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Toward Ubimus Philosophical Frameworks

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Abstract: We tackle the philosophical implications of post-2020 music practices. To situate our discussion, we address pending issues in current definitions of music-making. Our analysis indicates that post-2020 definitions of music should feature sonic information and events, framed through social interactions and through the material grounding of the musical activity. Ubiquitous music (ubimus) furnishes a promising playing field for the emerging aspects of creative music-thinking. New frameworks that encompass the dynamic, multimodal and situated characteristics of music while skewing an anthropocentric perspective on creativity may provide meaningful targets for ubimus research toward a new notion of musicality. Three artistic projects serve to exemplify key aspects of this proposal: Atravessamentos, Memory Tree and Lyapunov Time. We address the philosophical implications of these artistic endeavors toward the construction of ubimus philosophical frameworks.

Keywords: ubiquitous music, ubimus, musicality, distributed creativity, ecological cognition, post-2020 music

1 Introduction

The philosophy and praxis of music-making can be split into two categories: pre- and post-2020. The impact of the pandemic was immediately felt by the artists and by the communities devoted to musical activities, changing the way people live and share musical experiences. Despite being profound, these changes are not evenly spread. In some cases their consequences are not obvious. Countries that adopted early sanitary measures were able to recover a semblance of "normality" in their cultural activities. Countries that invested heavily in mass vaccination are now slowly regaining access to cultural activities.[1] But a large part of the world has suffered from a severe reduction of access to music enjoyment and creation, particularly when considering the modalities adopted until 2019. These caveats can be partially overcome by musical activities on digital platforms. Nevertheless, the majority of the extant digital tools were not projected to support the whole gamut of musical interactions that characterize in-place community-shared musical experiences.[2] These pervasive changes affecting the future of musical practices demand new ways of thinking about music.

1 Written during the first semester of 2021.

2 "It is expression that makes people go through all sorts of trouble to hear human performances rather than the dead-pan renditions of computers," Juslin, "Five Facets," 274.

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Music dates back to the predecessors of *Homo sapiens*. Hominins may have developed complex performative practices that featured sound as an important component.[3] This early and widespread presence of music-making places musicality as an evolutionary trait rather than as a product of exaptation.[4] To be musical does not necessarily mean to be a professional performer. Making and enjoying sound as a form of socialization is an ability shared by several species, including primates, dolphins, whales and some birds. Therefore, musicality is not a purely human trait.

After over a thousand years of written documents and over a hundred years of phonographic records, music has earned a position among the longest and most firmly rooted bodies of knowledge of the expanding set of human cultural endeavors. Despite this massive amount of information, music remains an elusive object of study. What do we mean by "music"? Is music an object or an activity? Is music the same as sound? Are there musical sounds and nonmusical sounds? Are we musical beings? Who or what can we call "musical"? Some of these questions have been addressed by artists, scientists and philosophers. Particularly since the second half of the twentieth century, we have witnessed an explosion in the diversity of documented artistic practices. This expansion in the access to and the distribution of musical knowledge applied an increasing pressure on the walls of the edifice of theoretic and musical discourse built to support the hegemony of an acoustic-instrumental way of thinking.[5]

Music theory and analysis have so far dealt with professional manifestations of creative practice. Consequently, they emphasize forms of eminent creativity that rely heavily on domain-specific knowledge. Extant music-theorizing implies describing, explaining and supporting activities exclusively done by trained musicians. The concepts and the applications explored in current music practices highlight the need for renewed music-philosophical frameworks that are not limited by domain-specific boundaries. Concepts such as the note, the rhythm, the instrument, the orchestra, together with the adoption of a strict separation between the professional musicians and the audience through the use of specialized venues have enforced a restrictive notion of what it means to make music. This notion persists until today.

In light of the increased usage of information technology across almost all artistic practices and the concurrent strategies of artistic product-sharing (which are also observed in communities that are geographically and culturally removed from the urban centers),[6] the potential impact of technological mediation on the material base of community-shared artistic activities needs to be reconsidered. Several of the mainstream compositional and music-theoretical paradigms of the twentieth century are foreign to this new context. Thus, new avenues of philosophical investigations that furnish alternatives to the standard musicological discourse may be necessary.

For instance, we share the ability to make music with some human-made things (such as computers). This aspect has been overlooked by past attempts to describe the conditions that foster the emergence of music. Mainstream musicological approaches tend to categorize musicality as purely human.[7] This biased perspective has postponed a discussion of music as an emergent byproduct of ecosystems that sometimes include humans as central stakeholders and other times relegate their participation to an ancillary role. How we characterize musicality may impact the musical ontologies, the creativity models and the conceptual frameworks applicable to musical endeavors. In turn, how we choose to deal with the agents and objects that comprise music ecosystems may imply either selling short or overpricing specific ways of making music.[8]

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3 Mithen, *The Singing Neanderthals*.

4 Dunbar and Shultz, "Evolution;" Honing et al., "Without it No Music;" and see Pinker, *How the Mind Works*, for an initial discussion on music as exaptation.

5 See Bhagwati, "Towards Interactive Onscreen Notations;" Bown et al., "Understanding Interaction;" Keller, "Compositional Processes;" Messina and Aliel, "Ubiquitous Music;" and Parmar, "The Garden of Adumbrations," for critical discussions of the acoustic-instrumental views.

6 Huron, "Lost in Music."

7 Blacking, *How Musical is Man?*. Blacking defines music as *human* organized sound. This anthropocentric view is replicated by the large majority of ethnomusicologists.

8 This finance-oriented metaphor is not arbitrary. The social value of music products and processes may be related to economic and material pressures in capitalist societies, in stark contrast to the community-oriented function of musical activities in pre-capitalist communities.

Fortunately, part of the post-2020 scenarios have been considered from both practical and conceptual perspectives within the emerging field of ubiquitous music (ubimus).[9] A body of ubimus research produced during the last 14 years may suggest ways to adapt infrastructure and procedures to a pandemic-ridden world. These new scenarios have philosophical, aesthetic and ethical consequences that have not been addressed by the mainstream twentieth-century music theories. Hence, one target of our discussion is to unveil the limits of the current philosophical proposals as explanatory and analytical tools when applied to the requirements of the emergent post-2020 musical praxis.

