relations supported by technological infrastructure and objects that "orientate people, knowledge and worlds" (O'Riordan, 2017). If our objects serve as instruments of thinking, Plato's distinction between epistle and techne breaks down, and we need to re-evaluate how our tools of externalising our thoughts into systems of discrete elements play a fundamental role in our music practice.

Understanding how emerging digital musical technologies trace their concepts, design and functionality to practices in the current cultural epoch will bring to light a study of new-media archaeology, conceptual epistles and performative paradigms, directed, in other words, to the study of how the new technologies of mixed music-making trace their design to the practices of material, symbolic, signal inscription and how practice is transforming and leading to creation. The New Grove Dictionary says of music analysis: "Analysis may be said to include the interpretation of structures in music together with their resolution into relative simpler constituent elements and the investigation of the relevant functions of these elements" (2001). Interesting here is the central focus on structure, perhaps the weakest point in terms of methods and tools used in electroacoustic or sound-based music analysis. The reason why structure (and the traditional concept of form) has proven so problematic in sound-based works has to do with the fact that this music is what might be *bottom-up composition* and the constitutive elements are various and multidimensional in relation with non-standard translation of sound into symbolic inscriptions or sonic writing.

More than ever, the equation of musical performance has been reformulated, not only because of the pandemic situation as a contribution for the fasten general interest on technological mediums associated with artistic and musical creation, but as well because electronic and mixed music have never been so proliferous, at the same time erudite contents on sound and timbre are arriving from different underground and experimental cultures, non-exclusive of formal education institutions. Technology is moving faster than musical practices and we are taking some snapshots of techniques applied in musical composition and performance, techniques whose materiality will be quickly replaced with new ones, but whose embodied structures continue and become re-implemented in later technical objects as a recycling of skills. Understanding how emerging digital musical technologies trace their concepts, design and functionality to practices in the current cultural

epoch will bring to light a study of new-media archaeology, conceptual epistles and performative paradigms, directed, in other words, to the study of how the new technologies of mixed music-making trace their design to the practices of material, symbolic, signal inscription and how practice is transforming and leading to creation.

LISTENING META-ENVIRONMENTS
Miguel Carvalhais

Listening is an epistemic process. Sound involves us as an epiphenomenon of the activity in our world. Placed in the centre of our acoustic worlds, we put our pattern-recognising brains towards parsing the aural information that reaches us and discerning relevant sounds, sequences of sounds, and relations in these. As our world, our technologies, and ourselves changed, so did the ways we listen. They adapted to city dwelling, industrialisation and mechanisation, noise pollution, and transformations in architecture and urbanism. Nowadays, they are going through a new reconfiguration pushed by the pervasiveness of computation, by the ubiquitous presence of computers, computer networks, computational media and objects in our lives.

We are immersed in computation, living in a post-digital world in which it is central to economy and communication and becomes fundamental to artistic practice, to artworks, and the aesthetic experience. Because computation is seemingly everywhere, in our tools and media, in our homes and cities, in our bodies and their indispensable technological prosthesis, it may also exist within an artwork. It may be used to create or develop the artwork or can even be the artwork itself. In similar terms to how Henry Flynt described conceptual art in the 1960s, "art of which the material is 'concepts,' as the material of for ex. music is sound" (Flynt, 1961) we may think of computation as a potential foundational material for new artistic practices.

Through our aesthetic sense, we listen and distil information from noise, creating meaning from causal, semantic and reduced listening (Demers, 2010; Chion, 1994), and trying to discern order in the irreducible complexity of soundscapes. On the other hand, artists look from within the frontiers of perception at the information overload and build new patterns (Coupland, 2011), new phase-spaces for patterns to be detected in. Artists create new arenas for exercising the aesthetic sense in this increasingly complex world. They contribute to the ongoing process of writing ourselves, thinking about ourselves, criticising ourselves, our world, and our technologies through the engagement with these "strange tools" (Noë, 2015) that are artworks. And art is, of course, not a technological practice, but it does presuppose technologies and can only *become* through technologies. "Technologies organise our lives in ways that make it impossible to conceive of our lives in their absence; they make us what we are" (Noë, 2015, p. xiii) and art directly engages with those practices and technologies, primarily as a way to understand how they affect us, and finally, as a means to reorganise ourselves.

