Rethinking the History of Technology-based Music
Collected Abstracts

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Critical Sonic Practice:
Inclusive Research through Global Electronic Music

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Global electronic music shares innovations and trends throughout the African diaspora, like ripples on a lake. The shared cultural practice of music and dance, from bootleg tapes to mobile phones and the internet, trans-African cultural production is ever-changing and restricted by the norms of its colonized geography. Music research has tended to focus on music from European composers, and music technology has furthered this position. Recorded music and the inclusive genre of electronic music, however, are rich resources for music research, especially for underrepresented cultures whose music stems from oral traditions. European colonizers and settlers used music, culture and other artforms in tandem with religion as tools of colonization. Focussing on the recorded music category of music technology — audio engineering and music production — invites research on music from oral traditions of the global south, as well as non-notated contemporary musics such as hip-hop and dance music. Intersectionality calls for a deeper discussion inclusive of class, gender, sexuality and dis/ability. Are we including all music genres and music creators with same gravitas? And if not, why not?

Critical Sonic Practice Lab dissolves splits in music research, practice and publication and investigating electronic musics that have typically been left out of the music theory, composition and music technology. The author's article "Critical Sonic Practice: Decolonizing Boundaries in Music Research" in *Continental Thought and Theory Journal* outlines guidelines for decolonizing music giving specific examples of decolonizing, such as "radical reclassification" thus broadening ranges of diverse electronic musics for analysis.

Reclassifying research in music composition, theory and technology to include all types of process--including participatory music, live performance and music technology--radically expands music research including that of black and indigenous musics of the world. (p. 188).

The crux of the critical sonic practice lab engages music creation — the practice of music making — with analysis and theory. 'Hui' is a VR movement theater piece in collaboration with director Kasia Pol and Ria Paki engaging Māori cosmology and *waiata* (Māori song), alongside traditional dance and martial arts. The author is creating an analog synth soundtrack; the ambient soundtrack was recorded in *Aotearoa* (New Zealand) using immersive recording is being edited and mixed in the lab for VR headphones, as well as large-scale installation with projections. In 2021, the lab hosted Critical Sonic Practice Symposium with academic and industry speakers on the impact of the pandemic on underrepresented music creators. The symposium featured "Elegy" a virtual streaming audiovisual experience in response to the COVID 19 pandemic, followed by live post-notes from author-poet, Fred Moten. The author's chapter "Embodied Listening: Grassroots Governance in Electronic Dance Music Venues in Accra (Ghana)" describes creating and participating in global music and dance as "embodied listening"; and examines the unique listening environments of Accra supported by local community of artists, venue and restaurant owners. The lab is currently cataloging a list of pioneering African-American composer George Lewis' notated, improvised and computer music compositions, as well as his extensive list of published articles to complement writing his entry on IRCAM's Brahms database. The author is a member of the AFRINUM project, a West-African music four-year research insight project funded by l'ANR (The French National Research Association). Critical Sonic Practice Lab is researching AFRINUM's Ghana segment running a pilot investigating microtonal nuance in Ghanaian scales using MIR (music information retrieval). Although the lab engages decolonizing perspective, centering Northern Christian harmony is necessary in the discussion—as these scale systems are a cultural choice at the heart of the European colonizing force of music. Although the findings are late stage research (and for this reason cannot be included), the underlying rationale for the study aligns with the lab's theory of radical archiving to research non-notated and underrepresented musics. Hence, rather than a fixed theory or answer, Critical Sonic Practice calls for malleable and radical decolonization in music research, practice and pedagogy.

In 2020, the author founded Critical Sonic Practice Lab as Assistant Professor of New York University's Music Technology Program, affiliated with MARL (Music and Audio Research Lab) and IDM (Tandon School of Engineering's Integrated Design Media Program) collaborating with colleagues from Gallatin and Tisch, a student lab manager and graduate students. The author's research informed NYU's undergraduate Global Electronic Music (GEM I) course, which has run for the past three years and could be taught on global campuses. Therefore, Critical Sonic Practice Lab confronts culturally embedded colonial and empirical exclusions in music research that may positively impact the real world in the key areas of music education, funding and music programming.

Didactic changes in sound compositions with synthesizer apps

Philipp Ahner (Trossingen University of Music)

Over the last 25 years, mobile devices have gradually conquered the everyday life of more and more target groups and transformed how we deal with music. Since 2016, the research project " Making Music with Smartphones: Creative and Productive Design with Apps in Collaborative Learning Forms in School" has focused on the development of didactic settings for music invention and composition with synthesiser apps in secondary schools.

Background Smartphones and apps are often credited with the role of facilitating student's creativity and motivation. Various research projects and field reports show that this applies only to a limited extent. However, the use of digital technologies in learning processes can be successful but depends on many factors. Most young people have a critical-reflexive attitude towards smartphones in classroom and the desire that the use of digital media is limited to individual learning phases. At the same time, the research results show that young people's musical activities with digital media are almost exclusively related to reception and consumption.

Aims Which factors motivate or inhibit students to use smartphones as instruments for making music and inventing music? As part of the Design Research project "Making Music with Smartphones: Creative and Productive Design with Apps in Collaborative Learning Forms in School" learning environments with mobile digital devices are being developed in secondary school music lessons. And based on the dimensions of "Self-Determination Theory" (SDT), students' self-descriptions of creative interacting with smartphones are explored.

Method The project is a research in the format Design Research / Design-Based Research and, as described, it pursues both research goals and development goals. In order to get a focused access to the action and thought processes of the learners, video recordings and stimulated recall interviews are evaluated. The self-assessments of the perceived autonomy, competence and social relatedness (SDT) serve as stimulus. The students used their own mobile devices (BYOD) in classroom and designed a sound collage (music invention) with live synthesizers. The iterative research process ran two meso-cycles in secondary schools (grades 8 to 11).

Results The evaluations show very different descriptions of the basic psychological needs. In the presentation, two particularly striking relationships are presented. On the one hand, the relationships between experienced competence and previous musical experience and the evaluation of the live synthesizers used. On the other hand, the relationships of experienced social involvement and technological framework conditions, such as number of devices or type of sound transmission are shown. Related to this and beyond, technological innovations have a significant impact: changes in recent years in the design of devices as well as changes in the features of apps are also changing the form of collaboration and the associated experience in processes of making music.

Since the beginning of this research project, the technologies have continuously progressed and with them the didactic challenges in connection with the technologies. In addition to the central goals of the research project, the results also show the "history" of changes in the didactic challenges in dealing with digital mobile devices in music lessons. Using examples from the empirical studies, the lecture will focus on changes such as structural changes (headphone connections via Bluetooth instead of mini-jack) or connectivity (Ableton Link) in their didactic challenges for creative ways of dealing with mobile devices in context of technology-based music in the classroom.

Finding the female users:
A feminist historiography of the Fairlight CMI

Manuella Blackburn (The Open University)
Paul Harkins (Edinburgh Napier University)

The story of the Fairlight CMI, a digital synthesizer that was designed in Sydney, Australia in the mid-to-late 1970s, is dominated by a few high-profile male users: Peter Gabriel, Herbie Hancock, and Stevie Wonder. In both academic and popular histories of the instrument, Kate Bush is often the token female user. In this paper, we shift our focus away from this well-known history and ask: who are the users that have been left out of this story? Where are the female users who may have been inspired by Kate Bush but who are not part of this familiar and limited narrative? Was there a lack of female users of the Fairlight CMI, or do accounts of this time overlook their activity and contributions in favour of male counterparts? Were there female producers and musicians who wanted to use the CMI but did not have access or the financial ability to do so? Using ideas and concepts from the field of Science and Technology Studies (STS) and the focus on users in the work of scholars like Trevor Pinch, Nelly Oudshoorn, and Steve Woolgar, we also ask if the designers of the the Fairlight CMI configured the instrument in such a way as to prioritise male over female users.

We will report back on initial groundwork conducted to identify female users of the Fairlight CMI. Our line of questioning and early day discoveries forms the first step of a larger project to develop a research network exploring women users, contributors and creators who can challenge the received narrative around the Fairlight CMI. Inspired by the work of feminist historians of music technologies like Tara Rodgers who writes that 'women are always rendered out of place as subjects and agents of electronic music history and culture', we aim to show how women may have been left out of the story as subjects and agents in the history of early digital technologies like the Fairlight CMI. We identify female users from the worlds of experimental music such as Roxanne Turcotte and Beverly Grigsby, the words of sound engineering like Jeri Palumbo and Susan Rogers, and the worlds of popular music like Julia Downes and Kim Wilde and ask why their stories have not yet been told. Uncovering new voices to tell stories is important now, not only to capture oral histories from those who are still able to contribute to these discussions, but also to write more nuanced histories.

In this paper, we also reflect on recent compositional activity that has drawn on the Fairlight CMI's sound library, as demonstrated in Blackburn's *Farewell Fairlight* (2021). This process raises questions about women contributors to this eclectic and iconic sample collection that was used widely in the production of popular music in the 1980s. There has been much scholarly focus on the ORCH2 sound, that was sampled from Stravinsky's 'Firebird' and used most famously in 'Planet Rock' by Afrika Bambaataa & The Soul Sonic Force. We are keen, however, to investigate the origins of other library sounds and highlight the role of women who contributed to the Fairlight CMI's adoption by users and its subsequent iconic status. For example, we know of Sarah Cohen's breathy vocal addition to the library with the widely used SARARR sample. We want to ask where these sounds came from and in what ways are they still being used to shape the sounds of contemporary music. By doing so, we will rethink the history of technology-based music and explore how women have been overlooked in the writing of history about the designers and users of digital technologies.

Antinomies of Net/Satellite Communication: Strategies of Musical Interaction. On research experimentation since the 1960s

Arild Boman (University of Oslo)

This presentation will describe musical experimentation with satellite and net communication in music from 1960s onwards.

Introduction Net-based cultures, historically recent and emerging, as in music, needs new models of research and practice: Interaction between musicians in different sites may for instance be described in matrices of relations and outputs, (the results of what musicians hear/receive from others and play/send to others from each site). With close sites and marginal net delays their overall musical output may be close to invariant across sites. And the net concert may be represented and transmitted as one singular output. – Increasing distances/delays between sites may generate a multiplicity of musical outputs, rapidly expanding with the size of the orchestra. As outputs vary between sites, the actual playing in the various (´theres´,´now´) in the matrix may not be accessed and exposed at any singular site.

Authenticating the musical output in one site, like at a particular stage/institution, etc., as the ´real´ one, as ´the´ net-concert, thus does not represent the actual matrix of playing. Delays may also make outputs from different sites incompatible, like destroy rhythmic or harmonic patterns in a concert. Blocking transmissions, to- or from particular sites/musicians may reduce such problems.

The development of net-based culture thus contains even various types of simulations of the basic interactivity that the technology represents. Controls of interaction matrices may be legitimate tools in composing net-music, but the unique potential for including humans by this technology is an inherent challenge about extensions of such inclusion. In research it may take various directions. AI-tools may for instance aim at reducing delay effects by prediction of musicians´ responses to inputs from others, and thus reduce their uncertainty over reactions from each other, (which in non-delayed, face-to-face relations may be realized and responded to immediately). The possible preciseness of such tools may however be questioned, for instance as they would not only predict acts of the other musicians, but even lead to basic problems of self-reference in relating to the very act of playing – of any musician, herself.

Since the launching of communication satellites in the 1960s, - a period of even growing cultural techno-scepticism, - these technologies have been welcomed as ultimate, even global unifiers of mankind. For one-way (like television) or serial (telephone) messages, such effects are easily noticed, however regarding continuous interaction, like in musical, visual, or bodily communication, the effects for instance of delays are not as easily determined.

Studies from the 1960s on satellite/net technology may differ from more recent research, simply because the technology was new, which made it possible to study initial encounters with the technology, before the emergence of what has become established 'mainstream' practices.

Research/method Following experimentation with computer music from 1961 onwards, MediaCulture (at the Department of Sociology, University of Oslo)[1] started experimentation with continuous interaction in music, visualization, and dance via satellite systems. In the first exploratory phase in 1972, actors used instruments, metronomes, and voice when trying to cope with the antinomies and inconsistencies posed by systemic delays. Experimentation also included studies of such tensions in actors´ initial encounters with VR in theatre music, using Erkki Kurenniemi´s computer technology.[2]

The next phase included testing how satellite communication systems and strategies could affect different types of culture. This was done with actors first interacting ordinarily in a studio, then divided between two sites/studios and interacting via a network, and finally interacting with net/satellite delays between different sites. The first set of experiments included a classical chamber music quartet in the Western art music tradition. In the second set, a jazz quartet. To extend the scope and incorporate studies of the global reach of satellite systems, a third set of experiments included a group of Jamaican musicians, conducted in 1978.

[1] MediaCulture, (later with the present Knowledge Channel (research broadcasting on the Norwegian National Television, NRK)), has been the basis for practical experimentation, research, and art workshops with new communication technologies in Norway and abroad, since the 1970s.

[2] Stina Høgkvist, *Synesthesia*, (On Arild Boman´s applications of Erkki Kurenniemi´s DIMI-computers in VR). Published for the exhibition of experiments in *I Wish This Was A Song: Music in Contemporary Art*, the National Museum of Art, Oslo 2012/13. p. 158-163.