In summary, this article approaches the conceptual implications of post-2020 music-making from a ubiquitous music perspective. There have been discussions on the philosophical aspects related to some forms of ubimus practice.[10] But the extant proposals are still scattered. To partially fill this gap, this text provides an overview of ubimus topics relevant to current music-philosophical trends, it proposes strategies to establish an empirical basis to address part of these issues and points to their potential applications and caveats. Section 1 revisits current discussions on the philosophical basis of creative music practices, questioning whether we should focus exclusively on the sonic components of musical activity. Section 2 addresses the notion of organized sound, linking this concept to related constructs in the realm of theoretical biology. Section 3 questions the limits of an information-centric approach to music thinking by pointing to some of the evolutionary constraints of music making. Section 4 introduces the concept of musicality highlighting the function of non-human stakeholders toward a better understanding of the ecologies of music-making. Section 5 discusses how the models of sonic ecologies and distributed creativity may contribute to music thinking beyond the mainstream genre-centric perspectives. Section 6 presents a preliminary definition of ubiquitous music (ubimus) and describes three artistic deployments that highlight the limitations and potentials of the ubimus methods for post-2020 contexts. These cases are similar to Dennett's "intuition pumps" but grounded on actual artistic experience. We address the limitations and the advantages of the deployed strategies. Section 7 summarizes the conceptual proposals and hints at a road map for the implementation of philosophical ubimus frameworks.

2 Music thinking today

Despite a persistent belief that the only music worth doing is created with acoustic instruments and composed by white, male geniuses from rich, central countries,[11] the current restrictions in colocated activities highlight the limitations of the hegemonic acoustic-instrumental paradigm.[12] Some of these limitations were already hinted at by the emergence of alternative forms of music making and sharing during the twentieth century. Varèse laid out the concept of *organized sound* in the early 1930s.[13] For him, music making does not only need to deal with pitches produced by musical instruments, it should also target other ways of handling sonic materials deployable by mechanical or electronic means, highlighting the spatial qualities of sonic projections. Also working at the beginning of the twentieth century and defying the established concert-oriented formats, Satie introduces the practice of *musique d'ameublement* – music that does not demand an effortful attention from the listener. Generative methods of music making were initially introduced in the pianola works of Nancarrow. Later, the incorporation of analogue and digital means of sonic manipulations enabled a wider range of generative techniques.[14] In the analogue realm, composers such as Stockhausen and Subotnick applied mutually opposed conceptual approaches to

9 Keller et al., "Ubimus Through the Lens."

10 Messina and Aliel, "Ubiquitous Music;" and Kramann, "Composing by Laypeople."

11 Ewell, "Music Theory and the White Racial Frame."

12 See also Lewis, "Too Many Notes;" and Weisberg, *Creativity*, for discussions on the construction of this myth.

13 Wen-Chung, "Open Rather Than Bounded."

14 This separation between digital and analogue techniques for music making is currently being erased by the computational approaches to analogue sound making (see Lazzarini et al., "The Ecologies of Ubiquitous Music").

incorporate analogue technology in music making. Stockhausen dealt with deterministic written instructions. Subotnick used improvisational techniques.

Concomitantly, the early implementations of digital equipment allowed Hiller and Xenakis to propose computer-based techniques for the manipulation of musical data. Hiller targeted style emulations of instrumental writing.[15] Xenakis[16] applied stochastic generation of musical parameters which were subsequently transcribed to musical notation. Schaeffer[17], Ferrari[18] and Schafer[19] employed recorded everyday sounds for creative purposes, each one adopting a particular aesthetic path to deal with the challenges presented by these mundane creative resources.

A possible corollary to these initiatives is that music philosophy with explanatory muscle should address a diverse body of knowledge and practice while avoiding the simplistic idea that music making is just writing notes on a sheet of paper or playing an orchestral instrument. This begs the question, are current philosophical proposals prepared to address the extant heterogenous body of creative approaches?

Let us consider Kania's definition of music: "(1) any event intentionally produced or organized (2) to be heard, and (3) either (a) to have some basic musical feature, such as pitch or rhythm, or (b) to be listened to for such features."[20] There are several shortcomings in this formulation. While the concept of event is sufficiently flexible to be applicable to all of the cited compositional approaches, the word "intentional" in item (1) is problematic. Both Xenakis and Subotnick explore techniques that target a reduction of intentionality or control.[21] Xenakis lets the random generation of parameters define the local details of the musical events. His process of decision-making remains at a second level of the musical organization, establishing tendencies, probabilities or ranges and letting the computer decide how each event is rendered. A complementary reduction of control operates at the local level of Subotnick's musical procedures. The characteristics of the analogue synthesizers employed by this composer preclude the specification and exact replication of the sonic outcomes. Hence, an approach frequently used by the composers that deal with analogue equipment is to establish improvisational guidelines and adjust their decision-making processes in real time, as the sonic output proceeds. This form of improvisation relies on a permanent feedback cycle involving the manual operation of physical controllers (e.g., knobs and sliders) and the patching of cables to change the routing of signals. The aesthetic decisions follow the composer's assessments of the immediate sonic results.[22] Thus, each decision is subject to a considerable amount of uncertainty.

The first clause of item (3) in Kania's definition also presents some difficulties: "to have some basic musical feature." The examples of pitch and rhythm, despite not being basic features since they depend on other characteristics of the sonic events,[23] could be construed as equating musical features to the acoustic features of sound signals. Let us assume this is the case. It is true that all the historical examples cited in the previous paragraph link music making to the physical existence of sound waves. The compositional concepts proposed by Satie, Nancarrow and Hiller can be rendered using instrumental sounds. Some of the compositional concepts proposed by Varèse, Schaeffer, Stockhausen, Xenakis, Subotnick, Ferrari and

15 Hiller and Isaakson, *Experimental Music*.

16 Xenakis, *Formalized Music*.

17 Schaeffer, *Traité*.

18 *Presque rien ou le lever du jour au bord de la mer* (Almost nothing, or daybreak at the seashore) (1967–1970) (see discussion in Drott, "The Politics of Presque Rien").

19 Schafer, *The Tuning of the World*.

20 Kania, "The Philosophy of Music."

21 See also the work of Morton Feldman who explores creative metaphors extracted from the methods of "action painting" (Feldman, *Give my Regards*).

