EMBODIED LISTENING, AFFORDANCES AND PERFORMING WITH COMPUTERS

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ABSTRACT

I consider here some contemporary approaches to the live performance of computer music. Drawing upon ideas of the embodied mind and the extended mind, I will outline a theory of embodied listening which problematises some of our assumptions about music, gesture and performance. Against the background of this theory, I will argue against approaches which put too great a focus upon gestural legibility in when design new computer-based instruments.

I will consider a diverse array of practices in contemporary instrument design which do not necessarily adopt principles of gestural legibility, and challenge some of our ideas about what instruments and musical performance should be. I draw upon the notion of affordances, and argue in favour of an approach to computer based instrument design which seeks to explore the unique affordances and singular possibilities we find in new technologies.

1. INTRODUCTION

The relationship between computer music and the live presentation of music is complex and riddled with anxieties. The tape music and electroacoustic traditions embraced the static playback of precomposed pieces, with no pressure on a composer to 'play it live', often because the studio processes and existing computer technologies rendered this technically difficult if not impossible. However, the design of new musical instruments or systems for the live performance of computer music has been a continual and continually growing issue of concern and area of research within computer music. These instruments might use microprocessors or computers coupled with sensors and controllers. Nowadays, easily hackable consumer devices such as the Kinnect or Nintendo Wii, along with a huge market for control surfaces, such as the Akai MPC controllers for DAWs, have made gestural control of computer music and the potential for 'live' performance a particularly important element of research surrounding contemporary computer music. The design and development of these instruments is often informed by a series of assumptions about musical performance, the role of gesture, and just what it is that makes a performance musically compelling. These are assumptions which I believe it would be healthy to challenge.

In order to consider the role of gesture, I will discuss the *embodied* nature of our musical encounters: listening is situated not just in the ears or mind, but involves the whole body and the instrument one plays. I will use this idea of embodied listening to problematise any overt focus on 'gestural legibility' in new instruments, suggesting instead that body movements are part of the totality of a musical performance, and it does not matter if they can be clearly seen to trigger or modulate sounds. It will be argued that such a focus on 'gestural legibility' may act to hinder explorations of the potentials of new instruments, and that we must approach them *on their own terms* rather than shoehorning them with preconceived ideas of what music and performance should be. Drawing on the concept of 'affordances', I will consider new instruments and technologies as possessing unique affordances and singular qualities which we can seek out if we approach them with sufficient openness, and without overly restrictive notions of what music, listening and performance are.

I will then look at some contemporary performance practices, not all of which involve computers, which are able to harness these unique, singular affordances of certain objects and technologies, and as such can productively inform the design of computer-based new musical instruments.

2. AFFORDANCES

This paper draws on James Gibson's notion of affordances, along with William Gaver's notion of hidden affordances, concepts which perhaps require a little initial explanation before they are deployed. The concept of affordances was created by psychologist James Gibson in 1977, and has since migrated to various fields, including Human Computer Interaction and Interaction Design. Gibson describes affordances as follows, 'The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill.'[12, p. 127] Affordances are not necessarily manifest or perceptible, unlike more quantifiable properties. William Gaver, has added to this the notion of hidden affordances, those affordances that are often only discovered through random, improvisatory, exploratory interactions. A pivoting door handle, for instance, clearly affords grasping, but it might take an exploratory interaction with it to discover affordance of turning the handle. [11] Clearly, musical instruments have affordances that might be more or less hidden, and these structure how we engage with them,

and the sort of music and performance practices that we might expect to emerge from them. Furthermore, exploratory improvisations with such instruments might reveal hidden affordances, such as is the case when the extended playing techniques of musicians such as Keith Rowe or Evan Parker reveal new sound worlds for the guitar and the saxophone respectively.

