EDITORIAL

Ubiquitous Music Making in COVID-19 Times

Damián Keller[12], Leandro Costalonga[3], Marcello Messina[124]

[1] Amazon Center for Music Research (NAP)
Rio Branco – AC – Brazil

[2] Universidade Federal do Acre (UFAC)
Rio Branco – AC – Brazil

[3] Universidade Federal do Espírito Santo (UFES)
São Mateus – ES – Brazil

[4] Universidade Federal da Paraíba (UFPB)
João Pessoa – PB – Brazil

dkeller@ccrma.stanford.edu, llcostalonga@inf.ufrgs.br, marcello@ccta.ufpb.br

1 Introduction

Picture a world with no mobility. Planes are landed. Urban transportation stopped. Large gatherings are non-existent and everybody is at home. That's 2020, today. Most countries have reduced social interactions to a minimum. Food markets, drugstores and gas stations remain open. But shopping malls, cinemas, coffee shops and pubs have closed their doors for the foreseeable future. The Covid-19 pandemic is among us, ready to strike the most vulnerable and sometimes also the healthy, rich and posh.

Covid-19 impacts every social strata. This is a key difference between this disease and the plagues that have been taking lives in the peripheral countries for decades. Pulmonary and respiratory diseases are among the leading causes of death worldwide. But according to the WHO[1] (2018), the so-called Group I conditions (communicable diseases, maternal conditions arising during pregnancy and childbirth, and nutritional deficiencies) are particularly devastating among the low-income populations.

Until today, music making has predominantly been done through face-to-face, synchronous interactions. While it is true that some forms of music making ─ for instance, studio post-production or karaoké ─ rely on resources that are prepared offline, the implicit target of musical activity is to make sound together, if possible in person and at the same time. The current pandemic has turned the traditional forms of music making into high-risk and in some cases potentially deadly activities. So is music making becoming an activity for a select elite, secluded from the mundane buzz and divorced from community exchanges, again? The answer from the ubimus community is a strong no!

[1] WHO (2018). The top 10 causes of death. Geneva, Switzerland: The World Health Organization. https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death

Ubimus research has targeted both more accessible forms of music making and a search for new modalities of artistic practice. These endeavors entail a deep understanding of the underlying creative phenomena – both the ones approached by disciplines such as musicology or music cognition and the emerging forms of creativity tied to the intense deployment of technology and involving the adaptive and opportunistic utilization of resources found in everyday settings (i.e., *little-c music* - Keller and Lima 2016). As in other fast growing fields, there is a tendency to incorporate technological resources without the support of a firm experimental evidence or a consistent theoretical scaffolding. Take for instance the recent emergence of the Internet of Musical Things. This proposal was formulated in parallel by Turchet and Barthet (2017) and Keller and Lazzarini (2017). After several exchanges in the ubimus community, the various acronyms were dropped (IoMT, IoMUT, etc.) and the label IoMusT was adopted.[2]

There are two issues worth mentioning here. The ties of the Internet of Things (IoT) with ubimus are explicit. Nevertheless, it is not yet clear whether the creative ubimus activities enabled by the IoT infrastructure can be labelled simply IoMusT. Turchet et al. (2018) attempt an inclusive definition of the term. But the examples provided unveil a bias toward a subset of long-standing forms of music making, strongly tied to the hegemonic acoustic-instrumental paradigm. Granted, ubimus is given a place as a form of music making that enables the exploration of the resources of the IoMusT. But part of the recent ubimus contributions to creative musical practices are not supported by the proposed IoMusT functionalities. Why is this so?

Ubimus has pushed the meaning of music making beyond the passive adoption of the technological infrastructure, initially designed around the use of musical instruments. Some IoMusT proposals enforce an early definition of ubimus, laid out by Pimenta et al. (2009). These proposals involve the deployment of tools rather than the development of the creative potential enabled by multiple forms of interaction among cognitive, social and material resources. Hence, they imply a narrow interpretation of ubimus research (alternatively, see Keller and Lazzarini 2017 for an up-to-date definition of ubimus).

Another limitation of the current IoMusT approaches is the priority given to the synchronous usage of remote resources. It is argued that the deployment of the tactile internet [Maier et al. 2016] will enable synchronous musical activities within a radius of 300 kilometers. Despite the tendency to increase the amount of information available on the spot, overcoming some of the technical caveats faced by the telematic approaches to music making such as network jitter and delay, there are human-performance limitations that even speed-of-light data transmission rates may not solve. One aspect is knowledge sharing. Network-based activities involving stakeholders with uneven levels of musical training demand careful attention to the strategies employed for supporting knowledge transfer. Moreover, recent ubimus experiences had their authors and participants speculating as to the desirability of synchronous interaction at all costs [Messina et al. 2019; Aliel and Fornari 2015]. The acoustic-instrumental approach relies on synchronous visual cues (such as those issued by a conductor during the orchestral performance) and on auditory cues (such as the click-track guide employed to synchronize

[2] After three years of research, there is a panoply of variations of this idea that highlight various forms of resource usage and several modalities of connectivity. One example is the concept of ubiquitous sonification. It furnishes a bridge between one thread of ubimus initiatives and the extant practices of sonification and musification [Sarmento et al. 2020].

meter-based music). These cues become useless when the temporal decisions are decentralized, as it occurs in various forms of comprovisation (see the examples by Messina and Feichas 2020; Aliel and Keller 2020 in these proceedings). Both generative strategies [Kramman 2020] and free improvisation [Clemente et al. 2020; Stolfi 2020] present difficult scenarios to synchronous aesthetic decision-making. Generative strategies, if not supported by consistent epimusical resources,[3] may become unwieldy for novices. Free improvisation relies on a large pool of tacit knowledge usually shared through arduous, long-term investments in collective musical practice. The synchronous usage of IoMusT resources does not necessarily address these caveats.

