Agility and Playfulness: Technology and skill in the performance ecosystem

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Whilst it is common in much discourse around contemporary musical practices to emphasise the differences between digital and acoustic ways of making music, Simon Waters' discussion of the Performance Ecosystem as an analytic perspective argues instead for a heightened sense of continuity (Waters 2007). This article lends support to this argument by developing an ecosystemically situated account of our relationships with technology and processes of skill formation. It is argued that this sense of continuity is justified, but that where differences of experiences do arise these are not, as sometimes supposed, an essential characteristic of digital technologies. On the basis that much of our skill formation consists of tacit knowledge, it is suggested that further discussion on how particular circumstances and skills arise would be revealing. Two possible headings for such discussion are suggested in the form of 'Agility' and 'Playfulness'.

1. INTRODUCTION

> Musicking human beings have always explained and understood the relationship between body, instrument and environment as dynamic and mutable. Our digital present is no different. It is not fundamentally distinguished from other eras by the problems and opportunities presented by its ubiquitous technologies … (Waters 2007: 14)

The idea of a performance ecology or ecosystem has been used by Bowers (2003) and Waters (2007) to develop a perspective on the materialities of contemporary digitally mediated musical practices which recognises material resources such as instruments and technologies as inhabiting a world rich in social, material and historical interconnections that inform practice. In this respect, the idea resonates with a number of other recent contributions. A degree of affinity with the work of Christopher Small is particularly apparent through the usage of *musicking*. Small's key concerns in *Musicking* (Small 1998) were to destabilise the musical work-as-object, resituating it as part of a field of relationships that make up any musical ritual, and to destabilise the hierarchy of musical participation by insisting upon the active nature of all participants irrespective of how remote their involvement may seem. Small, above all, was at pains to stress that music is something that people *do* (hence the verb), rather than some *thing* that could be encapsulated as an artefact, and that in encountering music we encounter a complex network (or ecosystem) of shifting relationships between entities.

Such concerns to re-integrate the theorisation of artefacts and human practices into accounts that recognise the interconnectedness that is so evident in lived experience have also become evident in other fields. Of particular relevance to the practices around contemporary music-making are different strands of work in the biological and cognitive sciences that emphasise the co-dependencies between minds, bodies and environments in human life (Varela, Thompson and Rosch 1991; Clark 2008); work in the social sciences that examines the relationships between computer-based activity in terms of its situatedness (Suchman 2007); attempts in anthropological discourse to bridge the gap between the cultural and the biological (Ingold 2000); as well as recent developments in phenomenology (Dreyfus and Dreyfus 1986; Dreyfus 1992) and philosophy of technology (Feenberg 1999, 2002). These have started to have some influence in discourses around contemporary music-making, informing orientations towards composition (Di Scipio 1998), instrument design (Armstrong 2006; Essl and O'Modhrain 2006), listening practices (DeNora 2000; Windsor 2000; Clarke 2005), and electronic musical culture (Emmerson 2007).

An important value of these theories is that they allow for an acknowledgement of the *irreducibility* of certain entities into what may seem to be their functionally salient properties; so, human *being* can not be adequately accounted for as an aggregation of cells and chemical processes (Maturana and Varela 1992; Ingold 2000), and various levels of social collectivity do not reduce neatly to aggregations of individuals or of smaller groupings (Born 2010). The fertility of such perspectives can, however, be potentially overwhelming. Pragmatically, in both formal and everyday analysis, it is necessary that we make conceptual 'cuts' in the network of connections in order to cope; of equal importance, however, is to remain alert to the contingent nature of such boundaries, as explained elegantly by Lucy Suchman:

> How far our analysis extends in its historical specificity and reach, or in following out lines of connection from a particular object or site to others, is invariably

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> a practical matter. That is, it is a matter of cutting the network, of drawing a line that is in every case enacted rather than given. The relatively arbitrary or principled character of the cut is a matter not of its alignment with some independently existing ontology but of our ability to articulate its basis and its implications. (Suchman 2007: 284)

I read Simon Waters' querying of the stability of performer–instrument–environment divisions as being isomorphic with Suchman's concern. Waters (2007) offers examples both of contemporary digitally mediated encounters and of engagements with more venerable musical interfaces that demonstrate how unstable these boundaries are in practice. In doing so, Waters also proposes a degree of continuity between digital and other kinds of musical practice which may seem controversial in the context of a wider contemporary culture that habitually points to the exceptional nature of digital technologies and proposes conceptual boundaries in terms of technological paradigms – acoustic vs. analogue vs. digital. These boundaries are, I think, unhelpful insofar as that they may serve to obscure and foreclose opportunities for hybridity (Waters 2000), conviviality (Emmerson 2001) and self-reflexivity. Conversely, there is a danger in arguing for continuity that legitimate experiences of differences between working with digital and other media are written out of the account. Such experiences of difference, whether positive or negative, warrant being taken seriously; however, different insights are yielded depending on whether one locates these differences as an essential property of a particular type of technology, or as something that arises in the ecosystem of lived relationships, as I will attempt to demonstrate.

