Proceedings of the Electroacoustic Music Studies Network Conference, Florence (Italy), June 20-23, 2018.

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Interdisciplinary Research as Musical Experimentation: A case study in musicianly approaches to sound corpora

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Abstract

Can a commitment to musical pluralism be embedded as a value in musical technologies? This question has come to structure part of our work during the early stages of a five-year project investigating techniques and tools for 'Fluid Corpus Manipulation' (FluCoMa)[1]. In this paper we frame our thinking about this by considering interdisciplinarity in Electroacoustic Music Studies, before proceeding to apply our thoughts on this to our specific project in terms of *practice-led design*. We end with questions as seeds for future discussion, rather than categorical findings.

Introduction

The authors are currently in the early stages of a five-year project concerned with the general topic of making music using collections of recorded sound (corpora, in a broad sense) in creative coding environments (Max, Supercollider, PD). The project aims to animate musical and technical research around this topic by developing new tools and learning resources, and by seeding a community of interest (Fischer 2009), made up of diverse researchers and practitioners. We will develop extensions for creative coding environments that enable techno-fluent musicians to explore and develop new techniques for constructing and manipulating corpora of recordings, and that seek to prioritise divergent, open-ended engagement.

This paper introduces the project to the EMS community, as one constituency we hope to involve, by framing our early work through the lens of musical experimentation. In particular, we consider the project as an interdisciplinary encounter between practice research and technical research that we consider as 'practice-led design'.

Through this discussion, we interrogate the ideas of 'techno-fluency' and 'divergence' more closely to explain how we set out to try and ensure that our ambition to establish a diverse community of interest has factored into our early work. Two core concerns for the team are that we minimise imprinting restrictive musical assumptions on the tools we produce, consciously or otherwise, and that we address barriers to understanding that may deter people from experimenting with apparently complex and unfamiliar algorithms, such as emerging

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techniques in machine learning. Both of these concerns invite us to reflect on the role and nature of disciplines within musical and music-technological practices, and how this might help us conceive a methodology that supports these commitments. We go to on examine the FluCoMa[2] project in greater detail, and explore how its musical ambitions relate to the general outlook we have developed, particularly how we might productively think through concepts like technical fluency and musical experimentation in relation to our aspiring pluralism.

We conclude with questions: as the project and its artefacts take shape, we want, and need, input from communities of practice that might have an interest in the topic of corpus manipulation and in bridging gaps between different musical and technical research communities, and hope to seed an ongoing discussion with the EMS network.

Interdisciplinarity: Practice Research + Technical Research

We regard *FluCoMa* as being interdisciplinary in two interrelated ways. First, the authors, who comprise the main researchers on the project, work within different but overlapping areas; that is, we bring different specialisms, and have tended to publish towards and address different (but overlapping) networks, which in turn mediate the ways in which we approach our research and our musical practices. Second, we assume (or hope) that the activity we wish to animate with this project will attract the input of a wide array of people, well beyond the edges of the networks we already inhabit, and they will bring with them a plurality of ways of doing, conceiving and speaking about music and technology. As such, we see it as crucial early work to think through interdisciplinarity as it applies to this particular project.

It is a commonplace to observe the interdisciplinary nature of scholarship around electroacoustic music or, indeed, musical studies in general (Born 2010; Emmerson 2007). Such is the complexity of music as a domain of human activity that we require methodologies suited to different scales of analysis and modes of understanding to grapple with its various aspects. A prompt for us in considering the question of musical pluralism through the optic of disciplinary commitments comes from Patrick Valiquet's recent essay, that invites us to understand Schaeffer's *Treatise on Musical Objects* (Schaeffer [1966] 2017) as an attempt to develop a pluralist musicology, rather than as a how-to guide for composers (Valiquet 2017).