Despite its current limitations, the use of the IoMusT provides a promising thread of research for ubimus initiatives. An especially intriguing avenue involves the incorporation of robots as active partners in ubiquitous music ecosystems. Musical robots have been successfully employed to increase the performance accuracy of humans in drumming tasks [Grindlay 2008]. But similarly to the issues encountered in human-to-human interactions in music making, robotic resources need to be partially aware of their (robotic and non-robotic) partners' actions and intentions.[4] According to Kapur (2005), "[the robot] must be able to sense what the human is doing. In a musical context, the machine can perceive human communication in three general categories. The first is directly through a microphone, amplifying the audio signal of the human's musical instrument. This serves as the machine's ears. The second is through sensors on the human's musical instrument. This is an extra sense that does not generally arise in human-to-human musical interaction. The third is through sensors placed on the [human] body, deducing gestural movements during performance using camera arrays or other systems for sensing. These are analogous to the machine's eyes." Beyond the use of the anthropomorphic metaphor, ubimus robotics entails an understanding of previous, current and future actions of the stakeholders. The problem of synchronization, currently explored by the NesCOM researchers, provides a complex challenge encompassing the technical issues of the support infrastructure and the study of the cognitive implications of remote interactions with the mechanical devices.[5] In some ways, this is similar to space exploration. The action-perception link that characterizes the musical actions exerted on passive objects is broken. To be aware of the robotic actions, the human partners use the partial information furnished by the robots. The temporal constraints may also be relaxed through iterative asynchronous exchanges, opening opportunities for creative strategies involving successive refinement. Therefore, a paradigm of musical interaction targeting passive "instruments", "orchestras" or enforcing centralized decision making may ignore key aspects of this ubimus ecosystem.

2 Artistic practices and creative processes in ubimus

The overcoming of musical interaction based on synchronous, face-to-face exchanges, prevalently (and often exclusively) trapped within the settings of concert halls and similar

---

[3] Extramusical resources that have a direct impact on the processes of sonic production.

[4] The discussion of robotic awareness can be related to the current philosophical explorations of what constitutes human consciousness. While this is an intriguing topic for theoretical speculations, it may still lie beyond the reach of experimental ubimus research.

[5] Weinberg et alii (2020) propose "listen like a human, play like a machine, be social, watch and learn, and wear it" as behavioral targets of musical robots. It is interesting to note the incorporation of embodiment as a key design feature. This view was pioneered by Brooks (1991), among others, and has gained weight during the last decade. This aligns the design of creative robots with the ecologically grounded approaches to creativity, yet adding another thread to the creative applications of ubimus initiatives.

spaces, has been one of the ongoing preoccupations of ubimus practice. Ubimus research has targeted multiple processes of collaborative musical creation involving the usage of remote resources. We maintain that the interaction between distant and yet interconnected agents has been among the priorities of ubimus research since the start of the field [cf. Keller et al. 2010; Miletto et al. 2011]. This fits surprisingly well within the new social protocols of physical distancing[6] motivated by the current pandemic.

Artistic responses to this ubimus priority, at times, tend to focus on the crafting of creative products that showcase remote interaction as part of a musical piece [Aliel and Fornari 2015] or on the implementation of creative processes conducted in a regime of remote interactions, not necessarily evident in the final products [Aliel, Keller and Alvim 2019]. In another recent thread, the focus on graphical live coding (live patching) entails a blurred distinction between processes and products, giving way, however, to a set of disproportionate reliance on synchronous interaction. In this experience, the numerical operations inherent to coding were followed by qualitative research approaches to unearth the embedded ecological, territorial and geopolitical metaphors [Messina et al. 2019]. Rooted in phenomenology and deconstructivism, the potentialities and shortcomings of the physical presence and its simulation(s) provide a basis for collaborative comprovisations, eventually resulting in a literal "hijacking" of the original piece [Messina and Aliel 2019]. Consequently, the authors and participants started wondering whether synchronicity was actually that important for remote creative activities.

This raised attention to issues related to presence and synchronicity within comprovisation frameworks is shared by several artistic contributions included in these proceedings [cf. Pessanha et al.; Aliel and Oliveira; Messina and Mejía], and by most of the papers documenting creative processes [cf. Kramann; Aliel and Keller; Clemente et al.; Messina and Feichas]. In particular, bodily presence with its metaphysical and somatechnical[7] implications is at the basis of the *InFracta* project, presented by the Corpo Generativo Group (Pessanha et al.), and characterised by the progressive transformation of gestures into sounds and, subsequently, of sounds into images.