In this article I will seek to add theoretical support to Waters' claim for the historical continuity of human musicking without erasing or delegitimising the possibilities of difference in practice, instead developing the grounds for an explanation of how these arise in social and historical context. What emerges from this is, per Waters (2007), a distinctly contingent notion of what constitutes the musical instrument so that acoustic and digital systems may afford more ready comparison. As the basis of my argument is epistemological – in that I do not see the basis of skill formation or of embodied knowledge as being significantly altered by digital means – I develop the central portion of this article as an extension and response to Thor Magnusson's epistemologically orientated account of embodied acoustic and digital instrumental relations (Magnusson 2009), by following certain 'lines of connection' out into the world and, in doing so, proposing a greater sense of continuity. In particular, I argue that such things as skills and affordances are intertwined with the social bases of practice as well as the technical, and suggest that there is value in further discussion that examines the ways in which our practices and relationships with musical technologies are inflected by the various differing sites and rituals they are spread over. On that basis, I suggest two headings – agility and playfulness – as possible areas for developing discussion on these points, and offer some elaboration.

2. DIFFERENTIATING THE ACOUSTIC AND DIGITAL

A recent article from Magnusson (2009) has offered an argument for differentiating acoustic and digital instruments in epistemological terms. His theory makes two particular contributions that I take as being especially valuable to an ecosystemic perspective on music and performance. The first is to provide, via the theories of mind and cognition of Varela et al. (1991) and Clark (1997, 2003, 2008), an account of the growth of musical skill that recognises the importance of tacit knowledge[1] as a feature of embodied personal growth that emerges through exploring and forming the world of material and social relationships we inhabit. Secondly, he accords an active role to equipment by noting that devices can exert agency and serve as scripts for action. For Magnusson, the former is paradigmatic of acoustic instruments, whilst the latter is argued to be inherent to digital instruments. Thus, an *essential* difference is proposed whereby 'software has agency and necessarily inheres more cultural specifications than any acoustic instrument' (Magnusson 2009: 175), such that our interactions become less embodied and there is greater potential for the foreclosure of creativity or the imposition of restrictive cultural horizons.

Insisting on the *necessity* of this difference is problematic, insofar as it would seem to take on a somewhat deterministic quality unable to account for the complex range of creative relationships people have with musical equipment. However, there is scope to expand upon Magnusson's argument such that we can retain his important foundational observations whilst providing an alternative explanation for experienced differences between instrumental types that avoids a deterministic implication. To do this requires a slight 'zoom' outwards in viewpoint, placing the analytical 'cut' at a different point in the network. As is not uncommon, Magnusson's discussion revolves around the nature of relationships to *the* instrument. In doing so there is a tendency for the focus of comparison between acoustic and digital music-making to collapse down into the material boundaries of whatever particular device is taken to be the locus of sound production, so that we might compare a piano and a laptop. However, such a perspective obscures a range

[1]Tacit knowledge can be succinctly expressed as a concept as 'knowing how' rather than 'knowing that' (Dreyfus and Dreyfus 1986: 3).

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of important features that can serve to mitigate the degree of difference between technological paradigms. By taking an analytical step back, we can place these apparently context-free objects back into the type of world in which they are encountered: a world in which these objects form a part of a network of relationships with other objects and with people.

Magnusson (2009) makes four particular claims that he sees as underlying difference between acoustic and digital paradigms. Firstly, that while the design of acoustic instruments is characterised by a bottom-up, empirically driven and embodied engagement with materials, the design of digital instruments is a top-down matter that involves the application of rational conceptual principles. Secondly, that this difference of design orientation follows through to a difference of usage orientation; whilst engagement with acoustic instruments is embodied, the degree of symbolic mediation inherent to digital tools breaks this embodiment. Thirdly, this difference of engagement means that whilst the process of skill formation with acoustic technologies is related to the gathering of tacit knowledge through situated experience, with digital instruments enskilment is necessarily orientated to a process of symbolic understanding. Finally, that because this enforced process of understanding is taken to be almost wholly on the terms of the digital instrument's designed affordances, digital tools thus possess an active character absent from acoustic instruments.

Each of these apparent sites of difference largely evaporates when our isolated instruments are placed back into a fuller social and material world, such that we can take our interaction with digital instruments to rest on the same basis of embodiment and networks of tacit knowledge, and recognise the active nature of acoustic technologies.