3. THE EMBODIED MIND

Contemporary fields of research such as artificial intelligence and cognitive science have brought us to challenge earlier models of a mind / body dichotomy and raised questions about the nature of cognition, perception and reasoning. An increasing amount of evidence suggests that the mind is best described as 'embodied' and cognition 'extended'. Whilst there is still no consensus on many of these issues, we can draw out some of the claims and investigate their effects on the way we think about listening and playing. I will ground my discussion with reference to two related theses from cognitive science: firstly, the mechanisms we use to perceive the world about us may also provide the basic neural structures with which we perform complex reasoning [14] Secondly, aspects of cognition are better understood when we don't limit our studies to the brain, but consider the interactions between our bodies and environments. [8, 27]

Cognitive processes can be seen to be routed in our lived, *bodily* experiences. Psychologist Margaret Wilson writes, 'Mental processes that originally evolved for perception or action appear to be co-opted and run "off-line", decoupled from the physical inputs and outputs that were their original purpose, to assist in living and knowing.' As an example, Wilson notes how explicit counting on fingers can become mere subtle nudges of knuckles, and then just 'the priming of motor programs but no overt movement.' [27, p. 633] Similar conclusions emerge from the works of cognitive linguists George Lakoff and Mark Johnson in their assertion that 'The same neural and cognitive mechanisms that allow us to perceive and move around also create our conceptual systems and nodes of reason... Because our conceptual systems grow out of our bodies, *meaning is grounded in and through our bodies*.' [14, p. 4-6] This idea that the neural structures which we use for perception may also be used for more complex cognitive tasks suggests that our ability to reason and even the way in which we construct notions such as 'musical meaning' comes from our experience of the material, physical world, and that our perception of that world is itself shaped by our encounters with it.

A process known as symbolic off-trading is one of the ways in which we can see our bodies playing a role in our reasoning and effectively 'doing cognitive work'. This could manifest itself in numerous ways, as Wilson suggests that many of the gesturing movements of speakers are not communicative nor epiphenomenal, but assist in the cognitive processes of the speaker. [27, p. 629]

Beyond our own bodies, the 'active externalism' thesis of Clark and Chalmers suggests that we also enter into 'cognitive systems' with components in our environment; when using a tool or technology, the human body becomes part of a coupled system, the totality of which should be seen as a cognitive process even if it is not contained to the head.[8]

Not only are our cognitive processes grounded in the body, but moving the body (or further acts of perception) can be an *active part* of these processes; moving and thinking can be construed as being embedded within each other and the ways in which we move our bodies can be construed as playing a role in the way we generate meaning in our everyday behaviours. In this way, our environment and the tools we use in that environment can be seen as coupled with and part of our cognitive apparatus.

4. EMBODIED LISTENING

These ideas of embodiment have implications for how we think about listening to and playing music. Wayne Bowman asserts that research in embodiment may offer strong grounding for claims about the central role of the body in musical experiences, suggesting that if listening to and playing music activates the same neural circuitry as bodily movement, then the bodily movements we associate with music should be seen as a fundamental part of what music is. [2, p. 50]

Embodiment and extension theses also suggest that we must recognise that listening involves more than just the ears, but the whole body, and in particular the musical instruments we might work with. The way in which we move when we encounter sounds and the way we move when we explore and play instruments can be seen as part of the cognitive processes involved in the perception and cognition of music, not just something superfluous or even something communicational, but part of how we generate musical meaning in our sonic encounters.

An interesting example of symbolic off-trading in music perception and cognition comes from a study of capoeira by ethnomusicologist Greg Downey. He describes watching a performance, observing the non-participating musicians playing along on their own phantom instruments, tapping fingers and hands, and how this was never simply tapping along to the rhythm, but would involve complex counter-rhythmic layers. He writes, '[The] incorporation of bodily skill conditions a practitioner simultaneously to hear the rhythm that is being played by another and to feel different, complimentary rhythms or variations emerging from his or her own fingers and hands.' [10, p. 498] The movements of the practitioners were not simply 'on the beat', but falling in between the beats, as the music is experienced and reconfigured through the body. These movements of the hands need not be seen as a conscious response to the sound after it has been listened to, but as part of the listening process. Downey suggests that within the context of people who have acquired instrumental or dance-related proficiency, aspects of the process of listening whilst dancing or playing upon these instruments are embedded in the body. Music becomes generalized in the limbs, not localized only in a relation between the ears and mind, and listening and moving becoming intimately intertwined.