Analyses of the first recorded material, (Satellite Music Interaction I),[3] showed that different approaches were taken by actors, like: 1) ignoring the system or 2) attempting to change it, 3) identifying/utilizing net/satellite delays as ´systemic rhythms´, or 4) ´drowning´ delays in arrays of actions, - 5) repression ("Forget the satellite, just play!"), or paralysis (no playing). A set of such strategies for interaction via satellite was identified, applicable for example in net-based composition and performance of music, (but even to visual art, dance, social ceremonies, demonstrations, etc.)

Results Such strategies were found to be differently distributed among the music types: Playing traditional Western classical music even crashed, despite the musicians´ ingenious attempts at finding strategies. Jazz musicians were found to manage delays by strategies like ´drowning the system´ in added complex rhythms, or by identifying and playing into ´systemic rhythms´. The Jamaican musicians were able to play even with changes of the system.

Here it is to be noted that the signal transport in satellite systems were changed from ´1-jump´ to ´2-jumps´, thus increasing the delays. From the intense attempts to reduce signal delays in games, financial-, military communication, etc. (limited of course by the speed of light), one should believe that reducing delay time would reduce musical problems. And that ´1-jump´ should be preferable for actors. But contrarily, the Jamaican musicians reported that ´2-jumps´, (which in principle may reach the entire planet), was best for their playing. These musicians thus found a ´really global´, but slower system to be the most suitable for their interaction.

Non-Western cultural elements and forms here were more compatible with advanced net/satellite technology than the classical Western cultures, that had created that technology. This indicates that possible ´holes´ in theories of an irresistible, Western, media-based cultural imperialism can be found.

In 1998, a 3-way Oslo-Helsinki-Warzaw Internet-concert was produced in order to explore how pre-composed, distributed and live collaborative performance could create meaningful musical outcomes. The presented works included experimentation in sonic, visual, and kinetic expressions.[4] The projects have proceeded in studying aspects and impacts of satellite/net systems. In these experiments, communication technologies have been found to present challenges for timing and temporality, as well as for the dynamics of freedom/tolerance of entropy in musical interaction.

Net/satellite communication has grown immensely, like in the 2020s´ pandemic blasts of digitalization of work, education, and culture. It has taken many, even problematic forms, like various types of simulations of direct, immediate sharing via net, in experimentation as well as in mass media productions. Patterns of net-music with musicians or audiences left in ´monadic´ (not shared) positions by net/satellite systems may for instance lead to hierarchies: - As where outcomes of interaction are only ´correct´ or meaningful in central/´frontstage´ sites; - Or by approaches where musicians/actors practically and/or theoretically are split into 'master' and ´slave´ positions that provide mere ´raw materials´ to a meaning not shared.

Conclusion and future work Advanced communication systems are drivers and instrumental in local and global processes. But they also lead to communicative inconsistencies/antinomies that may have social, economic and cultural implications. Amidst systems providing promises for human unification lie even sources of ex-communication of humans, as in the example of Western chamber musicians. In our presented musical studies, the outcomes have been found to relate to basic types of temporality and dynamics, here in musical genres or forms.

The challenge for critical, empirical research thus goes beyond exposing technologically based pseudo-communication and possible hierarchical aspects of net communication. It is also necessary to explore the possibilities and constitutions of new musical elements and forms, facing even antinomic conditions of human communication. Two basic questions: What kinds of sharing are possible in net-based communication? Which cultural elements and forms may cope with the antinomies of net communication? This is a work that cannot be shut off from music and cultural practice. The projects discussed in this article indicate that music might be useful in extending our understanding of this question, even beyond the realm of music itself.

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[3] Arild Boman, *Satellite Music Interaction I*, (1973), Institute for Social Research, Department of Sociology, University of Oslo.
[4] WHO – HOW – WOH? Performances of music and digital visual art was exchanged in real time between Oslo, Helsinki and Warzaw. The Norwegian location was at MediaCulture/Knowledge Channel studio, University of Oslo. (http://joranrudi.no/warsaw/)

Repurposed Items as Nonhuman Actors: Towards a Relationally-Defined Organology

Dylan Burchett (Louisiana State University)

The use of repurposed items in performances of technology-based music has long presented the Western musical tradition with issues concerning their definitions, classifications, and practices, largely due to the ways by which their fluxional natures and identities evade traditional methods of organological classification. Recent performances that contribute to the blurring of these lines have been seen in the work of Rie Nakajima, Ryoko Akama, and Choi Joonyong, among others, as the repurposed items they use do not fit easily into current "instrument" definitions due to the prior and current lives these seemingly autonomous items appear to contain. In many cases the items used in these performances are referred to as found, a term that feels reductive in its assessment of a repurposed item's lifespan and fails to account for the object's ability to both act and react within a performance setting.

Adherence to the term found in current perspectives in technology-based music appears to be at the service of traditional methods of organological classification that maintain the subject-object relationships expected of established musical performance styles. The subject-object relationships of established musical performance styles, which hold subject and object as discreet, separate entities that either act as subject or are acted upon or through as object, are ill-suited for discussing performances involving repurposed items as they ignore the greater interactive, contextual, and environmental factors in which subject-object interactions exist. In order to reassess current views on repurposed items in technology-based music, an an expanded perspective that reconsiders the aforementioned distance between subject and object is needed.

Drawing from art critic Michael Fried's framing of Donald Judd's sculptural work as theatrical, this sense of distance between a repurposed item and its beholder can be reimagined as a projection of presence from the repurposed item, one that includes the spectator and their mutual experience of context and duration in a site of performance. By including the spectator in its projection of presence, a repurposed item no longer contains its own singular presence as expressed by its medium, and instead functions as a nonhuman actor within a space alongside the human performer that perceives it, in effect becoming theatrical. By taking this perspective, the theatrical nature of repurposed items is therefore at odds with traditional methods of organological classification because performers act with these items, not upon or through these items, due to their inclusion alongside other spectators in the projection of the item's presence.

This projection of presence from a repurposed item also calls attention to the item's the perceptible prior lives external to its current functions within a site of performance. These perceptible prior lives and trajectories are evidence of the item's autonomy, signaled by guiding moments of engagement with the performer. In these moments, the sense of distance that contributes to the theatricality of these items is no longer a product of a one-way gaze, in which the performer is contained within the presence of an object that cannot return their watchful eye. Instead, as understood through Bertolt Brecht's concept of *Distanzierung,* which refers to the self-consciousness manifested in an audience member through an actor's acknowledgement of their breaking of the fourth wall in a theatrical production, this sense of distance can be understood as a two-way gaze born of ensnarement within the interactive forces of human and nonhuman actors that arise from mutual existence within a moment.

By considering how a repurposed item's ability as a nonhuman actor to return our gaze informs its autonomy, a new relationally-defined organology is required to map the network of a repurposed item's constitutive elements and trajectories between sites of performance. Such elements include a repurposed item's material qualities and trajectories, internal and external performance contexts and narratives, and ability to effect and be altered by on other human and nonhuman actors. An relationally-defined organology would refrain from defining nonhuman and human actors by their static qualities and productive capacities, but would instead seek to understand them through the potential meanings they stand to enact as momentary assemblages of characters that both act and react to the theatrical narratives, settings, and stagings that unfold in sites of performance.

Max - Expansion From a Programming Paradigm to a Distributed Lab

Jaehoon Choi (Rensselaer Polytechnic Institute)

Since the 1950s, computer programming languages for musical practices have emerged due to particularities in music, especially time, which is different from typical general purpose programming languages.[5] Each music programming language has different features and philosophy, and the development of these technologies contributed immensely to the artistic progress of computer music.[6] However, simply focusing on the technical side does not reveal the full picture of technology-based practice in music. The process of technological development often involves non-technical elements such as "economic, political, ideological, or cultural grounds,"[7] and it's crucial to incorporate those to fully understand the influence of music-specific programming languages. In this regard, this paper will focus on Max/MSP and Pure Data(Pd), one of the most popular computer music programming languages,[8] as a case study and will attempt to reveal their broader aesthetic impact by analyzing their history and design characteristics in an interdisciplinary approach.

Max/MSP and Pure Data(Pd), originally developed by Miller Puckette in the 1980s, share a common paradigm that Puckette refers to as "Max."[9] Following Puckette's designation, Max is coded by positioning rectangular objects in various location.[10] Each object has unique functionality and inlet/outlet numbers, and the user connects these objects with patchcords which represents the flow of data and signal.[11] The fundamental design goal of Max is to schedule realtime tasks and manage communication between them,[12] which was an unique approach compared to other music software programs that focused on creating a "sequence of actions."[13] This feature enabled users to experiment with automated musical system and interaction.[14]

This paper will show how Max has expanded from a programming paradigm to a distributed discourse of knowledge production and aesthetic implementation. This discourse will be termed as a lab, where the concept of lab is treated as a dynamic discourse, serving "as a kind of pragmatic persuasion, ordering, and organization of material and discursive regimes, invoking an entire network of power relations that determine what is and is not possible to say or do within a space designated as a lab."[15] This has been possible because of the design principle of Max, which resembles the notion of the "Open Work",[16] a concept coined by Umberto Eco and later applied to digital content by Alan Blackwell.[17] A subsequent developer of Max extended this notion of the "Open Work" to the ways in which the paradigm offers various layers of "incompleteness"[18] with differential affordances to contributing users.[19]

Max is designed to be simple and hierarchy-less by eliminating scopes/namespaces, excluding any type of linear control flow to prevent unnecessary complexity, and starting with a blank page when it's opened to minimize the introduction of any musical and stylistic bias.[20] Also, it provides different layers for users to participate in, ranging from end-users who will mainly utilize the visual programming environment to engineers who will create custom externals through the C/C++ software development kit(SDK) and also for users in between through tools like gen~. As the "computer-aided ethnography" work by Nicolas Ducheneaut shows, creating social engagement between incoming users and the software community is crucial for the project to be sustainable,[21] and Max's software architecture affords engagements to a wide user base that makes this possible.

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[5] Roger B Dannenberg, "Languages for computer music," Frontiers in Digital Humanities 5 (2018): 3.
[6] Victor Lazzarini, "The development of computer music programming systems," Journal of New Music Research 42, no. 1 (2013): 97.
[7] Matti Tedre and Ron Eglash, "Ethnocomputing," in Software studies: A lexicon, ed. Matthew Fuller (MIT Press, 2008), 97.
[8] Ge Wang, "A history of programming and music.," in Cambridge Companion to Electronic Music, ed. Nick Collins and Julio D'escrivan (Cambridge University Press, 2008), 8.
[9] Miller Puckette, "Max at seventeen," Computer Music Journal 26, no. 4 (2002): 1.
[10] Gregory Burlet and Abram Hindle, "An empirical study of end-user programmers in the computer music community," in 2015 IEEE/ACM 12th Working Conference on Mining Software Repositories (IEEE, 2015), 1.
[11] Burlet and Hindle, 1.
[12] Puckette, "Max at seventeen."
[13] Puckette, 32.
[14] David Zicarelli, "How I learned to love a program that does nothing," Computer Music Journal 26, no. 4 (2002): 44–45.
[15] Lori Emerson, Jussi Parikka, and Darren Wershler, The Lab Book. Situated Practices in Media Studies (University of Minnesota Press, 2021), https://manifold.umn.edu/projects/the-lab-book.
[16] Umberto Eco, "The OpenWork," chap. Openness, information, communication (Harvard University Press, 1989).
[17] Alan F Blackwell, "What Does Digital Content Mean? Umberto Eco and The Open Work," in Critical theory and interaction design, ed. Jeffrey Bardzell, Shaowen Bardzell, and Mark A Blythe (MIT Press, 2018).
[18] Zicarelli, "How I learned to love a program that does nothing," 45.
[19] Zicarelli called this the hierarchy of incompleteness in his publication.
[20] Puckette, "Max at seventeen."
[21] Nicolas Ducheneaut, "Socialization in an open source software community: A sociotechnical analysis," Computer Supported Cooperative Work (CSCW) 14, no. 4 (2005): 323–368.