The *Treatise* starts, of course, with Schaeffer presenting his developing research programme of 'experimental music' in terms of a cross-disciplinary problematic between musicology, acoustics and psychology, and the challenges of unifying what turn out to be very different ways of conceiving of the object of study. Distinct conceptions of what music is, or what sound is, remain an issue today, and a source of dissensus between (and within) the various disciplines that contribute to its study. Currie and Killin (2016) note that within scientific studies of music, different ontologies can be at work, creating an issue of incommensurability. Meanwhile, Georgina Born's argument for a relational musicology hinges on how musicology can come terms with the immanence of the social in music, in the face of the work of ethnomusicologists, popular music scholars, sociologists and anthropologists (Born 2010).

Simon Waters, meanwhile, asked a similar question of EMS, noting our collective tendency to focus more on the technicalities of our work than on the social and cultural places our practice inhabits (Waters 2007). Extending this, one of the authors has suggested that practice research in electroacoustic music (and music technology more generally) is well placed to complement and challenge more orthodox engineering research precisely by embracing the lived and

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[2] http://www.flucoma.org

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situated entanglement of technologies and people (Green 2014). But on what basis? For Schaeffer, the answer seemed to lie in attempting a synthesis of the viewpoints he attributed to his disciplines of interest (Schaeffer [1966] 2017, 13), resting on a universalised model of aesthetic perception (Valiquet 2018).

Such a synthesis seems less tenable today. As Carola Boehm notes, music technology is an area marked more by disciplinary fragmentation than integration, and argues that the term 'has perceptually different and shifting meanings, depending on the context in which it is being used' (Boehm 2007, 7). Deploying the same words to designate different things, without acknowledging those differences will not produce a viable synthesis, so much as groups of people talking past one another. Furthermore, hoping for a synthesis would presume that there are stable and knowable ontologies that we could associate with a given discipline in first place, and that they could even be combined, and – in our case – that we know in advance all the ideas that as yet unknown people may bring. Finally, and crucially, as Andrew Barry and Georgina Born note in their wide-ranging survey of contemporary interdisciplinary practice, this 'integrative-synthetic' mode of interdisciplinarity is unlikely to produce novel understandings in practice (Barry and Born 2013).

Another mode that is unlikely to be fruitful for this project is what Barry and Born call 'subordination-service': traditional divisions of labour are persevered and, again, it is unlikely that new understandings emerge. Barry and Born note that this can go both ways in encounters between the arts and sciences, pointing both at the ways that engineers were subordinated to composers in the IRCAM of the 1980s, and how artists can be drafted in to demonstrate the applicability or relevance of some technical research in a superficial way (Barry and Born 2013). However, they observe a third mode, 'agonistic-antagonistic', that respects and tries to work productively with difference and disagreement. This mode privileges what they call a 'logic of ontology', whereby mutually changed understanding of the area of study can emerge by confronting difference. Insofar as we take encounters between practice research and technical research to be extremely common in electroacoustic music studies and music technology, yet under-documented, under-theorised and too often slipping into a subordination-service mode, a supplementary ambition of *FluCoMa* is to take the opportunity to think through how an agonistic-antagonistic mode could be realised for the project, and how it might contribute productively to future encounters of this kind.

On that basis, it seems clear to us that a commitment enabling and encouraging musical plurality through this project requires a commensurate commitment to methodological plurality: if we are to minimise imprinting our own musical or technical assumptions the tools we make, we need to be alert to what unspoken priorities might be informing our notions of music-technical common sense, and to actively find ways of having those priorities challenged. After all, we are not well placed to make judgments *a priori* on what would best support people making music that we do not, adequately, know how to listen or move to (Stockfelt 1997; Roholt 2014). The following section, then, spells out some of our working assumptions and prejudices.

Some Proclamations on Music Technology

In the spirit of trying to be aware of the baggage that we might be carrying, and could leave littered across the project, what follows are explicit statements of some positions around music and technology that inform how we approach the project and the design work we describe later on.