The 'superfluous', theatrical gestures that many musicians put into their performances may be seen as part of this 'symbolic off-loading' or embodied listening. [5, 22] As Marcelo Wanderley et al note in their research into ancillary gestures of clarinettists, such gestures 'are not randomly produced or just a visual effect, but rather they are an integral part of the performance process.' A theory of embodied listening allows us to conceive of these movements as an essential part of the way in which we experience music. Wanderley observes clarinet players performing the same piece with instructions on varying degrees of 'immobility' that they must display in their playing, and when performing a learned piece they always tried to make the same certain movements, which were engrained on their mental representation of the piece. [25]

Embodied listening lets us consider how all of these 'superfluous' or non-musical actions that make up our musical experiences, whether they be the strange plethora of facial expressions coming from some jazz drummer, the head-nodding of an otherwise static laptop performer, or the wild hand gestures of a passionate vocalist can be seen as essential to the processes of listening and playing, and the lived totality of the music as it is experienced by an embodied mind.

5. COMPUTER MUSIC PERFORMANCES

We can now bring this notion of the embodied nature of our musical encounters to a consideration of some approaches towards new, computer based musical instruments and performance, which is perhaps epitomised by the 'laptop performance'. We often find a certain anxiety amongst many performers using laptops, lacking as they do the cultural familiarity of traditional instruments. This anxiety often centres around concerns about how some 'other' - be it the audience or another performer - will be able to comprehend the intent of the performer, understand the 'instrument' and be sure that some human agent is making decisions. This is often couched in terms of 'gestural legibility', and manifests itself in attempts to create and perform clear correlations between the performer's bodily movement and the causation or modulation of sounds.

What I will call, after Kim Cascone, the 'concert hall tradition' - having a performer or group of performers playing on some sort of stage to an entirely separate, attentive audience - contributes to this anxiety through perpetuating a series of expectations and assumptions about music and musical performances which has survived and permeated the way in which experimental, electronic and dance music performances are construed, presented and received. [6] As Cascone suggests, performances in such 'concert hall' scenarios (perhaps rarely literally in concert halls) foster the expectation of something visual - a spectacle - which can be problematic for a laptop performer, as it 'invokes the standard performer–audience polarity, which places the performer in the role of a cultural authority. During laptop performances, the standard visual codes disappear into the micro-movements of the performer's hand and wrist motions, leaving the mainstream audience's expectations unfulfilled.' [7, p.102]

Of laptop performances, it has become a somewhat tired cliché to say 'he could've just been checking his email'. Tired, but powerful nonetheless, and forever haunting laptop performances, underpinning many of the approaches taken in digital instrument design. In a paper given at NIME, Takuro Lippit (aka DJ Sniff) of STEIM research centre in the Netherlands describes some of the rationale behind his own turntable-controller-laptop set-up as being influenced by the 'illegibility' of laptop performances; 'Building a system that was coherent to the audience was [a] strong motivation for this project. This was a reaction to the typical laptop musician and performance that was becoming prominent at the time.' [15, p. 73] Another NIME paper discussing digital instrument design situates laptop performances as the flawed model against which digital instrument designers must work, writing, 'These performances can lack a sense of active creation, as well as a visual connection between the performer's actions and the audio output [...] A disconnect exists between the ostensible producer of the music and the music itself: there is no *visible causal link* apparent between the performer's gestures and the resulting audio'. [28, p. 168] For many, the problem is located in the lack of a moving body being seen to cause sound with gesture. Instrumental gesture, understood in terms of a moving body 'causing' sound, is seen as essential to an audience's experience of a performance. Even Miller Puckette, the creator of Pure Data and hence perhaps a 'godfather' of live laptop performances suggests that some sort of gestural legibility would help audiences. [19]

With this weight of consensus against them, rarely does a performer want to be seen playing his music motionless behind a laptop, even if the music was composed whilst motionless behind a laptop, and even if reproducing it live demands little more than being motionless behind a laptop. Extending computer music through new interfaces or embedded computers, then, is often informed by attempts to create and then perform 'gestural legibility', linking a moving body to sound created or modulated.