Aliel and Oliveira propose a new version of the *Lyapunov Time* comprovisation [Aliel et al. 2019] characterised by the deployment of the audience's mobile phones as triggers of the live electronics — consequently, non-musicians eventually become active participants of the performance. By extending the musical activities to a preliminary workshop and a rehearsal, the composer-performer-audience interactions transcend the limited timespan of the oficial performance. The usage of smartphones to support free-improvisation practices is also explored by Clemente et al. in what they describe as a TAFI (Technology Assisted Free Improvisation) approach. The authors apply various improvisational strategies in educational contexts to encourage the development of musicianship. This approach is aligned with the proposals presented by Brown et al. (2014) but instead of targeting the technological resources for sonic production, they employ the acoustic instruments to achieve ubimus-oriented objectives.

[6] Here, in line with one of the most important distinctions in social psychology terminology, we purposely replace what has largely been referred to as "social distancing" with the more appropriate notion of "physical distancing" [cf. Hipp and Perrin 2009; Matthews and Matlock 2011]. We believe that keeping this distinction in mind may prove useful for ubimus practices, too.

[7] "Somatechnics" refers to the intersection between the body as a purely material object and the very same body as a discursive entity, related to the encounter with biocultural and technological accessories [cf. Pugliese and Stryker 2009].

Another contribution that examines the creative interaction between musicians and laypeople is Aliel and Keller's experience within the artistic project *The Maxwell Demon*. Critically engaging with the concepts of entropy, paradox and simulation, the authors develop a mobile app for audio synthesis and processing. This tool is used for a studio performance session with a mixed sample of participants, including musicians and non-musicians. Among other things, the results highlight the negligible impact of previous musical knowledge for this type of creative activities, contributing to an increased engagement of lay participants outside of the concert hall.

Going by the intriguing title "Of Renouncing to do Something Grandiose", Guido Kramann's contribution is centred on a thought-provoking reflection on possible ways of structuring ubiquitous music practices, with an emphasis on comprovisation, to foster a deeper understanding of the lay participants' creative processes. Abundantly drawing upon board games structures, Kramann introduces *pulse2357*, an Android app based on the sonification of chess-like alternated moves performed by the two opponents.

Other communities have brought interesting contributions that have been readily embraced by ubimus practitioners. Comprovisation is a case in point. There is a well-established tradition of free-improvisatory practices in Brazil. But until recently, attempts to establish bridges between professionally oriented improvisation and the participation of lay musicians were rare. In an effort to overcome the artificial separation between musically trained subjects and casual collaborators, ubimus practitioners have laid out bridges to integrate improvisatory practices with active audience involvement. The artworks featured in the UbiMus 2020 highlight the diversity of the aesthetic perspectives enabled through and encouraged by ubimus research.

3 Technological advances for ubimus activities

Being musical is, without a doubt, a special trait of being human. The ability to coordinate and synchronize movements with an unlimited combination of sounds (featuring variations in texture, dynamics, pitch, duration) in perfect timing is a characteristically human achievement. Given an appropriate context, this complex activity can be performed as a group, on the fly, without prior knowledge of what is coming next. The predisposition to perform such demanding tasks has been studied and partially explained from perspectives ranging from the cultural to the biological. Music performance is subject to further constraints: we are limited by our body and by the characteristics of the material resources employed in sound making.

Musical instrument designs can borrow from the advances in electronics and computing to overcome part of the performance limitations of the acoustic instruments. Since Hugh Le Caine's pioneering experiments in the late 1930s, there have been multiple initiatives to address the need for varied and flexible sound-making tools. These initiatives gained a renewed impulse with the recent ubimus developments. The "music anywhere" principle embedded in ubimus involves releasing the performer from the constraints imposed by the physical contact with a material resource and by the requirements of colocated physical presence.

During this time of social isolation due to the Covid-19 pandemic, it has been observed that musicians are struggling to adapt web conference communication systems to perform group-based musical activities without observing important aspects of interaction support, such as the fact that the human rhythmic abilities did not arise to synchronize people with metronomes but rather to align the actions of groups of humans, leading to social synchronization and entrainment. If the support systems are unable to trick our senses into believing that we are in the presence of other musicians (through synchronization mechanisms refined throughout the history of human evolution), then they are doomed to fail. Based on this idea, Camporez et. al propose synchronization strategies and algorithms for musical robots so they can mimic the way humans synchronize with each other during a music performance. The emerging field of the Internet of Musical Things (IoMusT) has been dealing with these challenges for some time, as reported by Vieira, Schiavoni, and Barthet in their bibliographic research included in these proceedings. Sarmento, Holmqvist and Barthet present a view of ubiquitous sonification for a musical smart city that also demands support for organizing computational processes through synchronization.