2.1. Bottom-up empiricism and top-down rationality

The idea that the design and manufacture of acoustic instruments can be characterised as being craft-orientated, led by 'bottom-up exploration' whereas digital instrument design is necessarily tied to the top-down application of rational theoretical principles, is on the face of it a persuasive generalisation (Magnusson 2009: 173–4). Nonetheless, it is a generalisation, as Magnusson (2009: 173) acknowledges. The basis for explaining differences between technological paradigms shifts significantly if we cease to treat these design orientations as mutually exclusive. There are two components to this. The first is to consider the question in terms of the specific *type* of rationality that Magnusson implies when he talks of 'a mathematical understanding of sound' (Magnusson 2009: 174), insofar as this represents a particular corpus of conceptual scaffolds. The second is to consider the nature of conceptual apparatus in making more generally.

On the first front, scientific knowledge can be seen to have been applied to the design of acoustic instruments alongside more exploratory design strategies. This is particularly evident with various innovations to the design of woodwind instruments during the nineteenth century (Campbell, Greated and Myers 2004). Conversely, we can observe that not all approaches to digital instrument design are predicated on the application of scientific knowledge, such as with George Lewis' account of developing *Voyager*:

> Avoiding scientism on the one hand and anthropomorphism on the other, I don't feel the need to 'scientifically' prove the validity of any process I use to get my music to sound the way I want it to sound. I feel utterly free to work in an intuitive way while programming computers to create improvisations. This necessary combination of the utterly logical and the completely intuitive is what attracts me to this kind of work. (Lewis 1999: 110)

Secondly, considering the relationship between making and the world of ideas more generally, the situation appears a little more complex. Magnusson notes that in order to design digital musical instruments, extra-technical ideas about music itself are filtered through the top-down, symbolic process of modelling:

> Writing digital musical interfaces therefore necessarily entails the encapsulation of a specific musical outlook … the designer of the composed digital instrument frames affordances through symbolic design, thereby creating a snapshot of musical theory, freezing musical culture in time. (Magnusson 2009: 173)

The need to model, Magnusson argues, is inevitably reductive because such numerical models are partial; complex and dynamic ideas such as 'music' are irreducible to a finite set of symbolic parameters. However, the interaction between tool design and conceptual ideas becomes more complicated when we consider that this process of reduction is not the only way in which designs and extra-technical ideas interact. Andrew Feenberg notes that reductions are accompanied or compensated for by further interventions from both designers and users in a process he calls 'mediation' (Feenberg 1999: 206). These interventions are unconnected to the technical logic of the device but have to do with its suitability for particular social contexts, such as decisions about 'look and feel' or the range of functionality that is exposed. As such, the concept applies equally to the ways in our equipment is packaged and marketed, and subsequent ways in which users may customise or modify equipment, ranging from the cosmetic, such as taping over the Apple logo, to the more drastic and invasive, such as circumventing copy protection.

Feenberg argues that these mediations establish feedback loops with the processes of reduction in design, as certain interventions are liable to become

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enshrined over time as design principles, either explicitly through legislation and standardisation, or implicitly through convention. As such, the top-down design process takes on a less linear and more interconnected character as something embroiled in a complex set of historically and socially situated interactions, not only with ideas about the *thing being modelled* but also with ideas about the *modelling of the thing*. Furthermore, this process takes on a continuous and dynamic quality when interventions by users are considered. Designs are only ever contingently complete as they are always subject to modification in order to adjust their fit to sets of ideas outside of their technical logic.

2.2. The boundaries of the instrument

Mediating interventions on technologies also spill out into the world, over the boundaries of any particular device. Consider, for instance, the report by John Bowers that

> organisation of my playing environment makes things more effective for me, it gives clues to the legibility of my gestures, both for co-performers and audience … by moving from one side of the table to the other I can do different things and be seen [and heard] to be doing different things. (Bowers 2003: 47)

Bowers' design is not simply a matter of modelling musical preferences and devising more or less optimal ergonomics, but is also inflected by preferences about his social relationships in performance, which in turn affect the way in which resources are interconnected and located in space. As the use of physical space becomes part of the design, the conceptual boundary between instrument and environment is rendered more ambiguous.

This ambiguity has explanatory potential when considered in relation to two ideas from Feenberg and from Clark. Firstly, that just as the technological objects we encounter are very often *systems* of other technologies that have been interconnected and coupled, so usage also very often consists of assembling systems of interconnections and couplings. Feenberg argues for a degree of equivalence for these two forms of what he calls 'systemisation' (Feenberg 1999: 205). This is particularly evident in computers, which are highly complex coalitions of interconnected and interdependent systems, but is also familiar to any user of audio technologies where much activity, both physical and virtual, consists of making assemblages of interconnected components. Secondly, systemising activity is more radically positioned by Clark as being integral to ways in which our cognitive processes can be seen to take place in continuous interaction between our brains and bodies and the wider environment. Clark argues that cognition involves continuous acts of 'ecological assembly' (Clark 2008: 13), where external resources are enrolled into ad hoc networks in ways that distribute the cognitive burden of some task out into the world. Significantly, how technological or even how material a resource is does not appear to have much bearing on how likely it is to be involved in such a network, as Clark identifies a cognitive tendency to use whatever is at hand, resulting in complex mixtures of material resources, uses of space and organisation, and the deployment of symbols as ways of thinking through the world.