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- **Extensions, not Replacements**: We are not pursuing, nor especially interested in, developing technologies geared towards replacing people in musicking. Rather, we are seeking ways to extend people's capacities to music. As our research will involve applying and exploring a good deal of machine learning, we are sympathetic to a distinction between 'intelligence augmentation' and 'artificial intelligence' (Carter and Nielsen 2017). Likewise, we are not in the business of re-inventing wheels: we don't set out to replace the whole of someone's practice, whether established or fledgling, nor do we wish to disrupt the communally-established idioms of the various creative coding environments we are targeting. Rather, we aim to offer resources that can be made to fit productively within the apparatus with which someone has put work into crafting a relationship.
- **Signals are not Sounds**: Though it is easy to lose sight of, a signal – as in some temporal object of analysis – is not in the same category of thing as a sound with which we become embroiled (Ingold 2007; Roholt 2014). It follows that not all that is interesting, pertinent, or affective about music is available to techniques of signal analysis or information retrieval, not least because musicking is not just sounding (Born 2010).
- **Technologies are not Functions**: Only for the very simplest of tools might it be possible to claim that they can be reduced unambiguously to something that fulfils some function. Once they are let loose in the world, tools are entangled with all kinds of things: other tools, people's history and desires, and all manner of other contingencies; moreover, they do not just appear in the world spontaneously, in answer to some need but, rather, always gestate in some historical, political context (Feenberg 2002). Taken as such, technology is understood more richly as the emergent result of people interacting with tools (and other people, and so on).

From these generalities, we can expand to some commitments more specific to our project. First, *musicking is humaning*: whatever multiple things music might *be*, for our purposes it is distinctly a thing done by people, with other people. To take the making of music away from people, as if it were a chore, seems to us to be missing the point. Rather, playing with and through different degrees and types of delegation and human-material coupling is musical territory for people to explore, actively and critically (Bowers 2003; Lewis 1999; Park 2008).

Second, '*imperfections*' *are musical material*: there is no basis, *a priori*, to assume that signal processing that achieves some sort of perfect result (whatever that may be), would be enjoy greater musical affordances than something that had artefacts. Indeed, history suggests that musicians habitually find fruitful territory in things that are pushed past their notional operating limits (Keep 2005; Poss 1998; Waters 2007).

Third, it follows that *hearing is a practice*: noticing and find the creative scope in the sonic details of something is a diachronic affair, bound up with histories, tastes, fashions and so forth. New ways of processing and analysing signals, and experiencing the results require practise and reflection within the ecology of our other practices.

Fourth, *interfaces are identities*: our histories of interactions with the world contribute to our dispositions within it, and our sense of who we are. The *musical* interfaces we are used to dealing with play a role in our senses of fluency and musical identity that are, in turn, socially mediated across multiple planes and temporalities (Born 2010). Messing with this is no small matter, and this consideration has informed why we are targeting specifically Max, Supercollider and Pure Data. Notwithstanding a great deal of overlap in the *technical* facilities these environments offer, we contend that the communities of practice that gather around them

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are distinct and diverse, as they traverse institutional, disciplinary and cultural membranes in different ways, and embody different musical and technical values[3] of the sort that we wish to bring into dialogue with each other.

Finally, from all this, we are interested in *people, not users*. To make something *musicianly* is unlikely to be well served by a design process that tries assume that the people at the other end of the process are basically fungible and have goals that can be easily apprehended in advance. Such would be a reasonable approach for something that *is* seeking to make a chore less onerous. However, it seems to us that it is precisely people's idiosyncrasy, identity and so on that we would wish the fruits of our labours to help highlight and explore.

In the two sections that follow, we show how these thoughts have begun to shape our approach to *FluCoMa*. First, we describe the iterative method guiding us in the development of our tools. We then briefly interrogate the ideas of 'techno-fluency' and 'musical divergence' encountered in passing in the introduction.

Practice-Led Design?