In light of its current functioning as a "distributed lab,"[22] it is revealing that Puckette's initial motive was not to create a visual programming software but rather to make a realtime scheduler, saying that he "was thinking in a very formal computer science kind of way."[23] In this paper, I will show how this abstract, computer science based idea originated in Puckette's experience at IRCAM, a Paris-based research center founded in 1977 by the French Government to spreadhead musical research through computing and acoustics. Contrasting to the current distributed lab paradigm, Max initially was a solution to the realtime interaction musical objectives of a single lead user,[24] Philippe Manoury,[25] arising from the unique problematics of a unique one-of-kind signal processing computer, the 4X. This research will expose the social and dynamics of IRCAM during the 1980s, with analysis drawing on recent scholarship in Software Studies.[26] These elements are not independent but rather entangled, and this research will attempt to reveal its complex interrelations. Some of them include the common interest in realtime from both Puckette and IRCAM,[27] Puckette's close collaboration with Philippe Manoury as a lead user,[28] the strict division between the composer and musical assistant at IRCAM,[29] the opaqueness/oral culture/lack of documentation at IRCAM,[30] and the significance of the 4X machine during the 1980s.[31]

[22] Emerson, Parikka, and Wershler, The Lab Book. Situated Practices in Media Studies.
[23] Darwin Growse and Miller Puckette, "Podcast 090: Miller Puckette," Youtube, Online; accessed January-2022, 2017, https://youtu.be/cqQ8hY9QHkM.
[24] Eric Von Hippel, "Lead users: a source of novel product concepts," Management science 32, no. 7 (1986): 791–805.
[25] Puckette said in his interview with Darwin Growse in 2017 about his collaboration with Philippe Manoury as follows.
[26] Matthew Fuller et al., Software studies: A lexicon (MIT Press, 2008).
[27] Tod Machover, "A view of music at IRCAM," Contemporary Music Review 1, no. 1 (1984): 9.
[28] Von Hippel, "Lead users: a source of novel product concepts."
[29] Laura Zattra, "Collaborating on composition: The role of the musical assistant at IRCAM, CCRMA and CSC," in Live Electronic Music (Routledge, 2017), 59–80.
[30] Georgina Born, "(Im) materiality and sociality: the dynamics of intellectual property in a computer software research culture," Social Anthropology 4, no. 2 (1996): 101–116; Georgina Born, "Computer software as a medium: Textuality, orality and sociality in an artificial intelligence research culture," Rethinking visual anthropology, 1997, 139–69.
[31] Growse and Puckette, "Podcast 090: Miller Puckette"; Nigel Osborne, ed., "Musical Thought at IRCAM," Contemporary Music Review 1, no. 1 (1984).

Reconnections: Electroacoustic Music & Modular Synthesis Revival

Neil O Connor (University of Limerick)

For many electroacoustic music composers, focus is more directed toward both timbral and textural approaches rather than pitch centric domain processes. Further to this, both physicality and connectivity, through the use of hardware devices, is another current technique. Traditional protocols such as MIDI and programmable synthesizers provide a somewhat restricted timbral exploration of sound. Musical devices, such as a modular synthesizer, can allow for more interaction and often produce a more unrestrained sense of sonic exploration, creative platform and extension of compositional thinking.

This paper examines a 'reconnection' to past compositional approaches with the aim of making them relevant again today. These processes are applied in my own work and mediated through the use of a Make Noise Shared System Plus Modular Synthesizer. In particular, a focus on the module, Morphagene, is discussed, a module largely modelled on the Phonogene (1954), a multi-headed tape instrument, used by Pierre Schaeffer and Iannis Xenakis at Radio France (GRM). Developed alongside engineer Jacques Poullin, the Phonogène, allowed the user to control the speed of playback of a magnetic tape in accordance with the twelve semitones of the tempered scale. As sound manipulation practices began to change, through the use of Vari-Speed and Time Lag Accumulation. Further to this, created in 1954, the Morphophone allowed a delay effect to be applied to the sound signal. Also using magnetic tape as a medium, its twelve play heads enable the same sound to be replayed simultaneously but with a delay to produce an echo effect, while also varying the dynamics and timbre of the sound. Both these machines helped future directions for both Schaeffer and other composers working at GRM.

Modular systems that were developed during the 1960-70s were built to explore the possibilities of electronically generated sound and as the technology used at the time was basic, its resultats tone was similar. The development hardware emulations such as of Make Noises Morphagene reconsider and link composers with the spirit of electroacoustic music making, returning to more physical and interactive compositional and synthesis approaches.

This resurgence poses many questions; what has this reimagining of compositional processes made in the language of electroacoustic music making? There are many answers here, one being part of the modular synthesizers power is that it explores the continuum between instrument and object, virtuoso and the naive and secondly, that the machines power of immunity from classification and technological retirement, allows the modular synthesizer to act as conduit of expression for current and future electroacoustic music makers to engage more fluidly with their practice, a process that helps us reframe music of the past.

This paper considers the relevance of this issue both within my own work and as an important area of study by asking if these 'reconnections' to past techniques challenge or complement the established histories of electroacoustic music and to what end will it influence future directions as smaller cottage industry manufacturers use a vast online communities together to explore and develop a ethos of sonic exploration, exploitation and inquiry. Ultimately, it is this form of a communal will and want that will transform and shape the organisation of sound and its compositional implications into the future.

Exploring the mystical origins of Electronic Music

Simon Crab

This paper sets out to challenge the assumption that electronic music and technology-based music originated from 'rationalist' modernist origins and instead posits that it was, on the whole, aligned to what can be described as the irrational current of thought of 19th century Romanticism and Spiritualism. I will argue that the creation of electronic musical instruments and the consequent composition of electronic music corresponded to prevailing perception of the period that new electro-acoustic technologies – the radio, telephone, telegraph etc. – were closely related to the mystical world of 'the ether' – ideas that can be found in the Lebensphilosophie and vitalist philosophy of Ludwig Klages, Henri Bergson and others.

To support this argument I will use examples of electronic music and electronic musical instruments that were produced after the First World War in Germany and France. I will examine specifically Friedrich Trautwein's electronic instrument, the Trautonium (1930) and Paul Hindemith's use of the instrument in Des kleinen Elektromusikers Lieblinge (Hindemith 1930), Jörg Mager's electronic instrument, the Sphärophon (1921) and his ideas of musically led utopian revolution. In France I will use the examples of Maurice Martenot's electronic instrument the Ondes-Martenot (1928) which featured in Olivier Messaien's in his Turangalîla-Symphonie (1946) and Nikolai Obukhov's Croix-Sonore (1926) which became the musical focus of Parisian Rosicrucian ritual and the centrepiece of his magnum opus 'the Book of Life' (1926).

Although capable of creating a wide range of new sounds, expressions, timbres and noises, I will argue that the sonic palette of early electronic instruments were intentionally limited to allow for established Kultur to remain unchallenged. These instruments were instead utilised to provide dramatic, otherworldly atmosphere, imitate existing instruments or exploited for their technological advantages: amplification, affordability, portability and so-on. A prominent example of this tendency was the work of Jörg Mager who in Jan 1929 established the 'Studiengesellschaft für elektro-akustische Musik' in Darmstadt. Here, Mager pursued his obsession with microtonal electronic music alongside experiments with tone colour modulation using low frequency oscillators and white noise.[32] Mager's pioneering work was met with universal disinterest, instead he was persuaded (and financially coerced) to create a 'perfect' organ for use in traditional musical recitals, his sonic experiments relegated to providing bell sounds for Wagner's Parsifal (1930 and 1931) and film sound effects.[33] To underline this process, the type of technology pioneered by Mager was more efficiently applied by his younger ex-assistant, Oskar Vierling in his KdF Grösstonorgel of 1936, a large portable, amplifiable polyphonic electronic organ designed for Nazi party rallies and the performance of aproved German classical music.

Particularly in Germany during the early 20th century – but also to a great extent in France, Great Britain and Russia – the established musical tradition was considered an unchallengeable tradition that evolved under the watchful direction of bourgeois music institutions – a tradition that represented the unique character of the nation state and its historical legitimacy. This tradition was to be protected from the unpredictable forces of commercial musical technologies (gramophone, popular music, radio) and the disruptive sonic potential of new electronic instruments.

This paper will conclude with the argument that modernist thinking only became evident in concrete, electronic and computer music once the prevailing perception of technology shifted from mysticism to become associated with 'rational' modernity through processes of social and industrial rationalisation (Fordism, Taylorism) and a general culture of musical commodification through mass media and mechanical reproduction.

[32] Schenk, Emil. Jörg Mager, dem Deutschen Pionier der Elektro-Musikforschung, Darmstadt 1952, 13.
[33] For example the 1936 film Stärker Paragraphen als directed by Jürgen von Alten with music by Rudolf Perak.

Sketching shifting modalities in contemporary music practices including technology

Rose Dodd (University of Utrecht)

A dichotomy, a separation between electronic and instrumental music categories has endured, dividing these kindred traditions for years. An accepted ideation of aesthetic historiography in both terrains, has reinforced this fixedly binary outlook. Other art forms, - dance, art installation, and theatre began experimenting collaboratively, using both sound worlds, merging them, dissolving, and exploring their distinct qualities.

Tumbling, spat into life, freshly created outlier works shape themselves around a focal gaze which excavates a developing performance space, investigating at the edges of new and expressive practices, anarchic in tone, scrutinising existing codified, normative aesthetic narratives.

The unfolding of a developing catalogue of technology-imbued, and 'other', mis-stepping artworks involving music has been bleeding within and from across other disciplines for a while: works such as: *Black Box Music* (2012) Simon Steen Anderson; Yannis Kyriakides/Keren Levi *Unmute* (2019), Mauricio Kagel *Pas de* cinq (1965)[34]; Philip Venables, Ted Huffman/Andreas Borregaard *My favourite piece is the Goldberg Variations* (2021); Jennifer Walshe/Andreas Borregaard *Self-Care* (2017), for accordion, tape recorder& film[35]; Samuel Beckett's *Rockaby* (1981)[36]; works by Icelandic composers, Katrín Helga Ólafsdóttir's *Runner of the Year* (2019) for runner, timekeeper and ensemble, Beregrún Snæbjörnsdóttir's, *Areolae Undant* (2019), and Sól Ey; and *The Hands. The Double* (2021) by Kristin Ryg Helgebostad, Henrik Hellstenius and Ellen Ugelvik.

Sketching a retrospective and looser re-framing of categorisation, repositioning technology's material use in music, allows for a broader understanding: when including work from other genres, and art disciplines. Increased invigoration in performance practice, traced in these catalogued works, demonstrates that in assimilating other modes of thinking, across performance and technology, an expansive and denser developing re-thinking of historiography is possible. It is already taking place.

An increasingly flexible creative landscape needs to be acknowledged as the new ground zero. In this cultural landscape, the naturalisation of the co-existence of many gazes and the normalisation of agency, are beginning to be accepted as key features.

Welcoming other forms, from outlier tangential corners of *kunst*: a newly sketched re-historiography acknowledges a wider scope of levelling and equalizing inclusivity: a complex, but increasingly more complete idea of canonic formation. Offering more open and neutral framing: inhabiting the black box as a performance space is not only timely, but increasingly in vogue for contemporary *performative* works that are now being created.

Celebrating the morphable space of theatre's black box where difference power dynamics between the stage and auditorium are collapsed[37]: allows for more integral, more intense conceptualisations of artistic experimentation and practice. Meaning collapsed in on itself: outward overlay of historiographic encoding is now derived from multiple framings: cultural, historical, and, geo/technical[38]: and more acutely in focus, is the performativity of self. The relevancy of an archaic pedestal of culture, within which great composers' works have been cultivated, elevated, displayed: the concert hall, is overtime becoming subtly dismantled. Gazing, and regarding the performance space: evaluating and speaking to the *empty space*, is intrinsic to many works of value at this time.

We have broken through the looking glass.
Post-binary, we are now – posthuman.
Posthuman, we *are* the white rabbit falling down the hole – with our own endeavour shaping what the world through the looking glass is becoming.

Scoping this new landscape out is urgent work: as music spontaneously combusts into life within this differently defined space. Peter Brook's *denkpiste* or 'thinking arena,' and his notional *empty space*, seem to both be being conjured and inhabited in current musical endeavour and performative practices.[39] No longer trapped within the

[34] Dodd, R. (2017) Perspectives on the Music of Christopher Fox, p6. Routledge, Ashgate book
[35] Jacobi, F. (2018) Aesthetics of Resistance, p.44 Revolver|SpacePoetry
[36] Dodd, R. (2006) Electroacoustic & Instrumental Music: Composing knowingly, unpublished PhD thesis, p. 29
[37] Nibbelink, L.G. (2020) Nomadic Theatre, Mobilizing Theory and Practice on the European Stage, Methuen, (pp.5, 12, 40, 134)
[38] Braidotti, R. (2019) Posthuman Knowledge, Polity
[39] Nibbelink, L.G. (2020) Nomadic Theatre, Mobilizing Theory and Practice on the European Stage, Methuen, (pp.5, 12, 40, 134)

limits of a binary landscape, increasingly reflexive and thoughtful creative events are happening. Startling transfigurations are taking place.

The expanding fields, practices and histories of technology-based music

Ulf A. S. Holbrook (University of Oslo)
Jøran Rudi (University of Huddersfield)

Creative practice has historically been defined in relation to a given medium, and this has also been the case with technology-based music and art. Today, many of these music technologies are so fully intertwined with practice that we no longer consider them to be technologies. Where does that leave sound-based or technology-based art? What are the characteristics that we should talk about? Are the practices bound up in technological innovations, are they bound to situations and actions, or are they bound to ideas or perceptions? Or to all of these?

This paper seeks to examine the technology-based musical practices which have become prolific since the 1990s. Practices that spring out of, yet diverge from, the historical genres of acousmatic and computer music. The discussions in this paper draw on findings from an ongoing research project focused on technologybased musical practices among Norwegian composers and artists.

The term post-acousmatic (Adkins et al., 2016) attempts to encompass the wide range of new practices that have developed in the wake of acousmatic music, a music which is characterised by the broken link between the heard sound and the sound source. However, the large diversity in artistic aims and practices in technology-based music found today makes it impossible to discuss technology-based music and art within the confines of the history and tradition of acousmatic music. In-depth discussions of specific works or genres will be essential for unwrapping artistic intentions, perceptions, the role of technology, and the artistic results.