So, just as we can regard a computer as a system, it is also part of a larger ecosystem of potential interconnections some of which may be physical, some of which may be mediated by the 'virtual' activities of our brains. Furthermore, if Clark's account is true, then there is a case for regarding the systems we make and encounter around acoustic instruments as contingent unities in their own right, so that, under some conditions, systems such as instrument-score (and more complex extensions) can be considered as constituting the boundaries of the instrument. Thus the instrument becomes a term for describing the coalition of resources being used *at a particular moment*, as Franziska Schroeder and Pedro Rebelo observe:

> Instruments are never stationary but are always given within a constantly changing, indeterminate background or horizon. Consequently, they are context dependent and, furthermore, the context itself is temporary and always subject to change. (Schroeder and Rebelo 2009: 136)

Redrawing the boundaries of the instrument in this way means that the presence of symbolic mediations in our musical systems can be seen not to be an exclusive property of the digital, but is conspicuous throughout our environments and acts of assembly. With this in mind, we can examine the idea that symbolic forms can disrupt embodied relationships with the world.

2.3. Embodiment, symbols and computers

Magnusson suggests that 'to work with symbolic tools means that one has to continually switch modes from focusing on the world to focusing on the tool with regular intervals and to a more pronounced degree than in acoustic instruments' (Magnusson 2009: 173). This continuous switching implies, for Magnusson, an interruption of our *embodied* inhabitation of the world that yields to a *hermeneutic* orientation, based on intellectual understanding. Consequently, he argues that the basis of skilled action developed around tacit knowledge that applies to acoustic instruments gives way to skill development through intellectual understanding for digital instruments. I will examine this in two parts, as it is a complex claim. In this section I will argue that with digital systems our interactions remain embodied.

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I then consider the implications of 'understanding' and skill formation in the following section.

If we follow Magnusson in accepting the role that tacit knowledge, gained through active exploration in the world, plays in skill formation more generally, and accept my claim that as a result of ecological assembly symbolic mediations in music are not exclusive to digital systems, then it remains to be considered whether there is something peculiar about the nature of computers or about the specific types of symbolic mediation employed that disturbs embodied engagement. Armstrong (2006) contributes a useful discussion on this point that identifies the switching of modes, described by Magnusson above, as being a continual feature of human cognition rather than an extraordinary symptom of computer usage.[2] In this sense, then, the switching of modes by itself does not appear to account sufficiently for a detachment of our engagement.

What Magnusson describes when he distinguishes between focus on the world and focus on the tool is encapsulated in Heidegger's concept of the 'breakdown' that occurs when performative flow is disrupted and the Otherness of the instrument becomes suddenly apparent (Armstrong 2006: 64). Such an experience is obviously not limited to digital instruments, but are there grounds for treating it as an inherent property of the digital?

Initially, we can perhaps place different computer-orientated musical activities along a nominal continuum of embodiedness. We could, for example, consider performing EQ adjustments in real-time, selecting and refining parameters for offline processing, and non-live (undead?) coding as being progressively more distant from direct, bodily engagement with the world. EQ adjustment is uncontroversially embodied: the character of my adjustments is continually guided by what I hear. In the case of the more temporally interrupted process of applying, auditioning, refining and reapplying parameters, there would seem to be a case for this being characterised by more textual engagement. However, assessing what the various symbolic options on offer *mean* in context still happens out in the world, beyond the boundaries of the symbolic system. The possible interactions between the parameters of, say, a phase vocoder, and any particular sonic material are sufficiently complex that it is simply not possible to determine in advance *without a lot of practice* quite what the result might be.

Even when writing code, which would seem on the surface to be paradigmatically disembodied, it is possible to flow such that the separateness between myself and the machine seems to dissipate. When coding most fluently, I find that rather than simply implementing some structure that I have imagined in my head, what happens is *between* myself, the computer and the environment. I will play with space in the code as a way of helping me think more clearly about a particular bit; I will make use of doodles, sticky notes, changes of posture and musings out loud, as my work overspills the boundaries of the coding environment.

These very simple examples suggest that, as embodiment can happen with digital interfaces, the reasons for why breakdown occurs are reducible neither to the presence of symbolic mediations in the instrument, nor to an inherent property of digital interfaces. It is in more complex settings such as performance, however, that disruptions of flow are commonly experienced. Performing brings to bear networks of inter-related skills, many of which depend on being able to maintain focus on the world at large. Yet it is not reducible simply to an aggregation of skills, because the qualitative aspects of what we try to achieve when performing are inflected by social and cultural aspects of the environments in which we perform. The *meaning* of the symbolic aspects of an interface are in turn inflected by the wider context at hand. I argue in the following section that by situating our understanding of symbols in context they are subject to continual and contingent re-evaluation, and that the propensity for breakdown lies at the intersection of socially informed intentions and the technical affordances of the instrument.