The design approach implied by the discussion above might be thought of, contingently, as *practice-led design*. This is not to say that either the commitments or the process are new in the world (nor that this is, by any means, the best label for it), but helps us distinguish it from a more conventional, product-orientated process, albeit represented somewhat schematically.
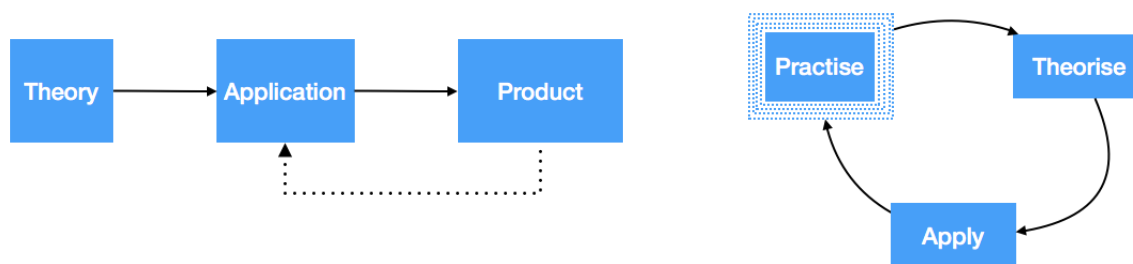

Figure 1: (a) A model of orthodox design and (b) practice orientated design

In Figure 1(a), we show this schematised process: design proceeds as the *application* of some theory, and results in a product. This follows Andrew Feenberg's general model of how technology functions in advanced capitalist culture: technologies are produced, in the main, by experts whose designs are mediated by the enterprise doing the producing. Whilst society can, in return, effect changes upon technologies, the pathways to do this are implicit (not direct), and tend to arise in response to controversy (e.g. safety concerns) rather than as a matter of routine (Feenberg 2002). Designers, for their part, are alert to this, and there is a steady growing literature around ways of reducing the distance between designers and public (Iivari and Iivari 2011) which, while it recognises the different ways in which artefacts end up having meaning for people in lived experience, still tend to focus on issues of *interface* atop a fixed technical logic taken as a given.

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[3] Max, for instance, is possibly dominant within the musical academy, but also connects to a wider constituency via Max For Live. Pure Data and Supercollider, as open source projects, with quite distinct aesthetics and modes of interaction, likewise become gathering points for different constituencies and modes of musicking.

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In Figure 1(b), we try to show what we have in mind for *FluCoMa*. A feedback loop between repeated *episodes* of practise – represented by the dotted surrounding boxes, and taken to be spread across time and practitioners – directly prompt us to reconsider theories and re-apply accordingly and iteratively. The scope of our input from practitioners widens as the project goes on. Initially, the very small pool of the authors and immediate colleagues fed in to the process. Following this, a group of eight composers work with first versions of the tools (in two waves of four, as we will have two toolkits). This then widens to a beta group, and public, open-source release, whereupon we intended to spend a significant portion of the project's later years seeking engagement widely to continue shaping the tools.

However, to initiate this hopefully productive feedback process, we do, of course, need to present our involved artists with things to use. In turn, this means that – as with any other design process – we need to think, somewhat abstractly, about whom it is that we are designing *for* and the types of outcome we wish to promote. In the terms of the original brief, our tools are to be targeted at *techno-fluent* creative coding musicians, and will seek to privilege divergent engagement. How, though, do these terms tessellate with the relational ideas of music and technology we've presented so far?

'Techno-Fluency' and 'Divergence'

Our early moves have focused on interrogating the ideas of 'techno-fluency' and 'divergence', with the goal of coming to an understanding of these terms that doesn't reduce people to users, and that we hope will help us avoid baking-in too many of our own assumptions and priorities to the materials we develop. We have tried to capture *Techno-Fluency* as being a matter of *music-technical disposition* that takes people's appetite for technical matters and implementation details to be a contextual, rather than genetic, affair: that is, we don't wish to make *a priori* assumptions that the 'technicity' of someone's practice is a matter of ability, so much as of preference.