Modern video conferencing tools allow hundreds of participants but not without its limitations, which become even more pronounced when dealing with time-dependent activity such as music performance. It is not yet possible to single out a group, but researchers have dealt with the limitations by establishing and enforcing social rules for that particular use. For instance, in a choir rehearsal, the "host" (usually the conductor) controls the microphones of all attendees opening and muting their channels as required, hence adopting a studio-engineer role. Everyone listens and sees the leader. This strategy can be highly efficient since chitchat is more controlled, everyone has a clear view of the leader and can even appreciate its vocal quality and technique throughout the rehearsal. Some of these tools have been upgraded to improve the experience, with features such as: a) support for audio sharing; b) software-based audio routing; c) support for multiple audio interfaces targeting heterogenous input; c) advanced media control for voice over music; d) private rooms with independent audio settings; e) background noise filtering and other forms of processing; and f) media sharing. The use of this software certainly requires a dose of creativity, but this does not mean that the tool itself was designed to support musical creativity. Vieira and Schiavoni (in these proceedings) discuss how the Pipe-and-Filters architecture, a common feature in software development, can boost creativity either by applying this technique in development or by using these structures as a way to organize the technical tasks.

It seems that the pandemic has leveled the way we make music by restricting the technologies suitable for this purpose. How is this different from the issues faced by people with disabilities when the tools are not designed with accessibility in mind? Camporez et. al. (this volume) use feature-extraction techniques to develop an Assistive Musical Interface that could aid mobility-impaired people to compose and perform synchronously with other musicians.

The challenges we are now facing due to the Covid-19 pandemic have been addressed by ubimus research for over a decade. Despite the multiple contributions on the technological front, there is still much to learn from the new working conditions imposed by physical distancing. Music making done by anyone, anywhere remains a key objective of the technological advances of ubimus research. But the meaning of anywhere has now been tinged by the weight of a community-responsible attitude that places further demands social interaction.

4 Ubimus in the field, applications in education and human development

An intriguing characteristic of the ubimus community is the intent to pursue ideas around musical issues that do not necessarily involve professionals (though as exemplified above, sometimes professionals are also included in proposals tailored for lay participants). Two areas of application have emerged as key targets of these initiatives: educational activities and human development and well-being. The former field has been championed by Helena Lima, Andrew

Brown and Nuno Otero, among other researchers [Brown et al. 2014; Lima et al. 2012; Lima et al. 2017; Otero et al. in press]. Two methodological approaches show promising results: dialogics and computational thinking.

Ubimus dialogics is based on the educational principles laid out by Paulo Freire [Freire 1997; Shor and Freire 1987], highlighting the role of the horizontal exchanges among group members, the respect for cultural diversity and the adoption of a positive attitude toward local knowledge. During the 1980s, dialogics strongly influenced the participatory design movement in Scandinavia [Ehn 1988]. Participatory design strategies have also been incorporated in ubimus design, emphasizing the grass-roots qualities of the ubimus methods [Pereira et al. 2018]. As previously stated, ubimus research faces multiple challenges related to the social implications of remote music making. While colocated music making has traditionally been used to encourage social bonding, it is not yet clear whether asynchronous musical activities may also have a positive impact on social cohesion. The application of dialogics could provide a path to investigate this issue.

Computational thinking (CT) has had a strong impact on twentieth-century music making. This perspective is implicit in the early initiatives of algorithmic composition and computer-based generative approaches to music making [Hiller and Isaacson 1959; Xenakis 1971]. In spite of its early usage by professional composers, CT has not been widely adopted as a strategy to ground alternative music-educational activities. Given this gap, ubimus furnishes an opportunity to apply the lessons learned in CT-based professional creativity to the realms of little-c music making and informal education. An attractive feature of the CT perspective is its potential for support of non-technical knowledge transfer. Some forms of computational thinking may be enabled through embedded-embodied approaches to human-computer interaction. For instance, the deployment of creative surrogates may be tailored for computationally enhanced collaborative strategies [Keller et al. 2015]. These proxies may involve sonic, visual, audiovisual and haptic modalities, plus some hybrids that feature elements of each modality. Future CT strategies may also be expanded by the incorporation of taste and olfactory stimuli for music making [Mesz et al. 2012].[8]

Given the current restrictions in outdoor circulation and the impossibility of participating in large social gatherings, ubimus approaches present a renewed potential of application in music therapy and human development. Assistive technologies can be used to promote the inclusion of people with visual, auditory or psychomotor special needs in creative activities. This infrastructure may also be applied for the enhancement of musical experiences by the general population. Assistive-living scenarios could feature non-invasive, individually attuned, forms of support to enhance well-being and to foster health-promoting indoor activities. A case in point is walking. Music-listening is a widely adopted activity to encourage physical exercise. Could this practice be applied to creative music making? How could creative music making be enabled without restricting body movements?

Santos et al. focus on the demands of doing music in the context of elementary education, with a special emphasis on the development of ubimus infrastructure applicable both to educational and domestic contexts. They describe the implementation and usage of musical mats,

[8] Given the possibility of developing food replicators (a Star-Trek invention that has become reality through 3D printing), it is now possible to explore a complete package of nutrients, smells and textures, combined with audio resources to achieve aesthetically enhanced gastronomic experiences.

an artifact encompassing a desktop computer, a Makey Makey[9] microcontroller and a mat-based triggering mechanism. The implemented system makes use of the shareware utility Soundplant[10] as a tool for sonic production. Santos et al. carried out an informal study involving eighty seventh-grade students, doing activities within classroom settings. Despite the preliminary characteristics of the study, Santos and coauthors report a promising potential of deployment highlighted by the low cost of the equipment and by the playful modalities of interaction provided by the trigger mats.