2.4. Do you read me? Understanding

> How do computers, as necessarily symbolic devices, enable, produce, maintain, support augment, but also constrain and limit our cognitive processes and therefore creative output? (Magnusson 2009: 169)

Discussions around the significance of particular symbolic forms – scores and texts – are well-established musicological concerns. Significantly, for the purposes of this discussion, the nature of such texts as authoritative, autonomous, *self-contained* carriers of meaning has been called into question in the musicology of recent decades (Cook and Everist 1999), just as such notions have been rendered problematic for texts and symbolic forms more generally by currents like poststructuralism. Is there a reason to suppose that the symbolic forms that we encounter when we use digital tools are particularly different in this respect? I propose that there is not, and that this is made clearer when we adopt an analytic perspective that situates player and instrument into a rich social context. Two points arise from this. First, it becomes possible to view the process of enskilment with digital

[2]Armstrong's argument makes use of the concept of 'double embodiment' described in Varela et al. (1991). This notion captures two complementary senses of embodiment: the body as our physical housing, and the body as the site of lived experience in the world (Varela et al. 1991: xv).

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systems as involving the same degree of tacit knowledge and situated understanding as Magnusson rightly identifies with acoustic systems (Magnusson 2009: 170). Second, we can reposition the affordances of systems (or their lack) as arising in the particularities of the social, material and historical context at hand. This helps move towards answering Magnusson's question at the start of this section in a way that sees such a 'double aspect' (Feenberg 2002: 74–5) of computers as a property of any technology *in situ*, rather than of digital tools in particular.

One persuasive reason for regarding the symbolic forms used in digital interfaces as different and possibly less ambiguous than other texts is that they refer to technical and quantitive concepts that are simply *there to be understood* so that 'ergonomically, the interaction happens primarily through a symbolic channel, which gradually teaches the user to operate with technical terms (such as "low-pass")' (Magnusson 2009: 174). The meaning of a concept such as 'low-pass' is, of course, easy to describe *in the abstract* as a filtering operation on a signal that admits content below a certain frequency threshold whilst rejecting content above it. However, such a definition does not encompass the range of possible things that a person might understand the term to mean in practice. We can perhaps map this ambiguity on two broad fronts.

The first is that people bring with them historically contingent interpretations of concepts such as 'low-pass' that are shaded by lived experiences. That is, one's understanding of what a filtering operation is will be shaped by previous encounters with this and related concepts. We may understand filtering operations more or less solely in terms of our sonic experience of them, as memories and projections of their interactions with different types of sonic material, or we may understand them in more technical, conceptual terms such as specific types of circuit or difference equation. These are evidently schematic depictions, but sufficient to make the point that the epistemology of a concept such as 'low-pass' is at least partially accounted for by the histories of people's prior encounters.

Second, it follows that what we as individuals understand by such concepts changes with time and context. Most practitioners will understand the concept of 'low-pass' from multiple perspectives, both sonic and technical, and this understanding is subject to constant revision. Moreover, particular understandings are informed by context: what we are doing, and who we are doing it with. Consider, for instance, the range of particular meanings that the numeric properties of an equaliser may have. For a somebody new to such things, there is little or no experiential basis for associating these numbers – frequency, gain, resonance – with any particular aspect of what they are hearing. As such, the numbers demand attention as they learn, for example, how frequency as an aural phenomenon maps to frequency as a numeric range, helped or hindered to some extent by the clarity of their listening situation.

Such learning is necessarily an active, empirical affair. When we search around with an equaliser trying to locate some specific aspect of a sound, this can be likened to what Tim Ingold has called 'wayfinding', as distinct from what he calls 'navigation'. The latter, Ingold argues, is characterised by knowing in advance one's destination, the former by knowing one's destination when one gets there (Ingold 2000: 235–7). This description of wayfinding characterises working with sound well, and applies particularly to skilled, expert use; one *knows* when the right point has been arrived at without necessarily being able to articulate how one knows. Skilled practitioners will home in more quickly as they have learned to interpret the response in the sound as a guide of where to go next, developing skills that are akin to Sudnow's characterisation of 'grabbing' for the right chords on the piano (Sudnow 2001).

The distinction between wayfinding and navigation yields two additional, related points concerning the development of skill and the possibility of breakdown (see previous section). Ingold proposes a further distinction between mapping as an activity, and maps as artefacts. The former, he argues, can be considered as a 'narrative re-enactment' of our wayfinding (Ingold 2000: 234) – that is, as a learning process that arises through doing. The latter, on the other hand, is a guide to navigation: a set of instructions for getting from *A* to *B*.