In Figure 2, below, the boxes posit a set of five such dispositions, as they relate to how people might engage with their high-level creative-coding environment (e.g. Max or Supercollider, high-level with respect to, say, C++). The boxes at each extreme are faded to indicate that these are not what we're aiming at in this project. The dotted lines along the top are to suggest that, people can learn to hop from box to box, if they so wish. The solid lines underneath, on the other hand, represent that someone's disposition might have nothing to do with what they know *how* to do, but they might prefer to limit their 'technicity' for some reason. For instance, they might work in different 'modes' at different times, such as an exploratory mode that is more open to getting involved with the finer details of things, countered by a production-mode, where things just need to work; or they may just find that technical matters are a distraction from musical ones, irrespective of how well they grasp the technics.

Figure 2: Conjecture on Techno-Fluency

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The general tenor of this conjecture is supported by a set of opening interviews that we did with our eight commissioned composers. Even from this small sample, there was a clear feeling that the extent to which people were getting involved in the technical details of their working practices was a matter of preference in support of musical goals, and that appetite for understanding the internal details of tools was a highly variable affair, uncorrelated from a general level of technical comfort.

Can we also to find a way to approach musical 'divergence' as a contextual matter, rather than a genetic matter? That is, to avoid slipping in to regarding people as being more or less 'experimental' in relation to some arbitrary criteria that would, more likely than not, reflect our own priorities and tastes. 'Experimental' is not an analytically useful concept in the absence of any other context, given that the way it is deployed in current usage is, by and large, performative and doesn't tell one anything much about the qualities of the music at hand. To this extent, we don't see that it would help support our aspirations for musical pluralism[4] and clearer communication.

A more fertile starting point is suggested by Anthony Braxton's tri-partition of musical-cultural dynamics into forces of *traditionalism*, *stylism* and *restructrualism* (Lock 1988). Braxton insists that a musical culture requires the continual interaction of all three of these tendencies, which is a useful antidote to high-modernism's tendency to valorise change-as-such without sensitivity to either what the putative change is relation to, or who gets to adjudicate the quality of the change. By contrast, Braxton's model keeps us usefully orientated towards some point of reference and admits, at least to our reading, the possibility that this is not a static property of a musician, but – again – a *disposition* that can be witnessed in particular episodes or moments of practice and is, therefore, a dynamic matter.

The Aims and Ambitions of *FluCoMa*

So far, we have been somewhat coy about the detailed aims of the project, beyond alluding to the general topic of working musically corpora of recorded sound. The project was conceived on the basis that the size and complexity of collections we may want / have to work with, and our musical ambitions, are outstripping the appearance of new techniques to cope with this size and complexity. Meanwhile, there is no shortage of established or gestating technical approaches for realising some of these ambitions, but their appearance in the 'tool-scape' of musicians has been patchy. So, targeting Max, Supercollider and Pure Data, one aspect of *FluCoMa* is to make available, as open source plugins, some of these extant techniques, and develop new ones, trying to bear in mind some of the pitfalls that have made previous, similar work ephemeral or untenable.

Nevertheless, the original project description did have concrete musical impulses in mind. First, are the possibilities for decomposing and recomposing sounds into new hybrids, and the idea that these processes are bound up with corpus-making. Second, are techniques and tactics for finding one's way through collections of sound. Third, as a combination of the previous two, would be the potential for developing sonic montages, trajectories or interpolations between

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[4] The alert reader will point out that by dint of targeting the environments we have, and of speaking and working from a position of institutional shelter and privilege, aspiration to musical pluralism is already compromised. Indeed, this is so, but our efforts here are geared at trying to, at least, mitigate against the shadow cast by these factors, as part of a wholehearted effort to use our privileged resources to work productively across the academic membrane.

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sounds. Fourth, most ambitiously and most speculatively, would be possibilities for re-formed relationships between symbol and sound.