Electronic music technology is now in the hands of a record-number of people, and this proliferation has given rise to new socialities around music, where new sonic genres readily mix with other types of media content. Tradition-bound hierarchies of gate keepers are of less importance than previously, and several of the new genres have achieved institutional acceptance and inclusion in museums and festivals. Some practitioners deliberately maintain their independence and remain rebelliously close to what we can loosely label a “new” folk music – developed outside of institutionalised funding structures, and in informal contexts such as artist-run galleries, maker spaces, or club stages.

It is the innovations that follow from the broad migration to digital technology that fuel these developments. The binary mode facilitates flexibility in representation, direct combinations of information from different fields, and the ability to control complex co-variation of arbitrarily combined parameters. In combination with communication media and portable computation devices, new practices result in a range of technical, aesthetic, and social developments around music – interfaces for application of a technicist logic to human experience (Hansen, 2004). The proliferation of media and the dissolution of genre boundaries mirror Rosalind Krauss’ theorising of what had become the expanded field of sculpture, with its steps away from being object-centred and towards land art, installation art, and, later, “media art” (Krauss, 1979).

This expanding field of practice does not merely refer to its own materials or technologies (Waters, 2000) but extends the music and adds social perspectives. This expansion and turn towards an expanded sociality is evident in artists’ selection of sound materials, their processing and interacting with them, or the presentation in contexts that extend their meaning. The essential finding is that new technology-based practices find their meaning in broader contexts that involve composers, musicians, and audiences beyond traditional listening, and that conceptualism plays an important part when moving the music away a focus on medium and material.

Socially engaged art reflects 'an interest in producing effects and affect in the world rather than focusing on the form itself.'[40]

Brenda Hutchinson (The College of San Mateo)

While I do not specifically reference technology-based music as such in this paper, this work evolves directly from my experience recording and interacting with people (mostly strangers) in public space. Furthermore, the presentation of this work relies on dissemination through electronic means. Traditionally, this has meant radio, cassettes, CDs, DVDs, and public performance requiring electronic reproduction. Now Facebook, blogs, and other online portals and archives have joined the ranks of repositories and sharing platforms.

What my paper focuses on then, is the generative raison d'être of the work, and that is fostering and exploring the quality of our connections to one another and the natural world through our relationship with sound and listening.

Like air, one of sound's broadest and most powerful qualities is its availability to everyone in the world. Sound as a physically perceived, vibratory medium offers the potential of a unifying connection among all beings. It is democratization through availability. Listening is the key to this shared awareness and the omnipresence of sound provides a constant opportunity to practice listening for everyone. In her book *Software for People,* Pauline Oliveros elegantly describes the relationship between attention and awareness and their relationship to sound and the self.[41] Using a simple drawing of a circle surrounding a small dot in its center, Oliveros invites one to imagine oneself in the center. The dot represents attention and the circle represents awareness and one is to pay attention to both. She offers this as both a score for performance, and as an explanation for the type of focus required for her Deep Listening practice.[42]

As it currently stands, "Socially Engaged Art" is predominantly an extended practice of visual artists. And though focus on the relational is central to this practice, the production of tangible evidence in the form of an object remains important.[43] The dichotomy of artist/observer, even artist/invited participant, is preserved. Likewise, the traditional model of music-making often maintains a hierarchy of roles and functions, automatically generating notions of one who originates, one who performs, one who receives.

The medium of sound by its very nature dissolves the actual boundaries between sounding and receiving object. The movement of air and the transmission of vibrations over time are invisible, yet directly experienced and unite the vibrating object and vibrating ear, skin, etc. This interdependence dissolves many conceptual boundaries as well.

Experiential practice with the general public through this kind direct mutual engagement with sound and listening emphasizes and naturally creates the conditions for parity among participants as well. This parity of relationship along with the insights gained through this experience is potentially empowering to all participants. The inclusion of non-artists in the creation and production of the work is indispensable. It expands the scope and quality of this type of engagement and critical discussion. It is especially so with respect to idea growth and social change through the promotion of intimacy, personal connection and awareness of our relationship to each other and to the environment.

My proposal is to insert the idea of experiential practice into socially engaged art, defining, and discussing it as it relates to the medium of sound and the development of work through listening. I would like to offer a perspective on interacting with the public (primarily non-artists) in non-gallery or performance venues (i.e. in shared public spaces like parks, streets, and parking lots). These interactions focus on intimate reciprocal engagement through listening and sounding. Through these experiences with the ephemeral, time-based medium of sound, people may understand something about interacting with others that's possible only in this way, leading to previously unconsidered conceptual, aesthetic, and relational possibilities.

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[40] From Nato Thompson's *Living as Form: Socially Engaged Art from 1991-2011* (Cambridge, Massachusetts and London, England: the MIT Press, 2012), p. 32.
[41] Pauline Oliveros. *Software For People*: *Collected Writings 1963-1980 (*Smith Publications, 1983), p. 140.
[42] Pauline Oliveros. *Deep Listening: A Composer's Sound Practice* (Deep Listening Publications: iUniverse Books, 2005) p. xxi.
[43] Nicolas Bourriaud maintains the importance and function of creating objects as part of the artist's function within the context of relational aesthetics. *"The artist's practice, and his behavior as producer, determines the relationship that will be struck up with his work. In other words, what he produces, first and foremost, is relations between people, by way of aesthetic objects."* (from the 2002 English translation of *Relational Aesthetics*, p.42).

Tracing Music Technology to its Interdisciplinary Roots

Joseph Hyde (Bath Spa University)

The history of technology-based music is immeasurably richer and more diverse if one separates it from its 'traditional' context within Western Modernist and Post-Modernist contemporary music. One way to do this is to look at the development of new ideas around sound and music in other artforms and even non-artistic disciplines.

This paper will focus in particular on such developments within an audiovisual context, around the history of what is often termed 'visual music' (broadly speaking, visual or audiovisual art which explores musical ideas or material). It will focus on specific instances where developments in visual music have, perhaps counter-intuitively, prefigured those in more widely-recognised music history, often by decades.

One example of this is a specific instance of visual music known as colour music, which generally involves a model where colours are equated with musical tones. This idea was outlined, startlingly fully-formed, by Newton in his 1704 book 'Opticks', and has been explored by many subsequent artists and inventors. This paper will detail in particular the work of Mary Hallock-Greenewalt, who developed the first electro-mechanical 'colour organ', the *Sarabet*, in the early 1900s. Although this instrument did not produce sound (and was rather designed for what she termed *Nourathar*, adapted from Arabic and meaning 'essence of light'), it pioneered key technologies, many of which she patented, that were later used in electro-mechanical and electronic musical instruments.

The artist Wassily Kandinsky was also interested in colour music, although a close reading of his theories around this reveal his theoretical framework to revolve more around 'tone' than straightforward colour/pitch analogies. This framework was developed in part through extensive correspondence with Arnold Schoenberg, who developed a corresponding musical framework in 'klangfarbenmelodie', which arguably established the blueprint for serialism.

Like many 19th Century artists involved in visual music, Kandinsky was hugely influenced by the Theosophy movement, founded by Helena Blavatsky. A belief embedded in this movement, drastically simplified here and perhaps diluted in much subsequent Spiritualist thinking, is that of vibration being the essence of existence. Two other artists associated with this idea will be discussed in this paper: One is Margaret Hughes Watts, who's late 19th Century invention the Eidophone offered both a sophisticated early form of audio visualisation and a prescient understanding of the spectral qualities of sound. The other is abstract film-maker Oskar Fischinger, who's theosophy-influenced ideas radically and demonstrably influenced the thinking of young composer John Cage.

In the cinematic era, a much more direct relationship between sound and image became possible through the invention of the optical sound track. This was the principle technology used for cinematic sound from the 1920s until the 1970s, and involved sound being encoded onto film as a visual trace. What is interesting about this for the purposes of our discussion is that such traces are to an extent 'human readable', and therefore 'human writable', and perhaps for this reason the optical soundtrack is where the first instances of audio synthesis can be found. From the late 20s, many innovators explored the possibilities of directly inscribing synthetic sound onto film, one of them being Oskar Fischinger. This paper will explore a particularly remarkable history of such work in 20th Century Russia, including examples such as Evgeny Scholpo's *Variophone*, a fully-featured polyphonic synthesiser developed in 1930, and the ANS synthesizer, first conceived by Boris Yankovsky and Evgeny Murzin in the late 30s - which offered a pioneering version of additive synthesis decades before any comparable implementation.

These developments in optical synthesis perhaps reached their apex in the *Oramics* machine developed by British electronic music pioneer Daphne Oram from 1957. This machine was developed at approximately the same time as other early self-contained synthesizers, but offers a much more interesting model. While the instruments developed by Bob Moog et al were arguably constrained by a traditional model based around a chromatic keyboard, Oram's instrument offered a far more radical implementation based around graphic inscription which was years ahead of its time.

What are we conserving? Functional conservation for music technology in museums

Annie Jamieson (National Science and Media Museum)

Electronic musical instruments, and associated audio technology, such as tape recorders, amplifiers, mixers, and speakers, are increasingly common in museum collections but they are often visually impenetrable for general audiences. Increasingly, museums acknowledge that effective and engaging display of such objects needs to move beyond traditional visual display, towards an emphasis on the functional qualities of the instrument: sonic and tactile/haptic aspects, and user interaction. Museums are also encouraging research engagement with their collections, and highlighting the importance of the material aspects of historical objects. Both of these ambitions depend in large part on the function of the object, either as display, or to facilitate understanding of the objects. However, traditional museum conservation practices are concerned not with original function and internal workings but rather with preserving the fabric of the object, and while working objects can be seen in many museums, they remain the exception rather than the rule.

While there exists both expertise and enthusiasm to maintain these objects in working order outside the museum context this is less so within the museum sector, where we have to work under a different set of constraints, especially as an accredited, national museum. Taking all of this into consideration, this paper asks: how can/should we balance maintaining an electronic instrument in working order against preservation concerns in the museum context?

Any attempt to answer this question must begin with a consideration of what it is that we are trying to preserve. What is the 'thing' that we aim to preserve? Can we truly separate the thing from its function? Can an object that was created in order to fulfil a specific function be considered as 'original' or 'authentic' if we have lost the potential for that function? Using examples from the collections of the National Science and Media Museum and drawing on a range of philosophical, STS and museological concepts, including Heideggerian equipmentality, and disruptive conservation, the paper will discuss how an object in a museum collection is currently defined, and how we might best refine the concept of the museum object so as to constitute a holistic entity that incorporates at least the potential to function as an essential element of its being.

This paper will propose the value of an innovative museum-based strategy for the functional preservation of electronic instruments to ensure that these objects retain the potential to operate in the long-term. It will also address some of the challenges to the proposed approach: for example, conservation expertise in functional electronic components and equipment is currently rare; the working life span of electronic components and circuits in a collections context is not well understood; cost issues; safety considerations; how museums might effectively engage the (currently) external expertise necessary for functional conservation programmes. Informed by examples from the audio industry, science museums, and time-based media art conservation, and in collaboration with museum conservators and vintage electronics specialists, the paper explores how we might establish the tailored minimum-maintenance programmes required to conserve the long-term potential for an instrument to operate for research or display purposes.

Convergence Potential in Parallel Praxis: Electroacoustic Music and Sound Design

Andrew Knight Hill (University of Greenwich)

The creative worlds of electroacoustic music and film sound design share common materials and tools yet have largely remained aesthetically isolated. As part of the AHRC funded research project "Audiovisual Space: Recontextualising Sound Image Media", we set out to investigate the potential in fostering exchange in these areas to: challenge theoretical conceptions of audiovisual practice, question the extent to which sound design might be considered a technologically mediated musical practice and interrogate the potential benefits of exchange between Sound Design and Electroacoustic music.

Michel Chion's seminal work Audio-vision (1994) transferred ideas of Musique concrète to the world of film sound, forming part of a growing wave of interest in sound by film studies scholars. Latterly this approach has expanded to more explicitly cite electroacoustic music, as new scholars seek to apply ever wider analytical frameworks of the understanding of film sound (for example Gates & Rudy 2004; Knight-Hill 2019; Kulezic-Wilson 2020). But these approaches remain largely confined to the academic sphere of critical reflection and there has been little transfer or communication in the worlds of practice.

By applying discourse analysis to both individual and group interview conversations we have begun to elaborate insights into the commonalities and differences within practitioners across these established fields including deep held philosophical beliefs. Some of the most striking results have highlighted a series of accepted norms around which the electroacoustic tradition has centred itself and which are commonly accepted as absolutes. These include: artistic individualism and autonomy in acousmatic practices (an active avoidance or negation of collaboration, manifest through the entire process from the original collection of sound materials to the elaboration and development of materials in the studio) an assumed exclusive ownership of creative expression through sound (negation of Sound Design as a valid form of creative sonic expression) and the significance of the western art tradition of the cult of the composer genius.