Concerning enskilment, we can suggest that numerical parameters might initially serve as a map for novices, who are given out to seeking out advice in the form of particular parameter recipes to accomplish a particular task.[3] Experts, on the other hand, will be able to proceed intuitively, finding their way through the interaction of material and processor on the basis of learned, tacit skills (Dreyfus and Dreyfus 1986). The parameters come to mean something quite different in each case. For novices, the numbers define the territory; the audible spectrum, for instance, becomes divided into pre-established zones where particular instrumental characteristics are taken to live (vocal presence at 5 kHz, for example). For experts, the relationship is reversed, as they have learned the skill of translating back from what is heard to a numeric representation.

On the second point, concerning breakdown, Ingold's distinction resonates with mapping in the sense of determining which external controls affect

[3]These sorts of questions can be readily observed both in the advice columns of magazines such as *Sound On Sound* and on Internet forums such as gearslutz.com.

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what parts of a digital algorithm. In particular, there is scope for contextualising critiques of overly simple and direct mapping strategies as yielding unsatisfactory experiences in terms of the degree to which such schemes afford only navigation rather than wayfinding, and thus militate against skilled development but also give rise to breakdown more frequently. By this measure, these problems are not intrinsic to the digital nature of our interfaces, but are related to particular choices by interface designers about what they expect their interfaces to mean to users. Direct parameter mappings of a granulator, for instance, are not especially musically suggestive, and are probably also quite opaque to someone unfamiliar with granulators. Fortunately, however, more wayfinding-orientated approaches to mapping are available (Bowers 2003; Van Nort and Wanderley 2006).

Finally, our interpretation of symbolic channels is also inflected by context. Nominally technical concepts and their symbolic representations are enlarged by connotations specific to social and material circumstances. The meaning of numerical parameters is tied up with the complex interaction between a process and the signal it operates upon. For instance, what counts as a 'broad' resonance setting for a filter depends on the sonic material, the particularities of the filter being used, the job at hand (techno filter sweep or mastering?) and the propensity of the loudspeaker-room-listener system to pick up on those changes. Moreover, in discourse quite what these concepts are taken to mean is sensitive to what is being talked about, and the relationship between interlocutors, as indicated by Thomas Porcello's investigation of the different uses of technical and metaphorical language between experts and novices in recording studios (Porcello 2004).

The process of developing expertise with digital systems is not merely a case of coming to an understanding of a technical system *qua* technical system but of developing complexes of skills that loop through and around the instrument (some of which will take the form of tacit knowledge), because the use of symbolically mediated systems still hinges on bodies of tacit knowledge extrinsic to the device itself. This, as Clark points out, applies equally to symbolically mediated activities on computers (such as playing Tetris) and to playing piano (Clark 2008: 75). Skills arise within 'the whole system of relations constituted by the presence of the artisan in his or her environment' (Ingold 2000: 291; Suchman 2007: 262), a system of relations that includes interaction with other agencies and with various traces of histories and cultures. Furthermore, the meaning of technical concepts encountered in technology arise, irrespective of their digitality, in this same system of relationships, as Feenberg says: 'the social character of technology lies not in the logic of its inner workings, but in the relation of that logic to a social context' (Feenberg 2002: 79).

2.5. Active technologies

This brings us, finally, to the idea that digital instruments manifest some kind of active quality or agency where other technological paradigms do not, an argument made by both Magnusson (2009) and Bown, Eldridge and McCormack (2009). Within the context of contemporary performance practices this is clearly a notion that needs accounting for, as various artists' work involves systems that exhibit some degree of autonomy of operation, such as George Lewis' *Voyager* (Lewis 1999, 2000), Arne Eigenfeldt's agent-based systems (Eigenfeldt 2008) and Agostino Di Scipio's *Audible Ecosystemic Interface* (Di Scipio 2003). However, for all that our digital instruments, as highly complex systemisations of technologies (see Section 2.2), may make this active nature more apparent, there are grounds for not regarding it solely as an attribute of digital technologies.

Considering first the condensed ecosystem of player–instrument, or agent–tool, relations, Ingold helps us appreciate that the material resources of undigital practice are not altogether passive with a detailed account of wood-cutting in which the character of action can be seen to be in response to the very particularities of the wood and the consequences of prior acting (Ingold 2006). Perception and action, as Magnusson describes, 'co-emerge through the agent's active involvement with the world' (Magnusson 2009: 169), rather than the process of making being one of mechanically executing an intention preformed in all its particulars (Ingold 2000: 294–311). This resonates with Bennett Hogg's depiction of 'the violin as lie detector' (Waters 2007: 5), highlighting that the instrument is far from being passive, but is a participant in an ongoing negotiation.

We might, however, regard digital technologies as being especially active because, as Magnusson notes, they seem to embody knowledge in such an explicit manner. Computers are, by this account, tools for automation, things to which we delegate tasks in formalised terms. Consequentially, they exhibit agency by apparently making skilled human action peripheral where once it was central; hence the concern expressed by Vaughan that the transition from analogue tape-orientated studios to digital-workstation-orientated studios could herald a process of deskilling (Vaughan 1994). However, Ingold provides an additional insight when he notes that 'as fast as machines have been contrived to do what had previously been done by skilled hands, different skills have sprung up to cope with the machines themselves' (Ingold 2000: 332). Again, this can be seen to apply equally to digital and nondigital technologies. Just as

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delegating the role of co-player to a computer, as Lewis does with *Voyager*, will entail human players developing skills to cope with the computer-player, so the delegation of remembering certain features of a musical work to scores or recordings (Frith 1996: 226–7) opened up new realms of skilled action.