However, when we think 'gestural legibility' through in terms of embodied listening, it emerges as something of a red herring. The movements a performer makes can be construed as being meaningful as part of the embodied totality of the music, regardless of whether they are triggering or modulating sounds. It is certainly one way of illustrating an understanding of how a new instrument might be working, but it must not be assumed to be an axiomatic principle of instrument design. Greg Corness complicates any ideas of there being clear, understandable relations between gesture and sound that contribute to musical meaning, citing as one example the way in which a group of his students all appreciated and 'understood' Ligeti's *Continuum,* believing it to be an electronic piece and ascribing meaning to it in this context, only later realising it was played on a harpsichord. As Corness notes, his students 'managed to form an understanding of the music with a false conception of its production. Such examples raise questions concerning [the] proposal that we understand music with the aid of the gesture that produced it.'

Further to this, Corness notes the way in which particular virtuosic performers are known for making their playing look easy. An understanding of how difficult a piece is, or how skilled a performer is at playing it, often relies on an understanding of both piece and instrument that many audience members do not possess anyway. During classical or rock concerts, a significant proportion of the audience may not be able to clearly observe how the performers are moving and creating sound: the actual hand movements of a virtuosic pianist may only be as clear as those of a virtuosic laptop musician. As Corness suggests, a lot of people's 'knowledge' about instruments and performances may be reliant upon acceptance of cultural norms and familiarity [6]. The piano arouses less suspicions than a laptop: it's an established performance tool, far harder to check emails on than a laptop, wildly inefficient for word processing or annual accounting, whilst the laptop enters the stage accompanied by the stigma of being merely some jumped-up calculator.

Not only is 'gestural legibility' a problematic concept, but using it as an axiomatic principle risks predetermining the way in which new instruments are used and thus foreclosing avenues of exploration of their unique possibilities. The instrument itself, as well as the myriad codes of the concert hall, shape the music performed and the nature of the performance: as Thor Magnusson observes, instruments contain 'knowledge systems' encapsulated in their very design, such as the piano keyboarded telling us of the unimportance of microtonality, the drum-sequencer telling us how natural 4/4 rhythms are, and the DAW asserting the naturalness of repetition, affording as it does such easy copy-pasting [18]

We might add to Magnusson's list that the 'New Gestural Interface' tells us 'music should contain events and gestures!', and thus expect to hear the traces of these design criteria in music performed upon such instruments. Of course, as Simon Waters notes, 'what musicians tend to be interested in and good at is using devices in a manner which operates at the edges of or outside the design brief'. [26]. Musicians may often subvert the 'design brief' and explore hidden affordances, the unexploited reservoirs of potential that these instruments possess. The piano affords being opened up and prepared in a Cageian manner, or retuned to just-intonation as La Monte Young on *The Well Tuned Piano* did; Autechre use volume data from analogue synthesisers to control drum sequencers in unusual ways that goes beyond the perceived confines of 4 / 4, and the DAW sequencer opens up the possibilities of minute and precise control of sounds, such that there is never any repetitions. [23] Nonetheless, the majority of users of a new gestural interface might be channelled into making gestural music, and whilst this isn't a problem in and of itself, it risks foreclosing explorations of the unique and perhaps non-gestural potentials of these technologies.

As Francisco Lopez notes, the values and hierarchies of the concert hall tradition that result in an emphasis on gestural legibility can serve to prevent electronic performance practices from being assessed *on their own terms* and from realising their potential. Lopez conceives of a 'breakthrough in music of perhaps historical proportions' that we might find in electronic instruments but that is hampered by a blind following of tradition [16]. Instead of trying to fit new instruments into our notions of what music and performance is, then, we should explore the new affordances they may have. We can now consider some approaches which do not 'blindly follow' performance traditions, instead approaching new instruments for their unique affordances.

6. ALTERNATIVE MUSICAL INSTRUMENTS

John Bowers, Phil Archer, John Richards and Simon Waters are amongst contemporary performers, instrument builders and theorists who move away from a focus on such things as 'repeatability' and 'perfectibility', instead introducing elements of instability, unpredictability and amateurism into their performance set-ups. These individuals break away from approaches which use one element of the performance - such as gestural legibility - as an index of musical quality.