Engulfed in computational technologies, our listening needs to adapt to online and offline environments marked by an "all-out internet condition" (Steyerl, 2017) that turns culture into a code/space (Kitchin & Dodge, 2011). As well as continuously breeding new media (Manovich, 2001; Carvalhais, 2016) computation is capable of endlessly generating new environments, not because the technologies are new in themselves, but because it allows the permanent re-articulation of environments and the constant development of new and sometimes unprecedented relations with their inhabitants. In the same sense as computational media became *metamedia* (Manovich, 2013), computational environments become meta-environments endowed with new affordances and expand across multiple and arbitrary forms and modalities. These meta-environments are augmented by computation to become more than a space-time where agents exist. Meta-environments become agents themselves. They become machines that act, machines through which computation emerges. They remediate the conditions of being itself (Galloway, 2010).

Meta-environments are ergodic (Aarseth, 1997) and they are interfaces (Andersen & Pold, 2018) to a liminal space, the in-between between the sensual and the real where computation is enacted. More than places, these meta-environments are platforms that transcend perception but with which it becomes nearly impossible not to interact. And as computational spaces grow to become more pervasive and immersive, they also come to be holistic and qualitative, bringing forward complex topologies that interface with us through vision, haptics, sound, and a variety of other computational senses and modalities that seem profoundly alien to us.

In these topologies of "immaterial materiality" (Kwastek, 2013), sound is often relegated to a subordinate role to visual media. But sound is nevertheless resilient and pervasive, and through traces from interaction with the computational, it seeps in and arrives loaded with meaning. Computation gained voices to communicate with the world, to announce its presence within a larger context, and it gained the ability to listen to us. To operate and navigate these meta-environments, we need the capacity to read them by deducing procedurality and computation (Carvalhais & Cardoso, 2018a; 2018b; 2017). That reading includes embracing the acoustic and the sequential; it includes listening to the computational.

As we inhabit meta-environments, we move in them as we listen to them. Our perception and attention drift through the environments and shift between them and "our inner sound world and thoughts and back again to the outside" (Westerkamp, 2017, p. 30). But what does this movement mean when we are in a meta-environment that transcends physical space? We conceptualise computational environments in spatial terms (Murray, 2012), but this is more than just a conceptual issue because when we interact with meta-environments, we are linked causally to computational systems and computational events. And their outputs are not simply recordings of past events in the form of signs or algorithms (Morton, 2017), but they are *futural*. They are actual events happening in a particular space-time, situated occurrences that happen *here* and *now* to

a particular person that interacts with the meta-environment in a defined context.

Human beings are an integral part of the computations deployed, engaging in an enactive aesthetic relation (Penny, 2017) where their somatic topologies become a part of the topology of systems that are time-based, that are contexts for composing objects and events in time, regardless of whether sound is used (Zielinski, 2006). Perhaps listening to computation should not specifically emphasise the modality of sound but also the perception of time-based processes and of other transient phenomena that are key to reading computation. Listening may be used to understand the processes of the computationalisation of environments and develop interobjective relations within them (Morton, 2013a).

Listening can be used to explore and interpret meta-environments, especially if it takes the form of a *computational listening* that emphasises computation, procedurality, and causality. When we inhabit meta-environments, we enter processes of *making-hearing,* developing retroactive loops between our gestures and actions and the auditory perception of their consequences (Bonnet, 2019). We engage in processes of just-in-time composition through which we try to make sense of experiences where we are conflated with computation and structurally coupled to the environment to produce new aesthetic objects that will, in their turn, produce new experiences (Harman, 2020; Harman, 2018). And although this process is very often visual, sound is an increasingly important component that can act as the main driver and as a fundamental medium for the development of the computational system's "technological umwelt" (Lee, 2018).

Computational listening encompasses the spatial and temporal boundaries of meta-environments, with listening becoming a hybrid of human and computational operations, becoming interobjective (Morton, 2013b), with the ear guided by logic and technology to navigate through the computational trying to hear-as the meta-environment (Carvalhais & Lee, 2019).

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