Finally, we may question whether the propensity of digital systems to 'script' action really is a special property of a given device or class of device when we consider the instrument as an assemblage of material and immaterial resources rather than as a single artefact. 'Agencies – and associated accountabilities – reside neither in us nor in our artefacts but in our intra-actions', writes Lucy Suchman (2007: 285), so that when technologies seem to script our action, this scripting is as much a social matter as a technical one. The apparent imperatives of given technologies exist as matters of convention and consent in the same way that cultural codes of behaviour, dress, language and music arise through the co-dwelling of humans in environments shaped and filled by artefacts. It follows that to withdraw consent, to disrupt apparent imperatives is also a socially inflected matter rather than a purely individual action.

When it seems that our digital systems are imposing upon us restrictive 'cultural specifications' (Magnusson 2009: 175) then this can be understood more fully as arising in a particular complex of social, historical and material circumstances than as an inherent property of digitality. It allows us to acknowledge, for instance, that those things we are trying to achieve that the computer appears to be 'making' difficult are socially constituted aims, whether that be virtuosity (Jordà 2004), intimacy (Cook 2004; Plans Casal 2008) or togetherness (Schroeder, Renaud, Rebelo and Gualdas 2007). Cultural specifications and, it follows, affordances arise in the fold between our socially and historically ensconced priorities and the social-technical histories of our machines, themselves reflective of particular priorities. Affordances, therefore, are partly constituted by convention and by consent. Consent can be withdrawn, of course, and new affordances are found by disrupting what is taken to be correct usage or by trying to achieve something apparently perverse – such as when Phil Archer deliberately overloads his CPU to create variations of current on a USB bus that is controlling a slide guitar made from eviscerated CD players (Archer 2006: 24–5). This non-compliance is socially inflected in the same manner; apparent perversity is relative to socially situated expectation, and affordances for disruption emerge more readily in a social milieu that sanctions such things.

2.6. Summary

The epistemic features that seem to distinguish the digital from the acoustic when viewed from the close-up vantage point of player-instrument dissipate somewhat when we zoom out and consider players and instruments as situated in an ecosystem of connections and histories.

1. 'Top-down' and 'bottom-up' design practices are less readily distinguishable, as a complex web of different types of conceptual framework that relate and interact in various ways can be seen to feature both in both digital and acoustic making.
2. Artefacts are systems within systems, and can readily incorporate disparate mixtures of the high- and low-tech, and material and immaterial, resources, such as symbols and ideas. The practical boundaries of instruments, in such a view, become contingent and dynamic, prompting the suggestion that such configurations as violin-plus-score may be considered as an operational unity that presents symbolic mediations, like a digital instrument.
3. Symbolic mediations are not unique to digital systems, and do not, on their own, account for breakdowns of embodied flow.
4. The symbolic components of performance ecosystems are not stable channels of fixed or unambiguous meaning, but are subject to contingent interpretation in practice. Digital instruments, like acoustic instruments, are interacted with on the basis of mixtures of tacit and formal knowledge.
5. The propensity for agency of digital instruments is also present in the acoustic realm, both through the active nature of working with raw materials and acoustic instruments and through the way that both opportunities and foreclosures of creative potential emerge in the context of particular social, material, historical and political systems.

It is worth emphasising again that arguing against the *necessity* of the difference between acoustic and digital instruments is not an attempt to negate or otherwise devalue the experiences of such difference. Rather it is an attempt to relocate the explanation for these experiences to a wider context with, I believe, more explanatory potential, and to propose that where digital instruments might seem particularly potent in their 'cultural specification', this is a difference of degree that arises in particular configurations of people, materials, symbols and histories.

That our relationships are spread out to such an extent across the worlds we inhabit serves to remind us that our practice is similarly diffused, something in Ingold's terms in which we *dwell* (Ingold 2000). When we come to perform and design digital instruments we bring to bear a range of cultural, social and bodily competencies beyond the technical ability to communicate with the machine on 'its' terms. Where there do seem to be significant differences in the musical experience between digital and acoustic

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practices then, in addition to Magnusson's call for designers to take seriously their potential in establishing cultural horizons, it is also a matter for practitioners to communicate about, both between themselves and more widely. Specifically, there may be fruitful discussion to be had on the kinds of conjunctions of skills, priorities and preferences we find ourselves bringing to bear, and the kinds of coping strategies we develop.