22 This creative approach also impacts the procedures applied to technological design. Whether the technological infrastructure, the musical activity or the social and environmental factors take precedence is less consequential than the fact that all these aspects should be taken into account.

23 Pitch depends on harmonicity and rhythm depends on a hierarchical structuring of time based on periodicity.

Schafer demand electroacoustic sonic means. Furthermore, Schaeffer, Ferrari and Schafer's proposals imply not only rendering sonic results but also capturing sounds from the environment. So a question arises, how do we handle the musical experiences that do not yield sonic waves as a byproduct?

Take, for instance, music-making by means of brain–computer interaction (BCI).[24] This area of research has not yet explored electro-mechanical stimulation of the inner ear because this is an invasive and possibly risky method of deploying information to the brain.[25] Nevertheless, during the last decade there have been advances in BCI that hint at the possibility of reducing the role of sonic actuators toward centering the technological design on the manipulation of sonic information. This reduction has various implications that change the focus of the philosophical discussions on the function of the body as it relates to technological support.[26] Complementarily, the initiatives that target music-making without sonic transduction entail a conceptual turn,[27] away from the centrality of sound envisaged by sonic art.[28] So a question to be asked here is: Are basic sonic features enough to define a musical experience? Or, rephrasing this question from a historical perspective: Is Varèse's concept of organized sound sufficient to define a musical experience?

One problem with Varèse's definition is his ambiguous usage of the word sound. If sound is understood as the patterns of vibrations rendered by a material transducer, then music devoid of sonic renditions would not be music. As a consequence, timbre imagery would not be considered a musical phenomenon.[29] To encompass imagery, rather than just dealing with rendered sound, music-making may entail handling sonic information in various ways. Sometimes this information is presented through mechanical means. Other times it exists as neurological patterns of electrical impulses that are not necessarily externalized as physical actions.

Despite its breadth, the sonic-information definition of music also suffers from some limitations. Consider the second clause of item (3) in Kania's definition, "[an event] to be listened to for [musical] features." To listen implies to interact with others and with the environment. Particularly in acousmatic and soundscape composition (as practiced by Schaeffer, Ferrari and Schafer), the act of listening is at the center of the compositional process. While acousmatic practices target the isolation of "musical objects," removed from their original context and detached from their situated meaning, soundscape composition envisages the reinsertion of sonic events within a *sonic* context.[30] This situated approach emphasizes the need to consider the impact of the local environment on music-making. Furthermore, recent perspectives such as ecologically grounded creative practice push toward a tighter integration of music-making and environment.[31] They suggest a cycle of mutual attunement between the musical actions and the environmental features involving a two-way flow of information.

So far, we have identified sonic information and social interaction as two requirements of a definition of music applicable to the twentieth-century creative practices described in the previous paragraphs. We also pointed to the potential development of some forms of musical activity that bypass the transduction of sound to deal exclusively with sonic information. Since this type of exchange cannot yet be deployed because of the lack of noninvasive technological support, we leave its discussion to future analytical efforts. As pointed out by Steinert and coauthors,[32] the responsible usage of BCI technologies will require addressing multiple philosophical implications. All of the practices considered in this discussion involve handling and sharing sonic information. Some of them extract this information from environmental events

24 Rosenboom and Mullen, "More Than One."
25 Salcher et al., "Case Report."
26 Steinert et al., "Doing Things with Thoughts."
27 Rovan and Hayward, "Typology of Tactile Sounds."
28 Truax, "Editorial."
29 Bailes, "The Prevalence."
30 The italics in sonic are justified because the practice of soundscape composition, beyond the collection of sounds, occurs in specialized venues (the studio and the concert hall). Consequently, the situated aspects of this musical practice are relegated to the sonic realm and do not entail a usage of everyday settings.
31 Keller and Lazzarini, "Ecologically Grounded Creative Practices."
32 Steinert et al., "Doing Things with Thoughts."

(Schaeffer, Ferrari, Schafer), others use analogue technology to generate the sonic materials (Stockhausen, Subotnick) and others employ digital means to obtain sound (Xenakis). Recent proposals underline the tight entanglement between music-making and the local environment.

3 Music beyond organized sonic information

An important aspect of musical activity is its relationship with the environmental resources. This can be assessed through a comparison between the resources employed in the activity and the resulting byproducts. This aspect is partially captured in Varèse's definition of *organized* sound. Recasting this definition in informational terms implies that the amount of information available in the creative products tends to increase throughout the musical activity, yielding outcomes with reduced levels of entropy. Other activities of living beings, such as eating, imply the opposite direction of informational flow: Materials with lower levels of organization are pumped to the environment as byproducts of the consumption of energy inside the organism.

But the assumption of increased levels of organization as a result of the musical activity may present some problems. The amount of informational content of the sonic creative products needs to be aligned with the aesthetic targets of the stakeholders. While some compositional proposals envisage a reduction of entropy of their creative yield, other proposals foster an increase in the entropy of their sonic outcomes. The latter approaches usually employ techniques of decision-making that skew literal replications.[33] Consider, for instance, Subotnick's improvisational usage of analogue equipment and Xenakis's incorporation of pseudo-random algorithms to generate musical data. The decision-making processes employed by these two composers entail a reduction of the predictability of the outcomes. Consequently, two instances of the same creative process do not necessarily yield the same sonic products.[34]

To assess these compositional approaches involves implementing simulations of the decision-making mechanisms and running multiple iterations of the models to eventually arrive at qualitative descriptions of the musical potential, a procedure known as analysis by modeling.[35] As a consequence, we are faced with a conundrum. Is the potential output of the creative method represented by the instance singled out by the composer? Or should we consider the theoretical possibilities of the procedural model through explorations involving multiple instances? This question impacts both the musicological and the compositional methods.[36]

For the purpose of the present argumentation, we can state that while all music-making features some form of organization of sonic information, musical activity does not necessarily entail an increase in the predictability of the creative products. The creative process does not always produce *more structure* in sound. The level of organization depends on the goals defined as a result of the musical activities. This aspect is not captured by a definition of music as *organized* sonic information. To be musical, sonic information produced during creative activity may feature either higher or lower levels of organization when compared to the sonic information of the raw creative resources. The flow of information depends on the targets of the stakeholders.