Camporez et al. target the usage of assistive musical interfaces based on eye tracking. They propose the application of information-retrieval techniques to deal with segmentation and similarity ratings of musical resources. The retrieval techniques are employed to find sound samples according to specific criteria. They argue that the facilitated access to large digital databases may enable new forms of music making [Stolfi, Milo and Barthet 2019].

Low-cost wearable devices offer opportunities to deploy music therapies outside of clinical settings. Domestic environments are particularly attractive because they provide a familiar and customizable context of use, which could be adapted for the specific needs and preferences of the targeted subjects. To unleash this potential, several technical hurdles need to be overcome regarding both the support for sound making and the human-computer interaction demands. Expertise in this area has been developed by Timoney et al. (2015) during the BeatHealth Project. According to the authors, wearable devices need to be lightweight and energy-efficient, but at the same time they cannot exceed the average cost of the current personal electronic devices. The ubimus strategy of hardware repurposing seems to be particularly well-suited to this end [Flores et al. 2010].

Complementarily, the infrastructure of the Internet of Musical Things (IoMusT) may furnish network-based resources for music making which could be accessed through the wearable components. The usefulness of the IoMusT and of other ubimus resources may be expanded through the development of machine-learning algorithms. By analyzing the history of interactions and by predicting future behaviors, therapeutic strategies could be tailored for individual needs. This form of ubimus support, involving the prediction of future events, has not yet received detaoçed attention from the research community. This thread might unveil new affordances and constraints for creative music making.

Summing up, multiple ubimus human-development approaches are actively being pursued by various research groups in the ubimus community. It is likely that this area will move toward a convergence in methods and concepts in the years to come. Two promising ubimus conceptual frameworks have been proposed by Helena Lima and Nuno Otero, dialogics and computational thinking. Their technological counterparts are still scattered and lacking consistent architectures. Current proposals include eye-tracking interfaces, trigger mats and wearable devices for physical activities. Portable prototypes have also targeted bimanual, touchless interaction [Keller et al. 2019] and multitouch-based techniques [McGlynn et al. 2012]. Hopefully, the strategies developed for creativity-oriented design could also be adapted for human-development ubimus deployments.

[9] http://www.makeymakey.com.
[10] http://soundplant.org.

5 Targeting a second wave of ubimus initiatives

In a recent publication, Keller, Messina and Oliveira (2020) suggest that ubimus is currently moving beyond the proposals laid out during its first decade of existence (more accurately, within a period marked by the beginning of the g-ubimus network activities and the first ubimus international publication by a major press, from 2007 to 2014). Hints that ubimus research is breaking new ground can be gathered from the variety of themes, from the need to broaden the conceptual perspectives and from the renewed relevance of the ubimus approaches facing the health-risks of the traditional artistic formats. The Covid-19 pandemic has literally changed the playing field (pun intended). How can ubimus research contribute to the renewed musical needs of a society in partial confinement?

First of all, enhanced support for social interaction seems to be among the pressing needs of a post-coronavirus world. Granted, the destructive impact of the neoliberal economic policies -- with a release of all legal restrictions on the financial accumulation and speculation -- has reduced the access to healthy food and reasonable shelter of large contingents of people. The Syrian and Venezuelan migrant crises -- both induced by an ongoing campaign to conquer oil reserves -- have placed millions of people in a highly vulnerable and potentially catastrophic situation. The consequences of the lack of shelter and food cannot be overstated. But the current restrictions on social interaction, especially when considering children, may also have long-lasting effects.

Collaborative music making by means of ubimus ecosystems could furnish a way to avoid some of the negative aspects of online social exchanges while encouraging meaningful ways of engagement [Brown et al. 2014]. Recent ubimus projects unveil interesting issues arising from the non-verbal exchanges prompted by synchronous and asynchronous resource sharing, without the support of face-to-face interaction [Messina et al. 2019; Stolfi, Milo and Barthet 2019]. Are facial expressions necessary for musical knowledge transfer? Acoustic-instrumental practices built around fixed scores, centralized decision making and linear organization of time would appear to indicate so. There are at least two aspects to consider: temporality and semantics. A key contribution of ubimus to musical theory is its ability to deal with time without resorting to genre-specific mechanisms [Keller and Lazzarini 2017b]. Tempo, beat or pulse, bar or measure and rhythmic figures are all forms of temporal organization intrinsically tied to meter-based music making. Ubimus ecosystems let the stakeholders deal with their sonic resources through the organization of temporalities rather than through the imposition of meter. For instance, time tagging uses local acoustic cues for decision making; Graphic-procedimental tagging employs selected visual features of found resources as visual triggers for musical actions;[11] The Playsound.Space system uses sonograms to complement the semantics-based selection processes and the sound sphere metaphor provides a combination of color-coding, tones of grey and airport-style abbreviations of semantic labels to furnish information on the sonic mix deployed on its virtual sphere. Musical partners rely on these cues to reach consensual decisions. While it is true that some collaborative ubimus activities have relied on explicit verbal exchanges to support collective decision-making, synchronous