We approach these goals in two waves of development, that will yield two software toolkits for each of Max, Supercollider and Pure Data, alongside online knowledge resources and a discussion forum to support playing with the toolkits, and a discussion. The toolkits are themed respectively around signal decomposition – as a basis for corpus build – and corpus manipulation. In line with the perspective on practice-led design above, our commissioned artists work with exceedingly early versions of the software and knowledge resources, and contribute actively to ongoing development, ahead of public, open-source releases.

Early Technical Work

In the first year of *FluCoMa*, we have been focused on developing a toolset aimed at the first of our musical impulses, by producing objects for signal decomposition as part of exploring the ways in musicians might form a collection of recordings into a corpus. We have conceived of this in terms of three general types of thing that we might want to 'decompose' a sound in to:

1. *Slices*: There are many options for how we might choose to divide a sequence up in time. Some of these are well-trodden, particularly at shorter time-scales. However, there are few facilities available to musicians for exploring longer-time scale slicing, or for engaging playfully with a computers' idea of what characterises a 'change point'.
2. *Layers:* Ways of separating sounds into notional components, based on some underlying set of assumptions. Some of these might revolve around archetypes that we customarily deploy when describing sounds in the studio, such as separation in to transient, noisy and tonal components. Others can be more exploratory, such as re-purposing to playful ends research from source-separation.
3. *Objects:* More open-endedly, we can try and represent a sound as a group of spectro-temporal shapes. This might be quite deterministic: 'here is a shape, find me others', but we could also ask: 'here is an impression of a shape, find me things a bit like it, in some respect'.

At the time of writing, we have a toolbox of fourteen objects for Max and Supercollider, which were presented to our cohort of commissioned musicians at plenary in Huddersfield in September 2018, and with which they have started to grapple. The objects developed so far deal with applying some extant approaches for signal decomposition using, for instance, sinusoidal models (Serra and Smith 1990); transient models (Godsill, Rayner, and Cappé 2002); median filters (Fitzgerald 2010); and matrix factorisation (Smaragdis et al. 2014). A fuller discussion of the objects and their algorithms will be the subject of a future paper. Meanwhile, we are also examining the decomposition potential of current trends in signal processing, such as deep neural networks (Roma, Green, and Tremblay 2018a, 2018b), as well as creative approaches to browsing collections of sound (Xambó et al. 2018).

Community and Knowledge Mapping

An equally important strand of the project is to produce resources that support the kinds of exploratory usage and discussion we hope to animate by seeding an active community of interest (Fischer 2009) around the topic of musicking with corpora, and the affordances of the tools the project develops. Bearing in mind the claim above, that becoming *musically* attuned to these affordances requires the opportunity to accumulate histories of practice with them, this

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aspect has a longer horizon: whilst we aim to do the *bulk* of core technical development early on, a good deal of the final three years of *FluCoMa* will be in pursuit of developing and nurturing a community that we hope will outlive the project.

To enable this, it will not be enough simply to drop the tools into people's lives and hope that they will be adopted and generate activity, let alone community. A clear lesson from previous contributions to creative coding environments, especially ones that use new and / or abstruse algorithms, is that people need to be *invited* in and offered ways of orientating themselves that make sense in the context of their history, desires etc. As such, a crucial connecting plank between our wished-for tools and wished-for community is what we are calling (for now) a *knowledge mapping*.

This knowledge mapping, we have realised quite quickly, cannot proceed simply on the assumption that helping to build knowledge consists only in making information available. Not only do our combined years of teaching make this abundantly clear, but so too do the experiences of tools where the possibilities simply haven't been apparent because all we have is information about the underlying process, rather than potential avenues to explore. On this basis, we conceive that our knowledge mapping will need to bridge the community of practice and the software with something rather more like the tentacular mesh represented in Figure 3, than something that can be represented as clean, crisp concepts, connected by clean, crisp lines that