Recapitulating, rather than dealing exclusively with sounds, music-making involves handling sonic information. The aesthetic goal may be to increase the amount of information furnished by the creative resources or it may involve reducing the organization of the sonic byproducts to expand the range of possible outcomes. A tight bond between the procedures and the objectives of the creative activity entails the use of *situated* musical information. This process of grounding, framing or contextualizing depends on

33 See Keller, "Sonic Ecologies," for a discussion of the compositional implications of this approach.

34 This is also related to replicability.

35 Keller and Ferneyhough, "Analysis by Modeling."

36 Coelho de Souza, "Categorias;" and Marsden, "What was the Question?."

both material and social factors. Current perspectives on evolutionary theory, on the one hand, point to the material resources and the impact of the activity of organisms on the local environment as either enablers or deterrents of creative potentials. Complementarily, they highlight the stakeholders' interactions as key mechanisms to ground the creative process.

4 Music beyond humans

The ability to imagine, plan and perform movements and sounds in temporally organized patterns (featuring variations in texture, dynamics, pitch or duration) is a characteristically human achievement. Given an appropriate context, this complex activity can be executed as a group, on the fly and even without prior knowledge of what comes next. The predisposition to engage in such a demanding endeavor has been studied and partially explained from perspectives ranging from the cultural to the biological. While sound is a central component of music, musicality may feature behaviors that sometimes furnish sonic products and other times do not yield a sonic outcome. Consequently, the targets of a broad definition of music should include sonic products and processes in addition to the phenomena and behaviors that enable musical experiences without a sonic product. The latter may be gathered under the rubric of musicality.

Various studies indicate that our musical capacity has an intimate relationship with our cognition and underlying biology.[37] Following a parallel path to the development of language, musicality may have evolved from extant neurological resources through environmental pressures or through sexual selection. Complementarily, based on the converging studies on music-specific responses, neural networks that support musicality may be partially involved in language, pointing to more overlap than segregation of the cognitive functions enabling these tasks.[38] Apparently, we humans share a predisposition for music, comparable to our predisposition to speech. To recognize a melody or to perceive a beat are complex skills that are trivial for most humans. They are examples of tasks simultaneously supported and constrained by our cognitive abilities and biology. For instance, instrumental music performance is subject to specific ergonomic constraints: We are limited by the anatomy of our body and by the characteristics of the material resources employed in sound-making. Nevertheless, we should stress that recent advances in prosthetics and robotics are starting to push these boundaries by means of biotechnological enhancements.[39]

Comparative research shows that while music itself may be specifically human, the mechanisms that underlie musicality are possibly shared by several species. Darwin argued that musical vocalizations precede language.[40] Impressing potential sexual partners may be one application of the ability to make music.[41] However, there are divergent perspectives on this. Other adaptive functions of music could be: (a) promoting and maintaining group cohesion, with music working as a glue that enhances cooperation and strengthens feelings of unity,[42] (b) easing the burden of care-giving while promoting infant well-being and survival (e.g., infant-oriented vocalizations may have paved the way for both language and music)[43] and (c) employing music as a resource to enhance skills with long-lasting impacts on culture and biology.[44]

A problem with a definition of music that only considers sonic information is its apparent divorce from the forces of biological evolution. Two of the most influential perspectives on evolution are the social-brain

37 Winkler et al., "Newborn Infants Detect the Beat in Music;" Fitch, "The Biology and Evolution of Music;" and Honing, *The Origins of Musicality*.
38 Särkämö et al., "Editorial;" and Oikkonen et al., "Convergent Evidence."
39 Muneoka et al., "Regrowing Human Limbs."
40 Fitch, "Musical Protolanguage."
41 Miller, "Evolution of Human Music."
42 Merker et al., "On the Role and Origin of Isochrony."
43 Dissanayake, "If Music is the Food of Love."
44 Patel, *Music, Language, and the Brain*.

hypothesis[45] and the niche-construction theory.[46] The former highlights the importance of social interaction as a mechanism for survival. The latter stresses the impact of the organisms on the local environment – leading to the formation of ecological niches – implying that the environmental pressures on hominid behavior may have demanded increasingly refined cognitive mechanisms to cope with environmental uncertainties. Both approaches have gathered strong evidence from diversified fields, including biology, paleontology, anthropology, social psychology and cognitive science.

These theories furnish a solid biological and material basis that may help us to construct better music-theoretical frameworks. The social-brain hypothesis points to social interaction as a key force driving the cognitive development of *Homo sapiens*. Apparently, the ability to perceive and predict the intentions of others during early hominid exchanges may have required a high investment of cognitive resources.[47] An increase in the size of human groups implied the need for social-bonding mechanisms as a complement to grooming. Music-making, in tandem with other forms of socialization, may have served this purpose. If Dunbar and Shultz's proposal is correct, rather than being a phenomenon that takes place just "inside the head" music-making is built upon interactions between social entities or beings. Thus, instead of just "listening," music-making entails an active exchange of sonic information among multiple stakeholders. Some of these stakeholders are human, others are not.

This section highlighted key elements and processes that need to be taken into account while pursuing philosophical and conceptual ubimus frameworks: sonic information and events need to be *situated* through the social interactions and through the material constraints and opportunities featured during musical activities which result from evolutionary adaptations. Some forms of organization can be found in most musical endeavors. But a tendency to reduce the level of entropy does not seem to be a general requirement of all music-making. The flow of information observed during musical activities could be linked to the aesthetic needs of the stakeholders. Thus, rather than simply dealing with organized sonic information, ubimus theoretical and conceptual frameworks handle sonic information *adapted* to material, biological, cognitive and environmental constraints.

5 Distributed creativity in music making

The preceding sections tested current philosophical concepts against the specific requirements of a diverse set of emergent compositional practices. Our target, rather than to elaborate arguments for or against a specific aesthetic perspective, was to identify basic demands shared by some of the musical approaches that are frequently cited in the academic literature as providing major contributions to current creative music-making.[48] This section discusses an approach that has been applied by artists from different backgrounds as a way to move beyond the hegemonic acoustic-instrumental paradigm. This perspective is grounded on actual deployments, so it holds promise for post-2020 music practices. But as any artistic proposal it depends on material and cultural factors that are constantly changing and that are subject to evolutionary pressures.