In colliding these parallel worlds of sound practice, bringing leading practitioners into dialogue around practices and creative approaches, we have held a mirror up to establishment electroacoustic practices and are able to observe the fallibility of certain founding myths and established norms. Beyond simple criticism it is our contention that these insights provide new opportunities to re-evaluate and reflect upon electroacoustic music practices and to question the limits which are conditioned into us. Whether Sound Design practices in film and media can ever be accepted as a form of technology based musical practice remains a decision for the judgement of the wider field, but they offer an opportunity to reflect and question the biases within the canon of technology-based music.

In this paper we will share an overview of our findings, presenting perspectives on praxis and critical reflection upon how the parallel practices of Sound Design and Electroacoustic Music have much to offer one another and how we can build collaborations within contemporary aesthetic and technological environments.

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Networked performance as a space for collective creation and student engagement

Hans Kretz (Stanford University)

My contribution examines the recent history of networked performance, or 'telematics', in light of the multiple possibilities telematics offers for re-evaluating traditional notions of New Music and other repertoires, and potentially, centering marginalised practices as well as contributions to technology and invention more generally by underrepresented artists and technologists in these areas. In this practice-based research presentation, I will also look to my own experience in directing and conducting student ensembles in considering its pedagogical potential.

When the practice of New Music is situated online, networked performance questions the distinction between the processes of writing/composing and improvisation, as the two are often interlinked in telematic performances. More specifically, telematics offers an ideal site for the practice of 'live composition', which dehierarcherises the roles and social distributions often present in the structures of New Music practices. Blurring these roles incites rethinking the notion of the author; but not necessarily, however, in the manner of Foucault or of Barthes of seeing the author as the 'last signifier', which minimises the author's presence, and thus risks further invisibilising underrepresented authors. Rather, by potentially levelling-out the roles of performer, improvisor and composer in the distributed online space, telematics creates a fertile environment for authorial practices to emerge, and thus for musicians with diverse backgrounds and practices to accede to authorship.

Telematic musical performances also bring new reflections on music technology itself, as they call into play questions of the nature of the network as a medium, an 'instrument', or a shared virtual acoustic space, as well as the roles of the participants within it. Making music online with near-zero latency calls for a fundamental rethinking of the potential of music technology to transform musical practice as such. In addition to overcoming, to a great extent, the barriers to synchronous collective music-making posed by the pandemic, and offering a space for the development of new repertoires as described above, it also engenders new opportunities for creating community internationally and presenting live music for international audiences. Reducing latency to near zero, means that these collective musical practices may include a range of genres, ranging from chamber music from the Western classical repertoire to collective improvisation spanning continents.

This presentation will specifically consider the space in which telematic music resonates namely, cyberspace – and the way in which students may be engaged in music-making and student communities may be formed within that space. In this presentation, I will look to my own practice as the director of the Stanford New Ensemble (SNE) as an example of the potential of telematics in academic environment. The SNE has been using JackTrip, a software environment for uncompressed, low-latency networked audio developed at Stanford's Center for Computer Research in Music and Acoustics (CCRMA) since before the pandemic to explore the shared performance spaces and practices telematics affords. Through the use of this environment, the SNE has been able to continue its activities uninterrupted throughout the COVID-19 pandemic. Particularly in light of recent improvements motivated by the demands of the pandemic, platforms such as JackTrip make it possible to create networked conditions far more favourable than those allowed by commercial video platforms generally used for teaching, meeting and personal communication, including for musical instruction: in a near-zero latency, near lossless environment, voices and instruments are both more intelligible and more timbrally rich, such that participants may feel more present and engaged in the online space they share with their musical partners.

As working in any technological environment may potentially be stressful for students – given that they may have vastly varying levels of previous experience in music or other technologies as well as vast differences in their own personal equipment – one key challenge in telematic academic environments is removing as many technological barriers as possible to participation. Through the development of personal JackTrip kits at CCRMA – consisting of Raspberry Pi running JackTrip plus an audio device and microphone – we have been able to provide a practically 'plug-and-play' environment which students can pilot with a clear and intuitive Graphic User Interface (GUI) from either a computer or telephone. Another potential barrier is posed by access to broadband: therefore, we have provided students with the option of performing telematically from either an individual or collective space in the Department of Music, depending on their preferences for COVID mitigation as the pandemic continues. This flexibility, allowing students to potentially participate locally from home, from their home countries, or from spaces on campus, has been vitally important in rendering collective musicmaking as inclusive as possible.

Re-scaling Beethoven: very long, very short

PerMagnus Lindborg (City University of Hong Kong)

The innovation of sound recording and reproduction technologies some 145 years ago spurred composers to imagined and indeed create works of extreme duration: very long– lasting days, years, or more – and conversely, very short– miniatures of a few seconds that nevertheless encapsulate 'large' expressions or denote a corpus of pre-existing music. Comparing Inge's *9 Beet Stretch* from 2002, and a section from Kreidler's *Compression Sound Art* from 2009, this paper reflects upon idea-based sonic art that explores duration. Listening to such works tests Karlheinz Stockhausen's notion of 'unified time structure', as well as Pierre Schaeffer's (1966) definition of a musical object as necessarily having an "overall temporal form" that allows "optimal memorisation"; especially, he claimed it could neither be "too short", nor "too long". In this perspective, we ask: what makes us understand a 'work of music' as a unitary whole? We use five perceptual constructs to discuss how duration affects the ontology of musical works. For very long musical pieces, we posit that the defining concepts are slowness, continuity, and repetition; and for very short pieces, they are recognisability and specificity. In conclusion, we propose that the principle that allows the serendipitous connection between Inge's and Kreidler's works is the overarching concept of iconicity: an extrinsic quality enabled by technologies of appropriation.

Schafer advanced that the 'soundscape of the world' is a "macrocosmic musical composition" (Schafer 1977, p. 5). Ever since there was a listener – a soundscape consists of events heard – the world soundscape has been playing: here, there, and everywhere. If the world can be listened to as music, it is the longest piece that could ever exist; it is continuous, changing, and it exists currently. Stockhausen introduced a "basic concept of a single, unified musical time; conceptual categories, such as color, harmony and rhythm, dynamics, and "form," must be regarded as corresponding to the different components of this unified time…" (Stockhausen & Barkin 1962, p. 42). The unified time structuring of periodicities can be significantly expanded well beyond what is humanly perceivable (Roads 2004, p. 3-6). All acoustic phenomena are integrated, from infinitely long (and old) waves of movement, to infinitesimally short (and fast-lived) physical vibrations that approach the theoretical limits of our current understanding of time and space.

Continuity Any process that is long enough tends to be perceptually broken down into segments. While the sense of hearing is active '24/7' and in the unborn fœtus (e.g. Marx & Nagy 2015), there are psychological constraints to our listening attention – sooner or later, the mind wanders – and a biological limit to staying awake. We can hear when asleep, but not listen. In the context of commercial environments, the *servicescape* (Bitner 1992) is semi-designed, often using *moozak* (Truax 1978-99) that is both an agent and an outcome of "the expanding, nonstop life-world of 'late capitalism'" (Crary 2013). The perspectives of *ubiquity* and *metabole* (Thibaud et al. 1995) give rise to the question of how sound events emerge in the mind of a listener, and how the perception of single events relate to the perception of the soundscape as a whole (Lindborg 2015b).

Slowness Not all works of long durations of listening (and viewing) contain slow music but most do. Leif Inge's *9 Beet Stretch* has a duration of exactly 24 hours. The technique of granular synthesis, with grain size and density carefully adjusted to the character of the music in different parts of the source recording - Beethoven's *Ninth Symphony* - that "maintains all the pitches of the original". Continuous minimally transformed interpolations of the original audio material effectively creates novelty: a slow, stretched-out, and original work of music.

Repetition Working with turntables and records, Pierre Schaeffer exploited the "infinite repeatability of the fragment", forcing himself to distinguish the sound as an object of perception, separated from its physical-material cause. Through repetition, there is no longer event, but music. Linking repetition with (sonic) continuity, it seems that a truly long piece of music must be continuous in the sense that there are no segments of non-activity.

Recognisability Musical miniatures were popular among classical composers. Beethoven's "Bagatellen" were perhaps exceptional in that they did not rely so much on inherited schemes (often popular dances and ditties), but rather became informal experiments in musical form. Johannes Kreidler (2009) proposed a 'near-vertical music', including the "Complete Beethoven symphonies, played in one second". At the very end of the second, we might grasp the distinct sound of voices, emanating from a lossy compression of Beethoven's *Ninth Symphony*. It explores the borderline between recognisability and machine-art.

Specificity It is possible to increase the lossy compression of data so that eventually, when it is extremes, the perceptual linkage between input and output is severed. Kreidler's 'compression art' balances at the edge of recognisability in order to remain specifically connected with the original. But the problem of specificity reappears also at the other end of extreme duration. As the musical structures of a piece of music are drawn out in time, their specificity decreases, until the relevant connotation disappears entirely. However, through this process, other qualities are gained, or rather: they are gradually revealed. Rehding (2015) writes: "as the tempo of the music

slows down, the previously inaudible dissonances automatically move to the center of our attention. The liminal deceleration of the music cannot help but bring the details into focus." However, Schafer's 'universal soundscape composition' cannot represent anything but itself.

After having considered, albeit briefly, the essential aspects of long and short music, I will make three claims. Firstly, that Inge's *9 Beet Stretch* is not a piece of "24/7" music, as has been claimed by Dittrich (2017). Secondly, that Kreidler's *Compression Sound Art*, specifically the 'Beethoven symphonies in one second', deals not with compression but with lossy compression – an important distinction. Thirdly, a listening-based understanding of these works depends crucially on the cultural status of the source material.

The slow music of *9 Beet Stretch* manages to establish itself as a piece with an identity, exactly because it relies on a well-establish cultural icon. The listener is drawn into the materiality of the orchestra and the voice - an imagined reality of the trace of something that *did* exist. If it is true that "plundered sound carries, above all, the unique ability not just to refer but to be; it offers not just a new means but a new meaning" (Cutler 2016), it means that when we listen to *9 Beet Stretch*, we listen, in fact, to three things at once: firstly, Beethoven, as a cultural artefact, in the semantic listening mode; secondly, the sounds themselves, in the reduced listening mode; and thirdly, audio stretching in and of itself, in the causal listening mode (cf. Lindborg 2019). By definition, derivative works only exist as extensions of previously created works, and their force of artistic novelty (if any), depends on their ability to retain a cultural connection with the original, evident in Kreidler's collection of 'compressed cultural icons'. While these are bursts of musical humour, Inge's piece draws the audience into an embodied mode of listening, offering an approach to the transcendental.

Toward a Civil Engineering of Music: A media-archaeological approach in the development of *mimium*, the programming language for music

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This research study follows a media-archaeological approach in the process of engineering-oriented tool making for music, through the development of “mimium,” the programming language for music (PLfM).

mimium is designed as a general-purpose functional language with a set of minimal additional features for musical purposes (Matsuura and Jo, 2021).

The authors developed mimium not in pursuit of a new musical expression, but rather as a method to explore how a PLfM tool gives constraint of expression to a culture. Originally, mimium aimed to incorporate a few specific musical styles (e.g., twelve-tone, or gridded rhythms) into its language specification.

However, such specifications resulted in the music-related aspects disappearing from its implementation process and it became difficult to make the claim of a “unique tool for music.”

Nevertheless, the authors do not consider this activity as a failure and would like to highlight the need for a different form of participation in music using technology by re-visiting the history of the relationship between computer and sound in a broad sense.

Computer technology has not always been applied to music. Rather, sound-related technology has had a major influence on the development of computers.

In the late 1950s, Mathews developed the MUSIC series, the earliest computer music software. However, attempts to generate sound with a computer had been made in the early 1950s. At that time, engineers used a speaker to listen to binary signals for debugging (Miyazaki, 2012). Then, they exploited them to acquire melody by manipulating the frequency of these signals.

Significantly, early computers themselves were structured on sound engineering techniques. An acoustic delay memory, one of the earliest memory apparatuses, stored data as acoustic pulses. John Presper Eckert, who developed this apparatus, also developed the earliest electronic computer, ENIAC. Growing up as a sound engineering hobbyist led him to use acoustic techniques to create the structure of the earliest computer (Eckstein, 1994).

ENIAC might not have existed without Eckert's background in tinkering, even if the machine was for used calculating a trajectory of artilleries.

Conversely, there are cases where the development of computer-music technology has lost sight of its original purpose because of a highly specialized division of labor. Miller Puckette, Max, and Pure Data (Pd)’s developer, utilized certain keywords such as "bang" and "trigger" to suggest a strong relationship between the military and music technology because military funds funded many early research on computer music, around 1960s (Puckette and Reese, 2020). Puckette also implied that the layered ecosystem in Max and Pure data (users, program developers, and the developers of libraries/objects) directly came from the division of labor (“the collaboration between specialists”) in IRCAM, the most known research institute of the computer music.

Max, the most popular sound programming environment today, was initially made for the IRCAM 4X, the first workstation that realized variable DSP in real-time in the 1980s. The workstation is remarkable in the history of computer music. However, the anthropologist Born has depicted 4X as the symbol of contradiction at IRCAM (Born, 1995).