[11] Graphic-procedural tagging, aside from being a metaphor for creative action, can also be classified as a form of sonification. This is one of the intersections between ubimus and auditory display that are being explored in the special issue dedicated to the overlap between the two areas that will be published by the Computer Music Journal.

face-to-face interactions do not seem to be a requirement for musically effective usage of ubimus ecosystems.[12]

A non-trivial aspect of creative practice is how to conceptualize the future. In utilitarian applications, anticipation basically involves using a sequence of the extant events to predict future behaviors or outcomes. Within the context of creative practice, there is a further demand to foster relevant and original results.[13] If anticipation precludes originality, it may be suited for rote activities but it will likely be detrimental for creative endeavors. This may constitute a barrier to pursue this path. The assessment of the contribution of future events (or the lack of contribution) to the creative outcomes can only be done after achieving the musical results [Pati et al. 2018]. It would seem that assessing the impact of the future on the creative performance is an impossible task. Nevertheless, if we consider the impact of the predicted outcomes on the creative potential, we may then get access to partial but useful information. The potential for creativity depends on the quantity and quality of the resources available for the projected creative 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 methodological path is being threaded by the ubimus community. It is still too early to determine whether it will yield answers for the multiple unknowns of future actions in creative practice. But at least it provides a way to deal with issues that so far have not been considered by other perspectives on musical interaction.

The ubimus workshops have provided a fertile terrain to seed new ideas. Some of the proposals discussed by the ubimus community were later adopted by other fields of research, including economics [Abolhasani et al. 2017; Oakes et al. 2011], interaction aesthetics [Xuan 2017] and tangible computing [Palaigeorgiou and Pouloulis 2018]. It is interesting to note that key ubimus proposals, such as the standardization of mobile and web protocols for music making, are slowly making their way as design targets of mainstream computer-music research. Consider, for instance, this statement by Gurevich (2012): "[...] standardization does have its benefits: spectators on some level know how [interaction with musical devices] works. Furthermore, the ubiquitous touchscreen mobile phone and tablet offer a richer gestural repertoire and palette of sensing technologies. Years of experience using and seeing others use these gestural devices have inculcated a suite of interactional techniques and paradigms into many of us. Although there is no substitute for embodied musical knowledge, many recent mobile apps have already demonstrated that mobile devices can offer both a low entry fee for novices and complex means for interaction." Gurevich proposal of using everyday personal devices in musical interaction design echoes the strategies employed and discussed in the early ubimus workshops [Flores et al. 2010; Keller et al. 2011; Pimenta et al. 2009].

How does the "embodied musical knowledge" mentioned in the statement above stand in relation to the strategies for musical interaction enabled by the ubimus ecosystems? Here a fine distinction needs to be established. Ecologically grounded creative practices applied the notion of embodiment to creative music making before this concept became popular among

[12] Despite the preliminary evidence on this trend, the implications of the lack of face-to-face interaction have hardly been documented. A whole area of ubimus research targeting the dynamics of social interactions and their relationships to the ubimus ecosystems is currently ripe for development.

[13] According to Weisberg's (1993) definition of creativity, creative processes and products need to be both original and relevant. Innovative proposals that are not considered applicable to the task or resources that are not utilized by the stakeholders do not meet the criteria to be labeled creative. Complementarily, resources or procedures that do not present any novelty are not usually classified as creative.

musicologists and anthropologists [Keller 2000; Keller 2001; Keller and Capasso 2006].[14] This notion was not divorced from the concept of embedded or situated action, indicating an epistemological approach consistent with the recently labeled E4[15] perspective [Malinin 2016]. While a detailed discussion of the implications of embodiment is beyond the scope of this editorial, limiting embodiment to one aspect of acoustic-instrumental music making implies a narrow vision on musical knowledge acquisition. The usage of interfaces and resources that emulate the behavior of European orchestral instruments is a prime example of genre-specific knowledge. Rather than calling this knowledge "musical" it should be labeled "orchestral" or even better, "piano-", "clarinet-" or "guitar-based" knowledge. This view of music making only targets the resources linked to the instrumental performance of acoustic and digitally emulated acoustic instruments. This type of knowledge has limited applicability since it does not encompass the rich experiences provided by a growing variety of multimodal artistic formats, by the application of analogue computing and it does not engage with the recent contributions of the makers movement to music making. In particular, ubimus research has shown that everyday musical creativity lies beyond the reach of this genre-specific perspective.

The expanded notions of music making encouraged by the ubimus conceptual frameworks seem to acquire a special relevance during these times of scarcity. Reduced physical mobility, lack of face-to-face, physical interaction, avoidance of crowds are all detrimental factors for the acoustic-instrumental ways of music making. Will musical robots, musical algorithms or refined methods of data analysis replace music making as it was done during the twentieth century? Not necessarily. Will the new areas of ubimus application, highlighting the usage of domestic settings, the asynchronous strategies of group support and the incorporation of multiple modalities of exchange help to foster well-being, musical diversity and meaningful interaction? This is one of the goals of the current ubimus initiatives. For better or worse, music making as we know it will have to make room for artistic practices compatible with a planet in decomposition.