As an alternative to a hegemonic discourse centered on the concepts built around acoustic instruments, Keller proposes sonic ecologies that involve interactions among human agents and material stakeholders.[49] These interactions can be described by three operations on the material domain: *expand*, when the pool

45 Dunbar and Shultz, "Evolution in the Social Brain."

46 Odling-Smee et al., *Niche Construction*.

47 This evolutionary pressure is described by some authors as the Theory of Mind.

48 For this reason, we have not dealt with the attempts at establishing a hegemonic discourse by part of these proponents. This issue is actively pursued within the ubimus community. It will probably lead to interesting exchanges with anthropologists that target the digital humanities.

49 Keller, "Sonic Ecologies."

of resources gets larger; *constrain*, when the pool of resources is reduced; and *shift*, when a qualitative change of resources is involved. Jones and coauthors adopt a similar framework, involving two activities: generation and evaluation.[50] Aligned with McGraw and Hofstadter's concepts,[51] the generation stage encompasses the search for materials and the cognitive processes leading to new resources. Complementarily, evaluation targets the selection of ideas. Expanding on Keller's model, Jones and coauthors propose the *nil* operator. A *nil* operation usually involves time spent away from the creative endeavor.[52] Lack of changes in the pool of resources is consistent with Wallas's incubation stage.[53] Nevertheless, this concept may need further refinements.

Based on previously scattered evidence, Keller and coauthors[54] propose an expanded definition of the *nil* operator as *the lack of explicit or conscious processes to enhance the role of the implicit cognitive resources during the creative act*. Given the recent findings on the function of the default mental network[55] – showing that part of the neural pathways relevant to creative thought stay active despite a lack of conscious processes – it is very likely that activities that do not impact the material byproducts, such as daydreaming, sleeping or doing repeated body movements, furnish an opportunity for reconfiguring the cognitive strategies devoted to the creative act. These processes may enhance the opportunities to access resources not usually engaged during the executive[56] music-making stages. On a similar vein, the noisy background of everyday settings may shape the creative outcomes by relaxing the pressure on the stakeholders to attain sonic accuracy and also by including the local sonic cues as resources for decision-making.[57] How these mechanisms operate and how they can be applied are open avenues for philosophical and empirical research.

The sonic-ecologies model[58] indicates the need to consider the distributed nature of the creative acts, grounded on exchanges among multiple agents and resources. On the one hand, musical activities are *embedded*. That is, they do not depend just on the cognitive resources of the participants. They rely on properties arising from the opportunities for action afforded by the materials and the agents. These properties are enacted during the creative cycle.[59] Behaviors change materials and materials drive behaviors fostering processes of affordance formation. These processes impact the way the resources are employed to support creative activities, yielding dynamic relationships among resources and agents, also known as *relational properties*.[60]

Complementarily, musical creative activities are *social*. This means that the material resources are not limited by the experiential knowledge of a single creator – knowledge is accumulated and distributed among all the agents participating in the creative act – often conforming a community of practice.[61] These social aspects highlight the need to consider the distributed nature of creativity. The romanticized depiction of a genius-male-composer working in his studio – far from the mundane distractions – is challenged by the sonic-ecologies model. In contrast with other models, developed targeting a single participant, the ecological perspective erases the boundaries between creators, resources and participants. The dismissal of *the* composer as an endless fountain of creativity and knowledge calls for a revised view on

50 Jones et al., "The Extended Composer."
51 McGraw and Hofstadter, "Perception and Creation."
52 See a meta-analysis of creativity models in Keller et al., "Ubimus Through the Lens."
53 Wallas, *The Art of Thought*.
54 Keller et al., "Ubimus Through the Lens."
55 Beaty et al., "Default and Executive;" and Kühn et al., "Playing Super Mario."
56 Executive: performance oriented.
57 Keller et al., "Anchoring in Ubiquitous Musical Activities."
58 Keller, "Sonic Ecologies;" and Jones et al., "The Extended Composer."
59 The standard definition of affordance, as proposed by Gibson (see Gibson, "The Theory of Affordances"), entails the active engagement of the individual with the environment highlighting the *opportunities for action*. Unfortunately, this term has been misused by several authors of the human–computer interaction community. A recent proposal targets the processes involved in creative practice through the notion of *relational properties* (see Keller et al., "Interaction Aesthetics and Ubiquitous Music").
60 Keller et al., "Interaction Aesthetics and Ubiquitous Music."
61 Wenger, "Communities of Practice."

agency to account for the socially distributed and materially grounded factors involved in post-2020 creative endeavors.

The next section features completed, documented and published artistic projects that were shared and assessed by the ubimus community. The methods are diverse and are directly related to the issues discussed in the previous sections. But, of course, they do not exhaust the range of deployments of ubimus practice. Their inclusion in this article is meant to furnish actual examples of the application of ubimus conceptual frameworks. Before presenting the cases, we provide a working definition of ubiquitous music.

6 Cases in ubiquitous music practice

Ubiquitous music focuses on the study of complex systems of human agents, material resources and their affordances applicable to musical activities supported by a variety of tools.[62] The human-oriented aspects of this area of research find support in the current perspectives on evolution, bearing implications for creative practice. As previously discussed, the importance of social-interaction mechanisms for survival and the prediction of the intentions of third parties are among the key components driving the development of higher cognitive abilities in humans. Somewhat complementary, the local impact on the environment, with the emergence of ecological niches, shapes the increasingly refined cognition mechanisms that arise as a response to uncertain conditions.

Ubimus approaches deal with local assets through open means of sonic organization and highlight the emergent qualities of behavioral patterns across modalities. Within the ubimus sphere, material resources serve to constrain the behaviors of the agents during the process of generating and organizing sonic resources. Furthermore, ubimus methods explore contradictions and paradoxes through the expansion of the sonic properties of real-world events. They also make use of local environmental features to configure multimodal ecologies. The following artistic projects furnish examples of the applications of diverse creative strategies, including material grounding, the use of behavioral ecologies, shifting, in-place and remote social interactions, comprovisational microstructures and comprovisational flowcharts. The section concludes with a discussion of the philosophical implications of the three projects within the context of the post-2020 musical practices.