In the 1980s, IRCAM focused on developing extremely basic technology, such as high-speed workstations that operate in real time, while Mathews focused on interface development during the same period, and musicians were not involved in the development process. As a result, they failed to commercialize 4X, except for the military use of acoustic simulation owing to Sogitec’s primary business, a partner company that owned its hardware production.

Currently, mimium is not an immediately useful tool for music production. However, today it is no longer possible to create or listen to music without any computer involvement. Therefore, designing a PLfM is useful for

examining the effects of technologies that are not directly designed for music. It is also beneficial as a historical research tool because it can provide the tool maker’s unique perspective.

Such an approach would be called "Civil Engineering of Music" in that it sheds light on an infrastructure that is usually invisible and introduces a perspective that differs from the existing professional division of labor.

Women in Spatial Sound – Working with the IKO Loudspeaker

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Brona Martin (University of Greenwich)
Emma Margetson (University of Greenwich)
Nikki Sheth (University of Greenwich)

Compositional practices in technology-based music can involve working in isolation, producing singular claims to knowledge, adhering to established conventions and encountering restricted access to infrastructure. These practices are gendered (Dobson, 2018; Smith, Choueiti, & Pieper, 2018) and technology has exacerbated such imbalances (Born & Devine, 2015). Commonly, women are fetishised as lone outsider composers, exceptional outliers (Rogers, 2016) which is reductive and risks objectification through the male gaze and the lens of commodification (Morgan 2016, 2017).

When women work with spatial sound, socially-mediated practices and knowledge-sharing can arise. With the novel IKO loudspeaker, there is also freedom from precedent. Though spatial sound has been developed within the patriarchy, it contains potent opportunities to redress notions of assumed techno-neutrality, genderless objectivity and sonic essentialism, prevalent within related communities. Spatial sound composition requires the situatedness which can counter subject-object binaries (Goh, 2017) and reflect a safe space, not one of solitude but of relationality. Such conditions are being facilitated by a collective of women (composers and sound artists – Angela McArthur, Brona Martin, Emma Margetson and Nikki Sheth) who work with spatial sound, and are currently composing with the IKO loudspeaker, within the SOUND/IMAGE Research Group at the University of Greenwich. By taking the loudspeaker into diverse settings, and through an inherently feminist perspective, marginalised communities are explicitly considered (Swords, 2017).

Through mutual support, transparency in process and role-modelling for others, they are redefining what it means to compose, as well as where this happens, and who future audiences and composers may be. The synergies of this moment in time, are exciting, and new. Though many networks and resources for womxn exist (female:pressure[44], Her Noise archive[45], Sound Women Network[46], Omnii[47], Normal Not Novelty[48], WISWOS[49], Many Many Women[50], and others) the practicing collective in spatial sound is notable in its absence (Nuts and Bolts[51] have created some spatial sound-specific resources).

This paper contends that group settings are a vital and revitalising aspect of how women work. The IKO icosahedral loudspeaker plays a role with its uniqueness, its sound reproduction, and its portability. The IKO also demands a relinquishment of control. Women are well suited to deal with these aspects of composition and reproduction, having been historically disempowered.

The authors experience feedback and knowledge as relational. They understand the illusory facets of control and don't attempt to have their singular voices heard above those of others. This necessarily provides a safe, fecund environment for plurality. To produce a "*women-only space is to produce that space as separatist and thus as reactive to the dominant male culture*" (Grosz 2010, p.24). Listener diversity benefits from this, and the IKO is particularly helpful in augmenting such plurality. In explorations with the IKO – a new spatial sound instrument - the collective can create and develop new approaches to working, freer of defined histories of practice and determined expectations. These practices create a social, diverse and safe space, for those who may have been underrepresented from compositional or listening spaces. This paper sets out the case for the female collective in spatial sound.

[44] https://www.femalepressure.net/
[45] https://hernoise.org/
[46] https://www.facebook.com/groups/soundwomennetwork/
[47] https://www.omniicollective.com
[48] https://www.facebook.com/groups/1829331857346754/
[49] https://wiswos.com/
[50] https://manymanywomen.com/
[51] https://www.nutsandbolts.space/

Upsetting the controls:
controllerist practice in electroacoustic music performance

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Music has been constantly reinvented by a multitude of inventions. In recent years, digital technologies have given rise to practices that not only break free from traditional canons of musical literacy, but further invite engagement by artists whose predominant expressive medium is other than sound. While avant-garde practitioners and circles of academic research communities have been at the forefront of this progress, emergent practices pertaining to popular music have often been overlooked. Such is the case with controllerism, a practice that emerged from the lineage of Dub mixing and Soundsystem culture (Llera Blanes 2017). As the digital evolution of turntablism, the essence of controllerist practice is evident in most types of contemporary live electronic music practice making use of modern MIDI controller devices. However, the topic is noted for its lack of literature in established journals, with the majority of contributions coming from postgraduate and doctoral researchers (D'Errico 2016) (Llera Blanes 2017), or mentioned in the context of Hip Hop culture and turntablist practice (Baldry 2016) (Campbell 2014). This paper argues that controllerism presents not only a technologically-driven evolution in instrument design, but it furthermore offers an opportunity for generating greater inclusion and transparency in contemporary sonic practices; it achieves these aims by diffusing the necessities for traditional music education and the need for sophisticated yet resource-intensive design of bespoke Digital Music Instruments (Jensenius & Lyons 2017). As a result, controllerism poses as an approachable and affordable entry point for novice practitioners, while simultaneously presenting sufficient breadth of options for real-time sound generation and manipulation. At a time where digital DJ practices are appearing in university curricula and graded examinations (LCM 2020), as well as the evident turn towards decolonising creative technologies (Gaskins 2021) and music education (Galloway 2021) (Castanheira 2020), the cultural background and technical possibilities of controllerism deem the practice as a research interest worthy of further investigation.

This paper aims to examine controllerist practice in the in the context of live electroacoustic performance by analysing its constituent elements, and comparing them with those from the field's established performance practices, namely Live Coding and multichannel diffusion of acousmatic music. A literature review contextualises the origins of controllerism, its key practitioners, as well as mentioning some of the criticisms it has encountered during its development (Van Veen & Attias 2011) (QSU 2013). Following this, the performance aspects that characterise controllerist practice are highlighted, with particular focus on *transparency* and *risk*; the latter describes the inherent risks of both improvisation as well as "playable" systems design that afford spontaneity at the cost of presenting an ideal or "faultless" rendition of a performance. On the other hand, transparency suggests the connections between performer inputs and their musical consequences (Siegel 1998) (Salter 2008), as these can be understood by audiences. The author argues that controllerism includes these aspects to a great degree, which places the practice closer to a traditional or "popular" musical performance when compared with other established performance practices in electroacoustic music. The presentation furthermore poses questions on why controllerism has been largely overlooked as a research topic within the field of technologically facilitated music, despite that the instruments used often intersect those found in practices that have been at the forefront of research topics, with some of the examined causes including issues pertaining around modes of music education, inclusivity and accessibility, as well certain prejudices caused by audiences' unfamiliarity with technology.

An analytical approach to the carefully constructed sound world in Alice Shields' Apocalypse

Treya Nash (Louisiana State University)

Composer, opera singer, and electronic music pioneer, Alice Shields' distinctive electronic operas combine her talents with her long standing relationship work at the Columbia Princeton Electronic Music Center. Her ambitious 1994 opera Apocalypse has never been performed, but a version of the work is available on CD and streaming platforms. Apocalypse is not part of the canon of electronic music. Electronic opera is seldom included in discussions on the development of electronic and electroacoustic music, partly due to lack of documentation. Despite Apocalypse never having been performed live, the CD is an excellent document of a full-length electronic opera.

Composers have been writing electronic opera since the 1950s, beginning in Europe with Pierre Schaeffer and Pierre Henry's ill-received Orphée 53, featuring a concrète tape track with live singers, violin, and harpsichord. Other early electronic operas combined orchestra with tape, using electronic sounds to perform as specific function, such as sound effects in Humphrey Searle's The Diary of a Madman (1958), and the voice of the computer in Karl Birger Blomdahl's Aniara (1959).

In the United States, Robert Ashley was a pioneer in multimedia and TV opera, beginning with That Morning Thing (1967), a work using tape track, chorus, dancers, and keyboard. His desire to reconcile American vernacular speech with the operatic tradition inspired composers of the New York downtown 80s scene like Mikel Rouse and Kyle Gann to write their own electronic operas in disparate idioms.

In the same city, though stylistically removed, Columbia Princeton Electronic Music Center composers forayed into music for drama. In 1966-67, Alice Shields assisted Vladimir Ussachevsky in writing incidental music for Robert Ward's The Crucible - for which Shields used her own voice as musical material - and Marvin Levy's Mourning Becomes Electra. Shields also wrote sound effects and interludes for radio plays and theater. Her contemporary, Pril Smiley, worked on the tape part for Elephant Steps, a radio pop opera.

Shields began writing acoustic operas in 1966, having them workshopped at the Lake George Opera Festival. In 1970, she premiered her first electronic opera, Shaman, a combination of tape track and acoustic instruments. The tape track consisted of nature, voice, and electronic sounds. For her next electronic opera, Mass for the Dead (1992), Shields created a tape track using voice and MIDI-controlled virtual instruments. She continued this approach with Apocalypse, a cross-cultural work for which she devised choreography in classical Indian bharatanatyam style. The main character of Apocalypse, the Woman, goes on a journey of spiritual and sexual awakening, cautioned by the puritanical voices of the chorus.

Shields created Apocalypse at the Columbia Princeton Electronic Music Center, though she was no longer technically working there. While many composers were turning towards the increasingly accessible home studio, Shields held a fondness for the somewhat dated analog machines of the "Classical Studio," preferring their physicality and careful presets to computer work. Shields combined analog processing with virtual instruments, predominantly using synthesized piano, percussion, and sitar sounds. This combination of the processed vocal sounds and virtual instruments creates an intrinsically electronic sound world in Apocalypse. Shields plays with context by creating realistic nature sounds through a combination of nature recordings and her own vocal emulations. These sounds are inextricably linked to their "natural" origin, but Shields processes them in ways that link them to a new, unnatural environment. The gratingly mechanical virtual instruments are used for the more 'traditionally' melodic sections, sometimes alone or as an accompaniment to singing. Operatic singing is the only thing that Apocalypse seems to have in common with traditional opera. The traditional singing is transported to an entirely new soundworld by the analog manipulations and virtual instruments, far removed from electronic operas such as Shaman, which combine a tape track with live instruments.

Though this opera has never been performed, it deserves a wider listenership, due to its unique combination of sounds, the intensity of the drama, and themes of sexual liberation. Apocalypse has been considered from the perspective of its cultural influences, but not from its context in the history of electronic opera, or through musical analysis. In considering its place in electronic opera, the combination of 90s MIDI sounds and vintage analog effects were singular in Shield's time, and will likely never be replicated. Analysis of this work, as well as discussion surrounding other electronic operas of this time period, will help to establish a stronger picture of electronic opera development.

RAISE THE CURTAIN!
A critical perspective on the idea of *Post-Acousmatic*

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Riccardo Ancona (The Institute of Sonology)

The aim of this abstract is to question the notions of 'post-acousmatic' and to suggest some perspectives on the relative debate. Although Adkins, Scott, and Tremblay (2016) attempted to systematise the meaning of the term, critical aspects still remain that in our view should be addressed.

In our perspective, the concepts presented by Adkins, Scott, and Tremblay (2016) rely upon an unsolved element of ambiguity underlying the term 'acousmatic'. This adjective can be applied to a phenomenon, a paradigm, a musical genre, a mode of listening, or a canon; each of the mentioned subjects involves a different nuance. Without trying to propose a univocal understanding of the term, two main interpretations can be addressed: on one side, the acousmatic phenomenon, which is inseparably linked with the unisensory, only-aural condition; on the other, the acousmatic canon, understood as a historically consolidated standardisation of technological practices and aesthetic conceptions about material articulation, syntaxes, form, and spatiality. Given this ambivalence, it becomes problematic to identify which subject of the acousmatic is to be overcome: is it the canon or the mode of presentation? Adkins, Scott, and Tremblay identify this overcoming either as an 'influence, an augmentation, or a critique of it [the acousmatic thinking]' (ibid.), consisting of 'a polyphony of activities which imply a variety of aesthetic or practical relationships with the acousmatic paradigm but are not contained within it' (ibid.). They argue that such a polyphony of activities is supposed to be formed by nodes of divergence from acousmatic music through different conceptions of time, pitch, modes of presentation, aesthetics, or form. However, some considerable musical divergences exist within the boundaries of what is described as acousmatic music: see for instance, the temporal dimensions of some works by Bayle himself during the 70s, Luc Ferrari's use of analogue distortion (Emmerson, 2007, p. 77), or the use of rhythm by Latin-American composers (Blackburn, 2010). Consequently, it remains unclear how the questioning of each of these aspects may be seen as a form of continuity, augmentation, or critique in relation to the acousmatic canon. A further understanding of the historical consolidation of this canon, and the fact that several divergent aesthetics can be traced in what is defined as acousmatic music are relevant subjects of discussion to be clarified before defining nodes of divergence.