6 References

Abolhasani, M., Oakes, S., & Oakes, H. (2017). Music in advertising and consumer identity: The search for Heideggerian authenticity. *Marketing Theory* 17 (4), 473-490. (Doi: 10.1177/1470593117692021.)

Aliel, L., Keller, D., & Alvim, V. (2019). A Soundtrack for Atravessamentos: Expanding ecologically grounded methods for ubiquitous music collaborations. In *14th International Symposium on Computer Music Multidisciplinary Research*.

Aliel, L., & Fornari, J. (2015). Creating an ecologically modeled performance through the remote manipulation of multiple soundscapes. *NICS Reports*, (12), 2.

Brooks, R. A. (1991). Intelligence without representation. *Artificial Intelligence* **47**(1), 139-159.

Brown, A. R., Stewart, D., Hansen, A., & Stewart, A. (2014). Making meaningful musical experiences accessible using the iPad. In Keller, D., Lazzarini, V., & Pimenta, M. S. (Eds.). *Ubiquitous music* (pp. 65-81). Cham, Springer.

[14] See Keller and Lazzarini (2017) for a coverage of ecologically grounded creative practices as they relate to ubimus. See also Carson (2020) for an informal discussion of early ecocompositional initiatives.
[15] Embodied, embedded, enactive, ecological cognition.

Carson, T. (2020). On Ecocomposition. *Journal of Digital Media & Interaction*, 3(5), 133-142.

Ehn, P. (1988). *Work-oriented design of computer artifacts*. Stockholm, Sweden: Arbetslivscentrum.

Flores, L. V., Pimenta, M. S., Miranda, E. R., Radanovitsck, E. A., & Keller, D. (2010). Patterns for the design of musical interaction with everyday mobile devices. In P*roceedings of the IX Symposium on Human Factors in Computing Systems* (pp. 121-128). Brazilian Computer Society.

Freire, P. (1997). *Pedagogy of the oppressed*, revised ed. New York: Continuum.

Grindlay, G. (2008). Haptic guidance benefits musical motor learning. In Proceedings of the Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (Haptics 2008) (pp. 397–404). IEEE Computer Society. (ISBN: 9781424420056.)

Gurevich, M. (2012). Spectators of mobile musical interactions: Opportunities and challenges. In *DIS 2012*.

Hiller, L. A., & Isaacson, L. M. (1959). *Experimental Music: Composition with an Electric Computer*. McGraw-Hill.

Hipp, J. R., & Perrin, A. J. (2009). The simultaneous effect of social distance and physical distance on the formation of neighborhood ties. *City & Community*, 8(1), 5-25.

Kapur, A. (2005). A history of robotic musical instruments. In *ICMC*.

Keller, D. (2000). Compositional processes from an ecological perspective. *Leonardo Music Journal*, 55-60.

Keller, D. (2001). Social and perceptual dynamics in ecologically-based composition. *Electronic Musicological Review*, 6.

Keller, D., Gomes, C., & Aliel, L. (2019). The Handy Metaphor: Bimanual, touchless interaction for the internet of musical things. Journal of New Music Research, 48(4), 385-396.

Keller, D., Barreiro, D. L., Queiroz, M., & Pimenta, M. S. (2010). Anchoring in ubiquitous musical activities. In *ICMC*.

Keller, D., & Capasso, A. (2006). New concepts and techniques in eco-composition. *Organised Sound,* 11(1), 55-62.

Keller, D., & Lazzarini, V. (2017a). Ecologically grounded creative practices in ubiquitous music. *Organised Sound*, 22(1), 61-72.

Keller, D., & Lazzarini, V. (2017b). Theoretical approaches to musical creativity: The ubimus perspective. *Musica Theorica*, 2(1), 1-53.

Keller, D., Flores, L. V., Pimenta, M. S., Capasso, A., & Tinajero, P. (2011). Convergent trends toward ubiquitous music. *Journal of New Music Research*, 40(3), 265-276.

Keller, D., Messina, M., & Oliveira, F. Z. (2020). Second Wave Ubiquitous Music. *Journal of Digital Media & Interaction*, 3(5), 5-20.

Lima, M. H., Keller, D., Flores, L. V., & Ferreira, E. (2017). Ubiquitous music research: Everyday musical phenomena and their multidisciplinary implications for creativity and education. *Journal of Music, Technology & Education*, 10(1), 73-92.

Lima, M. H., Keller, D., Pimenta, M. S., Lazzarini, V., & Miletto, E. M. (2012). Creativity-centred design for ubiquitous musical activities: Two case studies. *Journal of Music, Technology & Education*, 5(2), 195-222.

Maier, M., Mahfuzulhoq, C., Rimal, B. & Pham Van, D. (2016). The Tactile Internet: Vision, Recent Progress, and Open Challenges. IEEE Communications Magazine 54. (Doi: 10.1109/MCOM.2016.7470948.)