3. AGILITY AND PLAYFULNESS

By way of two possible headings to orientate such discussion I would like to suggest 'agility' and 'playfulness' as interleaving manifestations of skilled practice in music. These do not constitute an attempt, on my part, to establish a taxonomy. Rather, I am interested more generally in finding ways of languaging (Maturana and Varela 1992) about musicking (Small 1998) responsive to the array of different sites, temporal orders and social conditions that practice spans.

Agility and playfulness provide two possible points of focus for reflection on how various types of, possibly tacit, knowledge about the *interaction* of different components of the performance ecosystem inflect our action and constitute aspects of our craft. Both concepts have connotations of movement. In play, argues Martin Dixon, we engage in 'a circular – more especially a non-telic – movement of free, unencumbered passing and exchange' (Dixon 2006: 20). By contrast, there is a telic aspect to agility that describes something of the quality of movement from moment to moment.

- Agility can perhaps encompass the varieties of moving that are involved in performance as well as the kinds of movements between performative sites, musical codes and ways of signifying that practice involves. It could focus on the *instrumental*: the ability to handle one's (quite possibly uncooperative) equipment in performance, or coping with a 'polyphony of polyphonies' (Emmerson 2007: 114), with performing through technical failure, or with straightforward dexterity. At a different order of temporality, we can appreciate agility in the crafting of instruments and recordings, in negotiating the medium.
- Agility could also refer to the micro-social aspects of music-making: our ability to respond intelligibly to, or support, co-players and audiences, or to allow shared forms to emerge between players without pushing or pulling. It could also feature in our abilities to negotiate wider social situations, such as the performative transitions between concert halls, clubs, community centres and classrooms that carry perhaps more dramatically different social codes than sonic. Finally, we could think of agility in terms of larger-scale social levels, such as negotiating the contemporary profusion of genres and signs.
- Playfulness is suggestive of ways in which we can orientate movements with respect to the context we find ourselves in, the manner in which we conduct our 'wayfinding' (Ingold 2000: 235–7; see Section 2.4). It should not be mistaken for a necessary absence of seriousness; as Martin Dixon has explained, play is always a serious business for those involved, otherwise it ceases to function as play – it must be wholehearted (Dixon 2006).
- Playfulness, like agility, can encompass different focuses. We can, for instance, consider playfulness towards tools and media in terms of a contingent withdrawal of consent to engage with them 'properly' (see Section 2.5). There is an evidently playful aspect to the successive appropriations of technology that have occurred in electroacoustic music, from Cage's use of phonographs in *Imaginary Landscape No. 1* (1939) (Emmerson 2007) to contemporary hardware hacking (Collins 2006) and live coding (Collins 2007) practices.
- At the micro-social level, playfulness could describe both the ways in which players orientate towards each other and the ways various mediations between players – such as scores, machines, concepts and codes – interact with and script such orientations. This aspect is perhaps most readily observed ethnographically so as to capture the specific instances in which collaborative endeavours are inflected by social and material circumstances; Sophy Smith's examination of turntablist groups' creative processes is exemplar in this respect (Smith 2007). Similarly, playfulness can capture the ways in which we relate to further flung parts of the performance ecosystem, such as the codes and conventions that constitute particular performance rituals (Frith 1996; Small 1998) or playing with genres and other signifiers, as in discussions of sampling (Cutler 2000; Rodgers 2003).

4. CONCLUSION

The idea of the performance ecosystem invites us to consider the profusion of linkages and contingencies that make up practice and, as such, affords probing conceptual boundaries that underpin the kinds of categorical distinctions that inform discourse about musical performance, such as those between performer, instrument and environment (Waters 2007). The idea has been used in this article as a basis for proposing an extension of Magnusson's epistemological account of acoustic and digital instruments (Magnusson 2009). I have argued that, by situating accounts of players and instruments into a social and interconnected world,

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categorical distinctions between the acoustic and the digital dissipate somewhat, and that such differences in practice are contingent upon the shifting intersections between the technical and social. This being the case, it was suggested that capturing the nature of such differences and coping with possibly negative consequences could not be achieved fully from the perspective of the designer, but needs also to refer to specific contextualised experiences of usage and performance.

Enlarging the analytical frame by the small degree that I have attempted in this article – out from the abstracted performer-instrument and into populated, historicised environments – has involved brushing up against a number of other actors and valances further 'off-stage' (Suchman 2007: 223). These encounters were necessarily fleeting, in the interests of coherence and conciseness; nevertheless, there are a number of immanent themes that could ground further work. Firstly, there is the issue of what sorts of methods of enquiry afford what sorts of views of the performance ecosystem, and how this may inform the various disciplinary tendencies within which research into contemporary music is conducted. A further area for work, following from this, is elaboration on the various ways in which the technical and social aspects of music run into the political, not only in terms of the wider political economy of music (Attali 1977), but also regarding the role that the politics of knowledge may play in mediating access to or sanction for music-making, and how this may relate to wider contemporary polities.

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