Bowers and Archer have an 'infra instruments' project, which posits itself against MIT's 'hyperinstruments', the latter being a project which emphasize concepts such as 'the instrument', learnability and refined technique. Hyperinstruments are intended to facilitate 'rich interactive capability', 'engendering of complex music' and 'expressivity and virtuosity'. 'Infra instruments', on the other hand, foreground a 'constrained interactive repertoire', deploy 'few sensors' or 'gestural measurements', 'engender relatively simple musics' and are 'restricted in their virtuosity and their expressivity'[4, 17] The point is not that rich interactive capability, virtuosity and so on are thoroughly bad things that should be avoided, but rather that they should not be unquestioningly taken as the markers of a successful or interesting musical performance or new musical instrument: the multiplicity of performance cannot be reduced to such qualities. Through problematising any simplistic approach which presents 'virtuosity', 'complexity' or 'legibility' as a nexus of quality, we refocus attention on the whole 'performance settings', or what Bowers has termed the 'performance ecology'; the totality of the performance. As Bowers and Archer note, 'The whole performance setting becomes the unit of analysis, design and evaluation, not just the single "new instrument for musical expression"'/ [4, p 10]

Bowers and Archer identify multiple areas where we find 'infra instruments', such as their own Strandline Guitar (driftwood and pebbles assembled into a makeshift guitar) and De Housed Home Keyboards alongside Vienna's Vegetable Orchestra (who make the 'obvious mistake' of making instruments out of fresh vegetables, as oppose to some hardwearing material).[1] They also look at some of the approaches of contemporary electro-acoustic and minimalist improvisers, who often appear to remove the gestural body from their performances, challenging ideas that 'virtuosity' and 'gestural legibility' are crucial factors in

performance. Toshimaru Nakamura is one such improviser, who plays the 'no-input mixing desk' (a mixing desk connected back into itself in a web of feedback loops) who has described the importance to him of keeping very still when playing, because he feels that this is natural and honest Sachiko M, another minimalist improviser who often plays a sampler with an empty memory, producing only sustained sine tones, says of her contemporaries, 'I think these musicians' focuses are on hearing the sound, not physically playing musical instruments. Sometimes the instrument is an obstruction. They just want to listen more to the sound.' [1]. Whilst these infra instruments may not involve computers, the way in which they challenge the notions brought to computer-based musical instrument design is of great value, and the models for performance and musical interaction that they open up should be examined.

David Toop further considers the absence of the performing body amongst laptop improvisers, seeing it partially rooted in the sound-world they often choose to inhabit, and being bound up with what he sees as a new mode of listening, describing a shift away from observable physical technique and an immersion in considered listening and attention to the sound of rooms, and the precise placement of sounds. [24] These musics challenge the ideas that gesture and event are essential qualities of music and performance, reasserting music making and listening as multiple, diverse activities, which may then allow for an exploration of the novel possibilities of new technologies on their own terms.

It can sometimes be in the apparent constraints of new instruments that we find some of their singular qualities that are worthy of exploration and may helps us realise what Lopez described as the 'most important breakthrough in music of perhaps historical proportions' [16] These constraints may only be constraints when observed from the aspect of traditional modes of performance. Atau Tanaka describes how through engagements with perceived constraints and idiosyncrasies, creative relationships with these new musical tools might arise [22]

Whilst rooted in DIY electronics and in some ways the polar opposite of Powerbook sterility, John Richards's practice suggests different and useful ways in which we might consider the laptop – and computers in general- in performance. He inverts the design ideas which try and model the instrument around the needs of the performer, instead effectively considering the instrument as an 'actor', looking at the way in which an instrument, through its affordances and constraints, can *impose* certain manners of moving upon a performer, writing, 'Rather than thinking in terms of "mapping gesture," the design of electronic devices and their position on, for example, a tabletop can act as a way of dictating gesture and body movement in performance.' [20, p 30]