Malinin, L. H. (2016). Creative practices embodied, embedded, and enacted in architectural settings: toward an ecological model of creativity. *Frontiers in psychology*, 6, 1978.

Matthews, J. L., & Matlock, T. (2011). Understanding the link between spatial distance and social distance. *Social Psychology 42*(3), 185-192.

McGlynn, P., Lazzarini, V., Delap, G., & Chen, X. (2012). Recontextualizing the Multi-touch Surface. In *NIME.*

Messina, M., & Aliel, L. (2019). Ubiquitous Music, Gelassenheit and the Metaphysics of Presence: Hijacking the Live Score Piece Ntrallazzu 4. In *14th International Symposium on Computer Music Multidisciplinary Research*, 685-695.

Messina, M., Svidzinski, J., de Menezes Bezerra, D., & da Costa, D. F. (2019). Live Patching and Remote Interaction: A Practice-Based, Intercontinental Approach to Kiwi. In *14th International Symposium on Computer Music Multidisciplinary Research*, 696-703.

Mesz, B., Sigman, M., & Trevisan, M. (2012). A composition algorithm based on crossmodal taste-music correspondences. *Frontiers in Human Neuroscience*, 6, 71.

Miletto, E. M., Pimenta, M. S., Bouchet, F., Sansonnet, J. P., & Keller, D. (2011). Principles for music creation by novices in networked music environments. *Journal of New Music Research*, 40(3), 205-216.

Oakes, S., Brownlie, D. & Dennis, N. (2011). Ubiquitous Music. *Marketing Theory* 11 (1), 93-95. (Doi: 10.1177/1470593111403222.)

Oakes, S., Brownlie, D. & Dennis, N. (2014). Ubiquitous music: A summary and future research agenda. *Marketing Theory* 14 (2), 141-145. (Doi: 10.1177/1470593114521455.)

Otero, N., Jansen, M., Lazzarini, V. & Keller, D. (in press), Computational thinking in ubiquitous music ecologies. In *Ubiquitous Music Ecologies*, Victor Lazzarini, Damián Keller, Nuno Otero and Luca Turchet (eds.) (pp. 146-170). London: Routledge.

Palaigeorgiou, G. & Pouloulis, C. (2018). Orchestrating tangible music interfaces for in-classroom music learning through a fairy tale: The case of ImproviSchool. *Education and Information Technologies* 23, 373–392. (Doi: 10.1007/s10639-017-9608-z.)

Pati, K. A., Gururani, S., & Lerch, A. (2018). Assessment of student music performances using deep neural networks. *Applied Sciences*, 8(4), 507.

Pereira, V. S., Silva, S. L., Bessa, W. R. B., Alcântara-Silva, T. R., & Keller, D. (2018). Soundsphere: Participatory design as a strategy to develop sustainable tecnologies in ubiquitous music (soundsphere: O design participativo como estratégia para o desenvolvimento de tecnologias sustentáveis em música ubíqua). *Sonic Ideas*, 10(19), 7-44.

Pimenta, M. S., Flores, L. V., Capasso, A., Tinajero, P. & Keller, D. (2009). Ubiquitous music: concept and metaphors. In Farias, R. R. A., Queiroz, M. and Keller, D. (eds.), *Proceedings of the Brazilian Symposium on Computer Music (SBCM 2009*), pp. 139-150. Recife, PE: SBC

Pugliese, J., & Stryker, S. (2009). The somatechnics of race and whiteness. *Social Semiotics*, 19(1), 1-8.

Shor, I. & Freire, P. (1987). What is the 'dialogical method' of teaching? *Journal of Education,* 169(3), 11-31.

Stolfi, A. S., Milo, A., & Barthet, M. (2019). Playsound. space: Improvising in the browser with semantic sound objects. Journal of New Music Research, 48(4), 366-384.

Timoney, J., O'Leary, S., Czesak, D., Lazzarini, V., Conway, E. E., Ward, T. E., & Villing, R. C. (2015). The beathealth project: Application to a ubiquitous computing and music framework. *Journal of Cases on Information Technology (JCIT)*, 17(4), 29-52.

Turchet, L., & Barthet, M. (2017). An Internet of Musical Things architecture for performers-audience tactile interactions. In *Proceedings of the Digital Music Research Network Workshop*.

Turchet, L., Fischione, C., Essl, G., Keller, D., & Barthet, M. (2018). Internet of musical things: Vision and challenges. *IEEE Access*, 6, 61994-62017.

Xenakis, I. (1992). Formalized music: thought and mathematics in composition. Hillsdale NY: Pendragon Press.

Xuan, L. (2017). Reconstruction of artistic patterns of paper vines from the perspective of aesthetics and interaction. In *Proceedings of the 3rd International Conference on Social Science, Management and Economics (SSME 2017)* (pp. 187-192). (ISBN: 978-1-60595-462-2.)

Weinberg, G., Bretan, M., Hoffman, G. & Driscoll, S. (2020). Robotic Musicianship: Embodied Artificial Creativity and Mechatronic Musical Expression. Berlin and Heidelberg: Springer. (ISBN: 9783030389307.)

Weisberg, R. (1993). *Creativity: Beyond the myth of genius*. New York: WH Freeman.