Figure 3: A polyvalent mapping between people, knowledge and tools

model a flow of information. Because we know there will be many potential ways into, and through the software, and many places that people will come from, it follows that what we need is something appropriately multivalent.
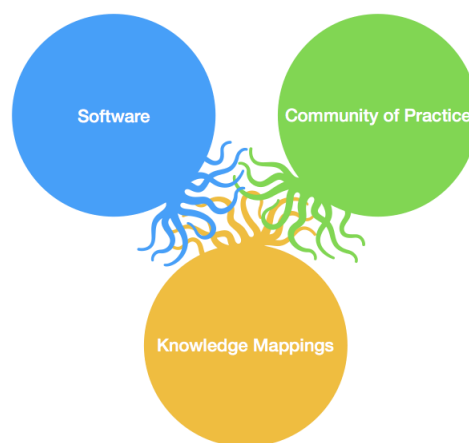
This is still very much a work in progress. What we have in mind is an ecosystem of resources, where the materials available in the musicians' environment (help files, tutorials, worked-through examples) are supported by online resources, including a forum, and a site that shares some of the aspirations of the original EARS project (Atkinson and Landy 2004), but with a slightly shifted focus on musical-techniques that are not yet well established, and an extra goal of aspiring to promote the kind of agonistic exchange between (sub-)disciplines that we described at the beginning of the paper.

Conclusion

FluCoMa sets out to animate work on musicking with corpora in ways that embrace musical pluralism and agonistic dialogue between disciplines, motivated by our views on the roles of technology in music practice. We propose an iterative methodology that attempts to combine practice research and technical research, to bring technological innovations and knowledge resources to music practices based on sound corpora in creative coding environments. Through this, we hope to foster a community of people with diverse technical and musical dispositions.

We end with questions, rather than (more) claims. Given the ambitious, and somewhat open-ended goals of the project; our wish for a community of practice to emerge from it; and our sense that our ideas and tools need to be subject to continual scrutiny, we present these as a seed for ongoing discussion within the electroacoustic music studies community.

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1. *How to design for divergence?* What qualities of music-making tools do people feel help avoid a sense that the musical results converge on something that is idiomatic of the tool itself? We suspect that, in many cases, musicians arrive at a particular ecology of tools and tactics partly on this basis. But what, in particular, are the qualities that people think contribute to this for the ways that they work? Clearly, the answer is not as simple as just pursuing radical open-endedness in the abstract: we can see how ostensibly quite limited and closed designs have enabled all kinds of productive divergence (e.g. the Roland TB-303).

2. *How modular to make things?* Part of the spectrum of design choices one faces for creative coding environments the extent to which one favours a few monolithic, high-level black-boxes, or a multitude of lower-level components that can be reconfigured at will. Our feeling is that the former can militate against possibilities for divergence, whilst the latter can present a barrier to entry, and has been a factor that hindered the wide uptake of some prior work that sought to make new process available in creative coding environments. So, how to balance these, and at what different points do people find themselves reaching for the black-box, versus exploring the space for play in different combinations of process?

3. *Is there a thirst for technical detail?* Similar to (2), it strikes us that the availability and degree of technical details in documentation and technical resources has significant effects on how people engage with a toolset, and whether they engage with it at all. We expect there to be a wide spectrum of preferences and proclivities here, in terms of people's preferred 'ways in' to interacting with new tools.

4. *How to be musicianly with AI?* A recurring theme, but on the horizon again, as we find ourselves in the midst of another AI renaissance, and somewhat breathless claims from some quarters about the artistic possibilities of machine learning. Nonetheless, impressive results have started to emerge, for instance from DeepMind's Magenta project (Roberts, Hawthorne, and Simon 2018), which positions itself as being concerned with extending, rather than replacing, human musicking. However, Magenta focuses, in the main, on approaches that rely on complex models with correspondingly large training datasets that are demanding to prepare, collect, use and customise. A concern with this approach is that it could present barriers both to entry and divergent usage. What other possible models of interaction with these technologies are available? How would people *like* to engage with 'intelligent' musical tools?

As the *FluCoMa* project progresses, we look forward to returning to the EMS community to share our results and discuss these questions, and hope that many of you will form part of the activity we hope to animate by using our tools and forum, as they become available.

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