Following Richards, we might consider laptops not as being *limited*, but rather as dictating certain body movements, gestural languages and singular ways of playing that we might embrace. A particularly poetic investigation of the singular nature of the laptop as instrument, allowing gesture and bodily movement to be dictated by the device in a decidedly elegant way, is Hans Koch's *bandoneonbook*, which emerges out of a search for such singularities and utilises the specifics of a certain range of Apple laptop, playing it in a manner not too far from a 'squeezebox':

> is it possible to find -besides clockspeed, cpu-power, more bit-depth on the ad/da converters, etc.- something specific to a certain machine, which can pass as an instrumental quality for that model [...] my research focusses on hardware-specific aspects of certain powerbooks and then goes on to make them playable with max/msp patches and interfaces [...] when apple introduced the titanium-powerbook series in 2001, the heralded big progress came with some minor sacrifices (no more audio-in) and one very special design-flaw: the microphone was put directly next to the left speaker and thus merrily feedbacking along with its fellow speaker as soon as one tried to use both. This sweet little feature/bug was the starting point for my piece bandoneonbook, which filters and tunes the feedback through a maxpatch, controlled by the keyboard and makes it dynamically playable via opening and closing the lid. [13]

Another, perhaps more obvious quality of laptops (and computers in general) is the absence of physical effort and gesture needed to produce and sustain sound, a 'distance' or 'detachment' from sound production that many interfaces try to overcome, for it is seen by many as one of the key problems with the laptop in a musical context. However, it may be something that can be exploited and explored as being in fact a singular and even desirable quality of the laptop. In 'Simple Interfaces to Complex Sound in Improvised Music', John Bowers and Sten-Olof Hellström introduce the concept of 'expressive latitude' as a principle in instrument design, favouring devices which are not continually coupled to the body and its gestures, leaving the body free to add emphasis to gestures, and creating a space for expressive body movements which do not affect the music. [3, p.125]

As our thesis of embodied listening suggests, the moving body remains an important part of the totality of the performance even if it is not triggering or modulating sounds. There is a powerful suggestion for instrument design, then, in Bowers's and Hellström's work: we can think instrument design not just in terms of what movements produce sounds, but in terms of those movements the performer can make *without* modifying or producing sounds, movements that are still an essential part of the totality of the performance.

The laptop clearly contains a great deal of 'expressive latitude', for when it is not coupled to an interface or sensors, many of the performer's movements will not be translated into sound, and the body might be seen to be at a certain 'distance' from the sound production. Joel Ryan from STEIM points out that this 'distance' provided by a computer would be construed as desirable by certain strands of thought within compositional

practices, describing how in this last century a great deal of effort has gone into distancing techniques for musical composition, evidenced in the Serialists, John Cage and post-war experimental musics, trying to limit traditional techniques, habits or romantic self expression. [21]

The distance that the computer provides, ignoring the expressive physical gestures of the performing body, can be seen as a positive and powerful thing, *mediating* gestures that we don't always want to translate into sound.

7. CONCLUSION

In approaches to the design of computer based musical instruments, I argue that we must avoid a reductive focus on 'gestural legibility', because the theory of embodied listening that I have outlined here suggest that the role played by gesture and the body can still have musical meaning even if it is decoupled from causing sound. Being able to see a moving body trigger or modulate sound must be seen as only one aspect of the way in which a performer's movement might function in the totality of a performance, and whilst clear causal links between physical gesture and musical event can be valuable in their contribution to the performance, placing too much emphasis on this gestural legibility takes attention away from many of the other things that make up the totality of a musical performance. We must instead open ourselves to the many different modes of performing and listening.

Contemporary performance practices which abandon pianos and guitars in favour of laptops, biosensors, driftwood and hollowed out turnips should not be judged on the basis of what they lack in relation to older instruments and practices, but on the basis of their *unique and singular capacities:* unique affordances which might manifest themselves as apparent constraints or flaws if we are assessing the instrument on the basis of traditional practices. When designing computer based musical instruments, we should critically consider what it is that makes a performance interesting, a gesture meaningful, and attempt to engage with the affordances of computers, rather than blindly accepting traditional instrumental paradigms.

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