6.1 Case 1: Atravessamentos

The Amazon Center for Music Research (NAP) was invited to create a soundtrack for a video-dance produced by the Research Group Nois da Casa.[63] The video material features shots taken in the Western Amazon rainforest, in the state of Acre. The temporal markings indicated below correspond to the documented version 4, featured in Example 1.[64]

The compositional problems to be surmounted involved three aesthetic aspects: 1. Consistency of sonic processes with the dance movements; 2. Consistency of sonic processes with the video cuts and with the camera positions; and 3. Compositional use of constraints furnished by the sonic resources. A mix of creative strategies targeted: 1. A musical piece with a simple but not necessarily simplistic structure; 2. The use of structural articulations based on the points-of-view of the video shots, serving as pillars for the sonic processes (e.g., 1:45, dancer face close-up and 4:53, scene of the *samaúma* tree); and 3. The use of acoustic-instrumental synthesis techniques for the excerpts with complex choreographies (starting at minute 3:50 and minute 5:52).

62 Keller et al., "Ubimus Through the Lens;" and Lazzarini et al., "The Ecologies of Ubiquitous Music."

63 Nois da Casa: led by dancer Valeska Alvim, working at the Federal University of Acre.

64 The total duration is 6:47 min.

Example 1. Scenes extracted from Atravessamentos, version 4.
https://youtu.be/h2kBwokW4Fo

Summary of contents. From the beginning of the video to minute 0:273, the screen remains completely dark (scene 1). The footage lasting from minute 0:27 to 1:04 features a dancer lying on dry leaves, wrapped in a veil, amidst a dark forest (scene 2). The first interaction of the dancer with the forest is featured on scene 3, with small gestures behind the forest bush (1:04–1:45). From minute 1:45 until 1:58 (scene 4), the dancer's face is hidden by plants and shadows. Scene 5 (1:59–3:01) highlights the dancer's interactions with a tree, from different angles – a far video shot and a close shot. The dancer interacts incisively, as if wishing to get inside the tree. The footage from minute 3:02 until 3:49 (scene 6) explores extensively the use of body gestures. The camera is kept distant from the subject. From 3:50 to 4:53, body gestures become complex and accentuated (scene 7), suggesting that the dancer is no longer entangled with, but confronted by the pervasive presence of the forest. On scene 8 (4:54–5:18), the dancer seems to establish a symbiotic relationship with her surroundings. The section lasting from minute 5:19 to 5:52 features playful gestures (scene 9). Scene 10 (5:53–6:43) features a change of scenery, with the dancer standing in front of a river. The gestures seem to converge with the rhythm of the natural elements (e.g., sound of rain). The last scene hints at the dancer embracing nature: the body remains fully naked and static. Scene 11 (6:64 until the end of the footage) features a moving shot of the canopy that serves as a visual background for the video credits.

Material grounding through biophonic gridworks. Natural sounds that hint at environmental processes provide the starting material for structural compositional decisions in Atravessamentos. The raw elements include recordings of rain, insects and wind, among a wide variety of environmental sources.[65] These sources were explored and expanded through a set of ecologically grounded audio-synthesis techniques.[66]

Behavioral ecologies, application of mimetic strategies. The mimetic processes are directly related to natural temporal patterns found in the environmental sounds. They also feature specific connections across modalities to foster associations between images and sounds. Examples include the use of biophonic sources to hint at the forest settings, synthetic pizzicato strings to emulate rain textures and synthetic broken-glass events synchronized with the dancer's gestures.[67]

Shifting operations. The biophonic gridworks provide a scaffold for associations with the Amazonian-Forest settings. Rather than establishing a strictly causal sequence of events, the application of shifting targets building or breaking the recognizable relational properties. For the suspension of expectations to occur, it is necessary to keep a congruent set of elements aligned with the contextual cues. Expectations are broken through the introduction of acoustic-instrumental events. These are used with parsimony to avoid the obliteration of the local sonic referents.[68]

6.2 Case 2: Memory Tree

The Memory Tree project is a multimedia installation designed to boost social interaction.[69] The proposal is simple: collect messages (through social networks) from people around the tree and play these messages to the participants. The installation fosters social interaction by promoting either the in-place encounters or just by letting the participants enjoy the soundscape under its shadow. The tree acts as an intermediary,

65 Compositional techniques derived from concrete music (Schaeffer, *Traité*) or from soundscape composition (Schafer, *The tuning of the world*) could have been employed. These techniques include audio trimming, pitch inversions and transpositions of sound objects (acousmatic procedures) or simple layering with minimal editing of recorded sounds (soundscape procedures).
66 Aliel et al., "The Maxwell Demon;" and Keller, "Compositional Processes."
67 As an extension of the cues provided by the biophonic resources, mimetic strategies provide a fertile context to work with cognitive dissonances.
68 See Keller et al., "Anchoring in Ubiquitous Musical Activities," for an alternative usage of this strategy.
69 Ribeiro et al., "Árvore das Memórias."

encouraging participants to talk to each other. These exchanges can be done either by voice or through synthesized text messages.

The installation was exhibited for two weeks, before the Christmas seasons of 2014 and 2015, at the UFES campus in São Mateus. The Memory Tree is decorated with Christmas ornaments, featuring flashing lights, LED hoses and baubles equipped with small speakers. The first year, the tree received over 600 messages from local and (surprisingly) from remote participants. As expected, some people just sat there with their faces glued to their portable phones, unaware of the changes in the ambiance or of the other visitors. Nevertheless, the contents of the voice messages were unexpected. The participants were using the tree as a musical device to send messages with snippets of songs. Encouraged by this usage, in 2015 the authors extended the technical capabilities of the installation turning it into a collective, community-operated musical device.

Example 2. Memory Tree 2014 edition. https://tinyurl.com/memoriestree2014
Memory Tree 2015 edition. https://tinyurl.com/memoriestree2015

6.3 Case 3: Lyapunov Time

Premiered at the São Pedro Theater located in the city of São Paulo, Lyapunov Time (LYT) is a comprovisation for solo duo, trio or quartet of clarinets and live electronics.[70] The piece proposes an aesthetic metaphor based on a theory laid out by Aleksandr Mikhailovich Lyapunov.[71] How a dynamic system becomes chaotic serves as an aesthetic point of departure for the artistic work. The proposed system features guidelines and contingencies. The guideline plans involve the construction of tools to create the work. The contingency plans feature unpredictable events. Thus, the guidelines represent the established compositional procedures that regulate the behavior of the dynamic system in performance. Concomitantly, the contingencies trigger unpredictable events that sometimes drive the system into chaotic states. The Lyapunov Time strategies shape the creative methods: comprovisational microstructures and flowcharts.