Nonetheless, what undoubtedly underlies every connotation of 'acousmatic music' is the centrality of acousmatic listening both in the compositional process and in the reception from the audience. Following this direction, Emmerson (1998) suggested that 'cross-arts work is ideally "post-acousmatic" in the sense of "taking account of and moving beyond" and not necessarily […] "anti-"'. A similar perspective can be found in Cope and Howle (2018) where the authors explore the possibilities of 'electroacoustic movie-making' (ibid.). The authors then pose the following question: 'is there such a thing as post-acousmatic music?' (ibid.). However, both Emmerson and Cope and Howle did not attempt to further investigate this concept.

It seems no connection has been traced between these different standpoints. Our intention is to further research on the concept of post-acousmatic, critically examining existing perspectives. In doing this, we suggest that the post-acousmatic should describe practices in which composers rely on modes of presentations literally breaking the acousmatic condition. In other words, this term should designate contexts in which practitioners present an evident intention to use a wider palette of perceptual approaches, while, at the same time, retaining some relevant connection with strategies and aesthetics clearly traceable to acousmatic music. Despite the fact that according to Emmerson (1998) and Smalley (2007), our perception-cognition relies on trans-modality even in a only-aural context, considerable differences can be traced in the intentions of the composers who consciously decide to make use of the relationships between different layers of perception. Conversely, those artists who intentionally decide to make use of the only-aural media, will generally show different behaviours in terms of compositional strategies and structures. Hence, a post-acousmatic paradigm can be framed as the idea of raising the acousmatic curtain, considerably relating to the different aesthetics and strategies within the acousmatic tradition. Even if, in a strict literal interpretation of this definition, one might include the practice of mixed-media works (instruments and electronics), the general perspective of Adkins et al. suggests that it makes sense to refer to post-acousmatic practices when dealing with nodes of aesthetics that are in a consequential relation with the acousmatic tradition, according to the aforementioned influence, critique, or augmentation.

Lastly, given the problematic approaches outlined in this paper, we would like to encourage a debate with the aim of rethinking and reframing what the term 'acousmatic' exactly designates, and which aesthetics are contained within its paradigm, in order to dissolve any ambiguity in defining what goes beyond it. Consequently, we would like to dissuade from the use of the word 'post-acousmatic' as an established historical label.

Exploring Cultural Diversity in Experimental Sound

Amit D. Patel (University of Greenwich)

Black and South Asian artists are some of the least represented ethnicities within the genre of experimental sound. By experimental sound, we refer to creative practices including computer music, noise, sound art, electroacoustic music, soundscape, and improvisation, which are overwhelmingly dominated by affluent White male practitioners. This leaves very little space for alternative experiences or diverse role models. Indeed, as highlighted by Born and Devine, experimental sound is "a cultural–educational domain that is generally understood as ethnically unmarked or 'non-raced' – as representing the musical-universal, the 'commonality of humanity' in music – [but which] is actually experienced as ethnically White and as linked to an invisible politics of Whiteness" (Born and Devine 2015, 139).

Ethnically diverse artists and their narratives have been excluded from the traditional discourse. Their experiences, therefore, provide a valuable counterpoint to the normalised White majority. This project "*Exploring Cultural Diversity in Experimental Sound*" presents the voices of these diverse and often marginalised practitioners, seeking to celebrate Black and South Asian experimental sound musicians and their underrepresented musical practice, it is important to note that the context of this study is situated in the United Kingdom.

Bringing together a diverse array of international artists and practitioners this project challenges the White norm in the field of Experimental Sound, giving underrepresented voices a chance to express their perspectives and addressing a significant knowledge gap into the field of experimental sound. Our research will build an understanding of the experiences of experimental sound musicians from Black and South Asian backgrounds, building awareness of the existing cultural diversity in electroacoustic music and sound arts, with a bias to help transform and support practitioners across Britain's diverse cultures.

Questions of cultural diversity are almost entirely absent from critical discourse within the experimental sound area, creating a bias of visible Whiteness. This research seeks to challenge institutional Whiteness in Experimental Sound practice and its associated literature. Building understandings from Black and South Asian composers - from their individual and collective experiences – an investigation has begun applying methods of participant observation alongside practice research, as well as in-depth interviews. These interviews have questions focused on three strands biographical backgrounds, musical practice, and their professional careers. Lastly, there will be a notion of bringing the participants together for focus groups where wider issues can be raised discussed and negated collectively. Some findings, for example, but not limited to are the desire for participants to not conform to limited stereotypical assumptions, and there is clear eclecticism and distinctions in their musical tastes and listening habits. A slow analysis of sorts is taking shape, but as we are only half-way through capturing our research data, there is a responsibility to ensure these sensitive experiences and materials are drawn out honestly and naturally.

Latterly, we will develop a report highlighting the challenges inherent for practitioners from diverse cultural backgrounds as they seek to navigate an art form that is institutionally White. This research has potential to make a social and cultural impact, which will help enable diverse communities to play equal roles within contemporary music practice. Whilst increasing diversity in arts, culture and music education that will allow our society to become more enriched, resilient, and supportive towards diverse communities. The research and its outputs will reveal new knowledge that has previously been neglected by academic circles, the research will unpack experiences and practices of diverse underground music that sits outside the traditional experimental and contemporary music scenes, giving voice to diverse composers, which also allows to raise critical awareness of the historical landscape within the field of music technology, re-valuating technology-based music, and its entanglements. This research will unpack how their identities as Black and South Asian artists as well as how their unique experiences are situated in relation to the structural and cultural contexts of experimental sound in the UK.

Issues of Ubimus Archaeology: Creative Processes in Risset's Little Boy

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Damián Keller (Federal University of Acre)
Victor Lazzarini (Maynooth University)

Ubimus archaeology (a-ubimus) targets the study of past musical experiences through the reconstruction of the musical products and the processes required for their deployment. The methods entail understanding the limits of technology of the time and its impact on the ways of music making. In some cases, resources and processes have become conceptually foreign and materially unavailable prompting for the application of new strategies of reconstruction and validation.

The transition that marked the move from the analogue-based practices of the 1950s to the digitally oriented techniques of the 1960s provides an interesting object of study for a-ubimus endeavours (henceforth 50-60 transition). This period is arguably the most influential within the technologically oriented music literature of the 20th century. But it is also among the least explored through evidence-based research. With a few notable exceptions (e.g., James Tenney), the composers of the time have produced a discourse tailored to convince the readers that their aesthetic choices were the best, that the paths laid out by their methods were the most fruitful and that their aesthetic views were "scientific", "visionary" and "unique" (cf. Babbitt 1958, Eimert 1957, Stockhausen 1962, Boulez 1963). Rather than attempting to confirm or refute these claims, our work on archaeological ubimus suggests dealing with the actual sonic products and comparing these outcomes to the results obtained with reconstructed resources.

This paper showcases our current efforts to build a conceptual and methodological framework for archaeological ubimus practice. We provide examples taken from one of the representative documents of the 50-60 transition, namely a section of the Computer Suite for Little Boy by Jean-Claude Risset (1968). We describe the strategies applied to build a working replica of the MUSIC V acoustic compiler, including our discovery of the earliest known version of the source code in the Fonds Jean-Claude Risset (Laboratoire PRISM, UMR 7061, 1968). By sifting through the archives while searching for documentation on the tools used by Risset, we have gathered evidence on his creative choices.

Our MUSIC V-compiler replica was used to synthesise the early sketches of the arpeggiated chord[52] from the Flight and Countdown section, highlighting its harmonic-spectral content. Our example examines the genesis of the feedback amplitude-modulation technique used in Little Boy, featured in item #510 of the Catalogue. We compare our findings with Risset's published version by means of his score annotations and his numerous retrospective accounts of his working processes. Furthermore, we trace the development of the MUSIC V sources from the original Bell Labs version to the transcription done by Bill Schottstaedt at Stanford University. Our target is to reconstruct the entire Little Boy and Mutations scores, involving adjustments of our MUSIC V compiler to synthesise Risset's code. We hope to illuminate the music-making processes independently from the creators' claims.

A-ubimus methods are potentially applicable to the analysis of other MUSIC V projects and related programs, such as MUSIC 360, MUSIC 4BF, or MUSIC 11, highlighting a diversified and idiosyncratic output, from Gerald Strang's Compusition No. 7 to Johantan Harvey's Mortous Plango, Vivos Voco (cf. Lazzarini and Keller 2021 for a general discussion). Due to the temporal proximity, technologically oriented musicology often targets the sound and software products on one side, and the testimonies of its protagonists on the other. Although the work on oral history tends to improve the quality of the extant musical archaeology, it fails to furnish a detailed account of the creative processes. Furthermore, rather than describing the creative procedures from the perspective of the protagonist (see Risset 1996a, 1996b), our reconstruction aims for a broader understanding of the experience of working at the digital and analogue studios during the 50-60 transition. Firmly rooted on a practice-based approach to the digital humanities and grounded on the available documents, scores and sketches, we attempt to contribute to historiographic research by offering conceptual tools to question the interpretations furnished by the early computer-music practitioners.

A critical examination of the earliest creative processes of technologically based music-making might help reshaping our understanding of the 50-60 transition. Rather than approaching Little Boy from a traditional musicological perspective centred on analysis, by means of audio-synthesis replicas we examine how the

[52] Pitch content: g#1, d1, g2, e3, b3, a#4

technological resources and their relationships with current ubimus practices might reactivate their creative potential, hinting at new futures for past musical objects and things (De Assis 2018: 41). Thus, our archeological ubimus endeavours may expand the current musical knowledge and the palette of creative strategies. This expansion is neither obvious nor accurately described in the writings produced during the 50-60 transition by composers and technologists.

Tracing ecosystemic virtuosity in performance of Simon Emmerson's Stringscape (2010) for violin and electronics

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This paper presents a perspective on performance of mixed music[53] for violin which looks away from a violin-centric approach to practice, and proposes a distributed, ecosystemic notion of mixed music virtuosity. In this context, the violin-centric approach is set out to describe 'the hierarchical duality of 'instrument(s) *plus* electronics' and its implicit division of labour' (Scipio 2017, 19). This presentation argues against such approach and supports the position in which the violin acts as but one of the elements of a larger ecosystem (Waters 2007). Examined from a point of view of a classically trained violinist, it will be argued that the performance practice for violin and electronics would benefit from expanding acoustic listening vocabulary and acquiring new skills which are necessary for identifying hidden affordances emerging from the cohesion of acoustic and electronic sound sources. From that perspective, the traditional notion of virtuosity as a 'great technical skill' on an instrument (Collin's dictionary) shifts its meaning from a violin-centric towards a decentralised, distributed notion of music making. Specifically, issues of amplification, sound diffusion and their effect on violin technique and sound production will be discussed in relation to various types of sound processing. Technical solutions enabling a response to alternations in violin sound production afforded by electrification of the acoustic sound, will be presented and showcased on concrete examples from *Stringscape,* and will include issues of intonation, dynamics, timbral variation and articulation. With a reference to Pierre Schaffer's notion of *enlargement* and *centering* (Schaeffer, North and Dack 1966), the role of informed listening will be explored in relation to sound production and specificities of mixed chamber music for violin.

By looking at Simon Emmerson's *Stringscapes* (2010) for violin and live electronics, hidden ecosystemic affordances of the piece will be discussed, and an argument of a wider relevance of the ecosystemic approach to the repertoire will be presented. To making the argument, the discussion is limited to the example of Simon Emmerson's *Stringscape,* however the insights developed through a close study of the composition provide a more comprehensive understanding of the dynamics at play in other works for the setting[54]. Grounded in ecological thinking of James Gibson's (Gibson 1979) and Gregory Bateson's (Bateson 1972), enactivist and embodiment theories of Varela, Thompson and Rosch (1991) and Andy Clark (1998), and ecosystemic approach to music interaction (Waters 2007), Di Scipio (2003), Green (2013), the presented observations are reliant on the performative analysis based on reflection and multi-modal scrutiny of relevant audio and video documentation.

Arguing for a distributed practice, the ecosystemic approach rests on the notion that musicking (Small 1998) is a practice which unfolds though various types of relationships and interdependencies between materials, people, objects, embodiments, and other manifestations. As such, the notion of ecosystemic virtuosity of mixed music for violin being presented as a non-hierarchical, inter-relational practice in which the violin, electronics, and the environment are approached with a sense of continuity and mutual reference. In the course of this presentation the following questions will be posed: what sets mixed music for violin apart from other types of chamber music? Does – and if so, how would ecosystemic approach inform performance of mixed music which is not composed ecosystemically? Finally, what makes a virtuoso ecosystemic practice? With reference to my own practice-led research this presentation will problematise mixed music for violin as an idiosyncratic type of chamber music performance practice.

[53] Music for acoustic instruments with live processing or/and fixed media (Tremblay and Mclaughlin 2009)
[54] The more recent work of following composers might be of interest: Agostino Di Scipio, Natasha Barrett, Malin Bång, Santiago Diez Fisher, Pablo Galaz, Sam Selem, Carola Bauckolt, James Dillon, Kaja Bjørnvedt, and others.