Example 3. Lyapunov Time. https://www.youtube.com/watch?v=JN1zbmt7PGg&t=122s.

Comprovisational microstructures. The use of extended techniques bridges the guidelines and the contingency plans. They feature sonic variations based on partially notated instructions. Any attempt to repeat precisely a gesture will yield different sonic results. This variability within a predefined guideline tends to expand the range of outcomes.

Flowcharts. This approach encompasses the use of comprovisational microstructures through extended instrumental techniques, opening possibilities outside of the guideline plans. The action-flowcharts involve structural choices. The selection of material is guided by the local conditions (a force, an agent or a sonic event). These guidelines are volatile, encouraging behavioral changes. This leaves room for flexible interpretations of the notated actions. In LYT each clarinet chooses a voice to initially guide the performance. LTY starts with all performers using the same notated material. On page 2, each performer can choose her part based on the current musical context. This method allows for a flexible usage of the flowchart.[72] The clarinet-key sounds avoid a fixed pitch, rhythm or timbre of the events. The sonic results are open. This technique allows for variations based on intentionality while avoiding identical repetitions. Page I features

70 Aliel et al., "The Maxwell Demon."

71 Lyapunov's work in the field of theoretical mathematics focuses on the transition of dynamic systems from order to chaos. According to Lyapunov, some classes of dynamic systems become chaotic at a predictable moment, hence the label Lyapunov time. Lyapunov time is used in dynamic system measurements. It is widely cited when dealing with immense measures, such as the phenomena that span the solar system.

72 Bhagwati, "Towards Interactive Onscreen Notations."

trills, a relatively easy technique for clarinetists that fosters small-scale variations.[73] The trill allows for subtle changes in duration, intensity, pitch or timbre.

The three cases presented in this section point to complementary creative strategies, aligned with the tendencies discussed in the first part of the article. All of them adopt fairly flexible methods to deal with *heterogeneous sources of temporal organization*. The Memory Tree features a fully distributed model of decision-making which depends on the cumulative inputs of both local and remote participants. This approach is aligned with the technique of *accumulation*, initially defined and applied in the deployment of the installation The Urban Corridor.[74] The macrostructural sonic results emerge from local, independent decisions. Lyapunov Time adopts a slightly more constrained decision-making regime but it safeguards flexibility by inserting variability at two levels of the behavioral ecology. At a micro level, the improvisational microstructures feature partially notated instructions that avoid literal repetitions. At a meso level, the choices of notated material are organized through flowcharts. These flowcharts ensure consistent sequential relationships but open the notational resources to individualized and context-based choices. The performers become co-creators of the macrostructure of the work. As a more rigid example of temporal organization, Atravessamentos features two processes that constrain the choice and the distribution of the sonic materials. One organizational principle is guided by the dancer's movements and by the imagetic contents of the concatenated video scenes. These elements hint at structural sections of the sound work, sometimes aligning the events with the imagetic material and other times exploring cognitive dissonances across modalities. The timbral characteristics of the local soundscape provide temporal anchors to frame the creative process. As in other ecologically grounded proposals, the temporal distribution of the environmental events informs the choices and timings of the synthesized sounds.

Social interactions shape these three artworks at multiple semantic levels. At a fairly abstract level, the three proposals furnish critical readings of the relationships between the artistic practice and the underlying cultural expectations. Atravessamentos shatters stereotypes by placing a dancer in a rainforest context, by mixing synthetic everyday sounds and environmental sources with emulated acoustic instruments and by exploring inconsistencies across modalities involving mismatched dance movements and sonic events. Lyapunov Time plays with various connotations of chaos, ranging from a literal (scientifically oriented) interpretation of the proposed metaphor, to a compositional strategy that encourages the participants to thread alternative paths along the dynamic notation, to unpredictable but constrained sonic outcomes by means of extended instrumental techniques. A common characteristic of these strategies is the impact of the local decisions on the global outcomes. Finally, the Memory Tree incorporates interactions among participants as a motivation, as an organizational principle and as a meaningful byproduct of its creative process. Music, in this case, is an enabler of community mirroring the factors that fostered the emergence of music-making in human evolution.

The three artworks were conceived for a prepandemic context, hence they suffer from caveats that need to be addressed, given the current sanitary restrictions. Presented as a video piece and realized through remote asynchronous exchanges among the artists, Atravessamentos is the proposal least affected by the current conditions. Lyapunov Time demands in-place interactions among several players. This constraint can be partially avoided by adopting synchronous (telematic) settings with the usual compensations for delay and jitter discussed in the literature.[75] An interesting aspect of this comprovisational proposal is its temporal flexibility, making it more resilient to temporal disruptions than a standard telematic performance. This issue highlights a research thread that may eventually emerge from post-2020 practices, the flexibility of the musical texture and the *temporalities* enabled by the ubiquitous music ecosystems. These characteristics may be compared to the properties of pliability and brittleness of material objects. But they are, of course, more subtle and difficult to define and study.

73 Aliel et al., "A Soundtrack for Atravessamentos."

74 Capasso et al., *The Urban Corridor*.

75 Barbosa, "Performance Musical em Rede;" and Turchet et al., "Internet of Musical Things."

The Memory Tree furnishes an interesting approach to interaction that may gain weight if the alternated sanitary restrictions continue to be enforced for a long time. Physical access to this installation may be seriously limited, possibly only allowing one person at a time and enhancing the support for touchless interaction.[76] An alternative partial solution seems to involve expanded reality (XR) technology to capture some aspects of the musical experience for remote participants. Is this the same as experiencing a three-dimensional soundscape at the shade of a large tree? Definitely not! The Memory Tree features good support for network-based sonic contributions but lacks *feedback on the local sonic experience* for remote listening. How to deal with the limitations of distributed musical experiences remains an open research question.