Rethinking Time Keeping Histories:
(Mechanical) Time Grids as Imagined and Social

Marcel Zaes Sagesser (Southern University of Science and Technology Shenzhen)

This paper investigates how the musical technology of time keeping, the *time grid*, has moved from concept to salience with the metronome in the early modern era and with the drum machine and software time grid in the twentieth century. Tracing through this history the sociality and the skill and labor of imagination attached to musical time keeping – and particularly technology-assisted, mechanical time keeping – is the main focus of this paper. Its main argument is that not only is the interplay between technologically created musical time and humanly created musical time fluid am multi-dimensional since it is always negotiated through humans, but also that the keeping of musical tempo, beyond and beneath this false binary, is always social. It is subject to constant negotiation and play among all involved subjects, and it constitutes room for such negotiation and play and therefore for moments of sociality, even – and particularly – if machines are involved.

The discussion of the advent of the metronome shows that while it renders a previously imaginary concept audible, what it ultimately does is enable musicians to practice, perform, and calibrate their performance tempi – it enables them to make music. A key takeaway is therefore that it makes little sense to think in a binary between human-kept and metronome-kept time. What these two versions share, is the simple fact that they enable one or several humans to make music. In extra-machinic musical time practices as much as in machinic musical time practices, one of the major modes of expression lies not in how the tempo is created and maintained, but rather how the musicking subject relates to that main regulating pulse. This relating is the moving from imaginary to actual; a process that involves the human capacity to *imagine. Imagination* plays an important role since it points to the imagined or imaginary parts of tempo-keeping (as a form of musical technologies), such as the mathematical idea of periodicity that informs pulse-based music in performance.

This paper attends to the various forms of sociality as well as imagination that are associated with tempo keeping and time grids. It traces these tropes across various stages of tempo-keeping's mechanization, electrification and digitization in order to understand how sociality and imagination hold different meaning at different times and for different practitioners and communities. The two examples discussed stem from art music (The other's own "#otherbeats," 2020) and popular music (Sly And The Family Stone, 1973). Both examples share that their underlying time keeping remains ambiguous between machinic and human. The analyses help the author formulate some notes toward a theory of sociality of musical tempo-keeping as a way of retroactively rethinking how the history of technology-based music has shaped musical production.

Yet the inquiry in this paper is far from producing a complete historical account of (mechanical) musical time keeping. Rather, it is organized in an ahistorical, nonlinear manner in an attempt to rethink history by way of creating several parallel, alternative narratives rather than a single, universal truth. For what is more, the author suggests using this rethinking of the history of technological time keeping as a way of teaching a new listening modality that attends to the nuances *between* mechanical and human-made musical time; a listening modality that develops alternative possibilities of unconventional art and pop musics, without essentializing mechanical over human time keepers or vice versa. The author in this paper proposes time keeping in music as an ultimately human and social act (done by several humans together, if only at deferred times, with the help of music technologies) – no matter what the devices and technologies involved are. They are made, negotiated, entrained to, danced to, by humans – whether or not the present pulse is metronomic in its nature. That attending to the nuances *between* metronomic and human musical time is important, as it is exactly those *in-betweens* where ideas about rhythm and its socio-cultural backgrounds become audible.

As listeners, when we listen to the music of our past, we must thus attend to the social *in-betweens* of musical time keeping as a way of rehearing and rewriting our histories of technology-assisted musics.

Co-Creative Spaces

Notto J. W. Thelle (Norwegian Academy of Music)
Bernt Isak Wærstad (NUST / Norwegian Academy of Music / University of Oslo)

Co-Creative Spaces is a research project that follows four musicians — Morten Qvenild (NO), Bernt Isak Wærstad (NO), Labdi Ommes (KE) and Gyrid Kaldestad (NO) — through a 6-month long co-creative process resulting in a final concert. The musicians create new music through interactions with each other and with artificial musical agents based on machine learning. The agents are modeled on recordings of the musicians improvising with each other, resulting in a dance of agency (Pickering, 1995) between the musicians and their simulacra.

Our research questions are:

- What happens to musical co-creation when artificial intelligence is included in the creative cycle?
- What kind of cultural biases are inscribed into the technology?
- How can a multicultural musical collaboration identify such biases, and how may they be attenuated?

The project is based on the idea that creativity is emergent in relations—not isolated within humans, but between humans and their sociocultural environment (Csikszentmihalyi, 1996; Simonton, 2003). Creative spaces emerge as ideas come to life through interactions—between musician and instrument; between hand, pencil, and paper; between collaborating humans. To create is to discover the potential these spaces offer and to refine them (Sawyer, 1999). The models created through machine learning may appear as creative agents with varying degrees of autonomy (Kaptelinin & Nardi, 2006). Co-Creative Spaces challenges the notion of musical co-creation as being something that only happens between humans. Humans, instruments, and technology are actors in a co-creative network (Latour, 2005). An iterative process is adopted where artistic and technological requirements mutually inform each other. Musically, a feedback loop is formed where co-performances, the creation of musical material, and its structuring affect each other in a procedural flux. Technological development of the musical agent environment is conducted by the authors in a parallel process to the artistic strand of the project, but informed by musical exploration and discussions with the whole group.

The project began with a one-week workshop in December 2021 and was concluded with a second workshop and a concert in May 2022. We present findings from the transcriptions of a series of focus group conversations recorded during the workshops. This data was analyzed using discourse analysis with a focus on how language conveys the musicians' attitudes to the development of a collaborative work, where technology is considered a co-creative actor. Among the findings is the participants' gradual acceptance of the aesthetics of the artificial agents as a genuine artistic contribution, and that giving more space to this creative agency enhances both the individual performative experience and the combined output. This finding could be tied to Benson's concept of an "other", and that musical dialog only occurs when each partner "*both* holds the others in tension—that is, holds the other accountable—*and* feels the tension of accountability exerted by the other" (Benson, 2003, p. 171). Whereas technologies historically have been viewed as tools for human creativity, this newer perspective puts an onus on the human participants to accept an encounter with technology that, in Gadamer's (1997) words, "breaks into my ego-centeredness and gives me something to understand" (p. 46).

As the musicians come from different parts of the world (Norway and Kenya), we will also elaborate on cultural issues that arose and offer a critical view of the potential biases inscribed into the technology. During the focus group conversations, an awareness developed that both technological and methodological adaptations were necessary to preserve adequately the Kenyan influence in the group. For instance, the software tended to disfavor repetition and rhythmical grooves, which is prevalent in the traditional style of Luo music and other dance-oriented genres. We adjusted the decision-making parameters so that the response system stayed longer in quasi-looping modes. Although this only led to slight changes in the response style, the collective awareness of a cultural bias inscribed in the software led the group to search for methods to circumvent these constraints. For instance, several improvisation sessions were made to revolve around themes led off by the Kenyan member of the collective. This also became a fixed part of the concert performance. Arguably, much more can be done to develop the software to accommodate other musical styles. The focus groups revealed that so-called "free improvisation"—paradoxically—is not so free after all.

Co-Creative Spaces aims to shed light on impending forms of music making that are only just emerging, but which by all accounts will make an impact on future music cultures—artistically, economically, socially, and politically. We have consciously avoided differentiating between composition, improvisation, production, recording, and live performance, but describe the co-creative process of music making in a holistic manner. We believe this view is more coherent with the pre-colonial, pre-institutional past, and also a better fit for the current and future development in music making.

Electroacoustic Composition Process as a Process of Com-position

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This paper proposes an electroacoustic composition practice that understands the process first and foremost within a multivalent network of relations, and is interested in the interface of connections. In pursuit of a practice where the composer is situated as an actor within a network of entangled relations with other agents and acts, I follow feminist, non-anthropocentric, and new materialist strands of thought, exploring topics of multivalence, agentiality[55] and embodiment through situated practices. Within the paper, I focus on these topics through the work of Karen Barad (theoretical physicist and feminist theorist), and Donna Haraway (scientist, philosopher and feminist scholar).

The word composition comes from the Latin *componere,* meaning to put together, to make-with and create a whole from several parts. The prefix *com-* is an archaic version of *con-* in Latin; meaning with, in combination, together. And *-ponere* means to position, to place. In this paper, I use the hyphen in com-position, to highlight and contextualize the act of composition as a relational act, where various components come together to collectively make-with.

Instead of placing the composer at the centre of the composition practice, the paper explores a multivalent com-positional plane where the centre affords to move and shift, either singular or at times shared and plural, but always in flux. The multivalent centre then, encompasses not just the composer, but other humans, more-than-human others[56], and materials, where they are no longer the object of study, but become the generators of negotiation, dialog and information itself.

This paper focuses on two main categories of relations within the electroacoustic com-position practice. 1) Relations between the com-poser and other agents, as well as 2) Relations between the modes of production that are part of the compositional process; which include aural analysis, performance, and evaluation.

Within the first relational category, the paper focuses on two groups of agents: a) Agents within fixed sound recordings, i.e. acousmatic agents. These agents could include a wide variety of living and non-living entities, ranging from animal, plant, environmental sounds. They are tied to bodies, space, time and situation; and b) Material agents,[57] which in this paper, are narrowed down to physical material objects that may range from conventional and non-conventional musical instruments, to everyday objects. In attending to material agent/human relations, I propose adopting a new materialist[58] outlook into musicking[59] practices, where materials are understood as agential, participatory things that carry the capacity to cause changes in our action and engagement with them.

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[55] In this paper agentiality is understood under Karen Barad's "agential realism". In what Barad calls agential realism, matter and discourse are inseparable; they are "intra-active". In the more common term interaction, entities exist before they encounter one another; they maintain a level of independence. In Barad's "intra-action", these entities emerge within their relationship, not outside of it. Barad talks about a mutual entanglement between the observer and the observed, called "phenomenon" in physics. She states (2007) that "A phenomenon is a specific intra-action of an 'object'; and the 'measuring agencies'; the object and the measuring agencies emerge from, rather than precede, the intra-action that produces them" (p. 128). This stance presupposes that these entities come into existence through their ability to act. Agency then, under the light of intra-action becomes a dynamic relation of forces that is not considered as something static, like an individual property (something that can be possessed), but an ongoing series of co-performative actions, situated and emerging from movement and performance. This proposes that being comprises a series of potential energetic forces that are both inherent, and always emerging within the relation of self with self and other.

[56] A term coined by the cultural ecologist and environmental philosopher, David Abraham. Today "more-than-human" points to a post-anthropocentric thinking that recognizes humans are embedded within the biosphere with animals, plants and environmental phenomena. In this paper, the term expresses non-human sounds that are in the environment, which include both living and non-living things.

[57] Material in music making practice can mean many things, ranging from physical objects that could be categorized under conventional and non-conventional musical instruments to digital interfaces, even to the sound file itself, and the list can still go on.

[58] There are various forms of new materialist practices. In my research, I follow feminist new materialist thinkers where, the matter of agency lies at the heart of the practice.

[59] "Musicking" is a term coined by Christopher Small, situating music within a relational and performative stance. The term highlights music as act, rather than a thing. He explains: "The essence of music lies not in musical works but in taking part in performance, in social action. Music is thus not so much a noun as a verb, 'to music'. To music is to take part in any capacity in a musical performance, and the meaning of musicking lies in the relationships that are established between the participants by the performance. Musicking is part of that iconic, gestural process of giving and receiving information about relationships which unites the living world, and it is in fact a ritual by means of which the participants not only learn about, but directly experience, their concepts of how they relate, and how they ought to relate, to other human beings and to the rest of the world" (Small, 2007, p. 9).

These two categories of agents are highlighted in this paper in order to trace an engagement process that diverges from the weighty, historically-conventional understanding of composerhood.[60] Within the bulk of our electroacoustic music discourses, aside from strands of soundscape studies, and other occasional mentions, these two types of agents are particularly described as passive, inert and static things that are to be controlled and manipulated. I ask, what may happen when we move out of this understanding of treating physical objects as well as recorded sounds as things that are passive, but take them in hand as agential forces? What might such understanding do to the human agent and its process of composition? The paper suggests a series of possible perspectives and practices.

The second category of relation in this paper, is more of an exploration of relations of the self with self. This is investigated through switching modalities of production between listening, analysing, performing and evaluating, which are all as part of the compositional act. By articulating and tracing the switch between modalities, the goal is to create an active dialogue between different modes of production. This dialog functions to offset a singular and static centre as it experiments with making/breaking, configuring/re-configuring boundaries and definitions between theories and lived musical experiences as they come into relation with one another. This process entails expressing materialities of music-making in an intimate and hands-on setting; not from a distance questioning what the appearances of things are, and what their relations might be. Instead the com-poser explores what to do with these things, their potentialities, how else might they be interpreted and expressed. This entails a generative process, rather than an illustrative one, which may serve producing new and fresh perspectives for our socio-acoustic practices.

Built within an entangled relational plane of multiple agents and acts, the com-position process offers a practice for learning to live and negotiate in a world of multiplicity and difference. I believe, such practices carry potential for cultivating, caring and thoughtful outputs into the common record of our musicking practices.

[60] In the bulk of our discourses found in the written historiography of music creation, the composer is portrayed as someone who gives life to what wasn't there, someone who controls and manipulates the passive and static sound. The roots of this understanding stems to the 19th century Eurogenetic romantic heritage of the essentialist and genius composer mindset. Since 20th century, numerous approaches have been reconfiguring boundaries of the essentialist composer, and scrambling the previously established vectors of composer, performer, audience.

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