7 Ubimus philosophical frameworks: Where do we stand and where do we go?

The Covid-19 pandemic has changed the artistic playing field. The consequences of the lack of shelter and food cannot be overstated. But the current restrictions on social exchanges, especially when considering children, may also have serious and long-lasting deleterious effects. Enhanced support for social interaction seems to be one of the pressing needs of a post-2020 world. How can music philosophy contribute to the renewed artistic challenges of societies in partial confinement or with limited mobility? For instance, collaborative music making by means of ubimus ecosystems could furnish strategies to partially avoid the negative tendencies of online anonymous interactions through the encouragement of meaningful mutual engagement.[77]

The expanded notions of music-making fostered by ubimus practice seem to acquire more relevance during these times of scarcity. Reduced physical mobility, face-to-face or full-body interaction, or the avoidance of crowds are all detrimental factors for the acoustic-instrumental ways of experiencing music. Will musical robots, algorithms or refined methods of data analysis replace music-making as it was done during the twentieth century? Not necessarily. Will new strategies involving the usage of domestic settings, collective interaction and the exploration of multisensory modalities help to foster positive social exchanges and a new sense of community while ensuring cultural diversity? These are some of the goals of the current ubimus initiatives.

This article revisited key contributions of twentieth-century practices to shape a genre-agnostic perspective applicable to post-2020 music-making. Two promising definitions of music were set against the requirements of frequently cited aesthetic proposals of the last century. Kania's usage of the concept of event deserves further study and refinement. Varese's notion of organized sound may be replaced by the concept of *situated sonic information* featuring some level of organization. The direction of information flow suggested by Varese's definition cannot be established *a priori*. On the contrary, this is an empirical question that demands dealing not only with the sonic outcomes but it also demands considering the material and social factors of the situated aesthetic experience.

An ecologically grounded perspective provided a scaffold to discuss an expanded notion of musicality, including the role of the non-human stakeholders. This approach is aligned with the emerging concept of distributed creativity that rescues musical-interaction research from an individualistic, elitist and supremacist focus on illuminated composers and virtuoso players[78] toward more inclusive notions, such as everyday musical creativity.[79] The consequences of this change of emphasis are manyfold. Firstly, rather than creating yet another barrier to musical engagement, a target of ubimus concepts and deployments is to diversify the settings where music-making takes place. This initiative is aligned with the requirement of

76 see Keller et al., "The Handy Metaphor," for a proposal along these lines
77 Brown et al., "Making Meaningful Musical Experiences."
78 Wessel and Wright, "Problems and Prospects."
79 Keller and Lima, "Supporting Everyday Creativity."

physical distancing imposed by the post-2020 contexts. Outdoor activities and home-based music making have become viable alternative artistic venues. Secondly, rather than being forced into the hierarchical, in-place, synchronous model of the orchestra, distributed participation features expanded forms of temporal organization that stretch the fabric of musical time. Resilient support, rather than centralized synchronicity, may entail flexible and localized access to sonic information through multilayered and multimodal channels of information exchange. Thirdly, social interaction as a creative driving-force recovers a prominent place through multi-target, complementary methods. Instead of dwelling on domain-specific knowledge, ubimus handles the exchange of musical information by means of creative-action metaphors, such as time tagging, spatial tagging or creative semantic anchoring. These approaches reduce the need of long-term musical training. The usage of local resources serves both as a scaffold for decision-making and as a potential source of new ideas. Meaningful engagements are encouraged by means of collaborative, open-ended, horizontal exchanges. As a result, several ubimus initiatives emerge as promising strategies for post-2020 educational contexts.

Orchestras reinforce the established forms of instrumental thinking, based on social biases that separate composers from performers, musicians from audiences and artistic spaces from everyday environments.[80] The interfaces and the resources that emulate the behavior of European orchestral instruments furnish a prime example of genre-specific knowledge. Rather than calling this knowledge "musical" it should be labeled "orchestral" or more accurately, "piano-", "clarinet-" or "violin-based" knowledge. This view of music gives precedence to the performance of acoustic instruments and their digital emulations, projecting the idealized notion of a superhuman virtuoso. While it is reasonable to maintain the legacy forms of music-making to preserve diversified geographical and historical traditions, genre-specific knowledge is hardly applicable to all contexts. The rich experiences provided by the emergent multimodal and multisensory artistic formats, the application of analogue and DIY technologies and the community-oriented characteristics of the makers' movement are not encompassed by the acoustic-instrumental bias. Furthermore, ubimus research has shown that everyday musical creativity lies beyond the reach of this genre-centric perspective. How to integrate culturally specific aspects of music-making into ubimus research is still an open question.

One potential contribution of ubimus to the new music-philosophical frameworks is its ability to deal with musical time without resorting to genre- or domain-specific mechanisms.[81] Ubimus ecosystems let the stakeholders handle their sonic resources through the organization of temporalities, avoiding the corset of meter. For instance, the creative-action metaphor time-tagging uses local acoustic cues to scaffold time-based decision-making processes. Graphic-procedimental tagging employs selected visual features of found imagetic resources as visual triggers for musical actions.[82] Tempo, beat or pulse, bar or measure and rhythmic figures are all forms of temporal organization intrinsically tied to meter-parsed time structures. While it is true that some collaborative ubimus activities may rely on explicit verbal exchanges to support collective decision-making, synchronous interactions do not seem to be required to achieve musically meaningful outcomes. Consequently, ubimus approaches stretch the fabric of musical time.

Finally, a non-trivial aspect of creative practice is how to conceptualize the future. In utilitarian applications, anticipation basically involves using a sequence of past events to predict future behaviors or outcomes. Within the context of creative practice, there is a further demand for both relevant and original results. If anticipation precludes originality, it may suit rote activities but it will likely be detrimental for creative endeavors. This is a barrier to pursue anticipation in ubimus practice. The contribution of future events (or the lack of contribution) to the creative outcomes can only be assessed after achieving the musical results.[83] It would seem that establishing the impact of the future within creative tasks is

80 Small, "Performance as Ritual."

81 Keller and Lazzarini, "Ecologically Grounded Creative Practices."

82 This and other related strategies may have implications for the development of multisensory media infrastructure, highlighting the need to address concepts which are applicable across modalities, such as iconicity.

83 Pati et al., "Assessment of Student Music Performances."

impossible. Nevertheless, if we consider how the predicted outcomes impact the creative potentials, we get access to partial but useful information. The potential for creativity depends on both the quantity and the quality of the resources available for the projected actions. If the context of a creative activity is known, anticipation could involve assessing the quality and quantity of the resources applicable to the creative processes while taking into account their future potential contributions. This is a methodological path currently threaded by the ubimus community. It is still too early to say whether it will help to predict future actions. But at least it provides a way to grapple with issues that have not been addressed by mainstream perspectives on music-making.

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