
Applying Kinaesthetic Empathy and Extended Mind Theory to Invasive and Discreet Instruments in Sound-Based Live Performance

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I have taken the ambiguous psychology of Kinaesthetic Empathy and the relatively recent ideas that form Extended Mind Theory and re-contextualised them so they are relevant to sound-based live performance. I then used these psychologies as a guidance to investigate how we interact with discreet and invasive instruments by analysing specific examples of performance, sound installation and composition. I have defined 'invasive and discreet' by using examples of how these instruments are presented as objects in the context of performance. For example, the way in which an object or system can physically invade, and make use of, the performance space when employing technology and physical sculpture; or how an object or system can interact with the performer through tactility and psychological presence. During the process of defining discreet and invasive instruments I noted that there is no binary differentiation because the instruments denotation is dependent on context, sound palette and how they are interpreted as objects for creative expression by the performer. I concluded that the physicality of invasive instruments gives strength to the presentation of ideas in live performance. This is in opposition to discrete instruments which I argue are better suited to studio production or acousmatic performance.

1. INTRODUCTION

In this article, I intend to deconstruct and investigate the following thesis statement: 'Do invasive instruments that interact with external concrete ecosystems and environments by utilising affordances and kinaesthetic empathy have greater strength as performance tools than inward-looking discreet instruments that investigate themselves, the mind and the body?' I will examine and define some examples of discreet and invasive instruments and compare how we interact with them as performance tools using kinaesthetic empathy and extended mind theory. My definition of musical instruments is broad and will extend from electromagnetic fields to the human body as a percussion device. I will extend my investigation beyond the discipline of music and look into dance and other performing arts where I will discuss how certain

practitioners in these fields explore sound and interaction through movement. I will employ this multidisciplinary method in order to gain a new, and hopefully unique, perspective on sound and movement.

I define kinaesthetic empathy as a method of understanding embodied motion, the latter I interpret as an abstract expression of thought. As such I will be using it to study many areas of sound art and sound-based music that are performed using physical movement. Kinaesthetic empathy is related to kinaesthesia and proprioception, however, it is difficult to define and I suggest should be interpreted as the perception, understanding and, to a limited extent, unconscious experiencing of the aesthetics and meaning of observed movement (Reynolds and Reason 2012: 17–22). I will be focusing on the area of the gestural spectrum that covers embodied motion, rather than concrete and theatrical movements that mimic interaction with the physical world. So, for this article, references to gestures are references to embodied motion, and vice versa.

I posit the argument that in order to integrate the human fully into live empathic kinaesthetic performance, we need to focus on instruments that are concrete and invasive rather than those that are inward looking and discreet, the latter I shall describe hereafter as meta, or meta-instruments; for example, electroencephalography-based systems (hereafter EEG) and other instruments that lean towards interaction with virtual worlds. Concrete instruments, such as guitars, bells and tables can extend cognition beyond the body and add an extra element to the localised, stage based,¹ performance ecosystem that would assist in communicating artistic intent to an audience that is physically present. If chosen correctly, a concrete instrument will become intrinsic to a performance and present thought as visible utterances. In combination with the appropriate sound-generating gestural technology and sound palettes, it can create a

¹Loosely defined as an area where the performance takes place.

gestalt performance that is greater than the sum of its parts.

2. KINAESTHETIC EMPATHY

Kinaesthetic empathy is usually defined as the perception and understanding of conscious and unconscious body movement of the performer by an observer. There is an area of kinaesthetic empathy in performance that I define as non-concrete gestural and embodied movement within the space ‘around the body whose periphery can be reached by easily extended limbs’ (Laban 1966: 10). Laban named this space the kinesphere and David McNeill suggests that these non-concrete embodied movements ‘do not just reflect thought but have an impact on thought. Gestures together with language, help constitute thought’ (McNeill 1992: 245). He is suggesting gestures are cyclic and the kinetic movement triggers empathy not only in others, but also in one’s self as a form of thought process. This embodied action is the physical kinetic realisation of cognition (Clark 2008: 123) as it is presented through kinespheric movement of the body. Therefore, kinaesthetic empathy is experienced by the performer as well as the observer. The nature of embodied movement and gesture together means they are ambiguous enough to be interpreted by each spectator and performer individually, rendering each movement a semiotic artistic utterance or external representation of thought. This embodiment is abstract and open for interpretation by a performer or receiver whereas, conversely, I regard pragmatic concrete gesture as theatrical. It communicates something with pedantic clarity; for example, a chopping gesture, a time signature, a rude gesture or a specific language gesture, such as sign language, gesticulation or semaphore. Often but not always a form of mime or mimic.

3. STRUCTURAL PSYCHOLOGY AND EXTENDED MIND THEORY

Structural psychology is the study of the structural workings of the brain whose main working method is introspection (Goodwin 2015: 176). This philosophy has been heavily challenged and considered by many to no longer have relevance (Hergenhahn 1997: 247). It is a psychology that I believe applies strongly to discreet instruments because it places little importance on external environmental interactions due to its introspective nature and minimal connection with actors outside of the body. Conversely, I consider invasive instruments to be congruent with another theory, extended mind theory, which posits that human cognition is extropective, iterative and ‘based on the active role of the environment in driving cognitive processes’ (Clark and Chalmers 1998: 7). David

Kirsh then re-iterated this definition using the context of chance and interactivity:

Owing to interaction with external things, it is best to see processes inside an agent as just one component in a larger network of parts extending far beyond brain and body. With external tools and resources, a person and his or her environment form a distributed system – an unequal partnership but a partnership nonetheless – that spreads state and control across brain, body and environment. We are bound in complex ways to the outside and have evolved to count on this binding. For instance, because our brains are tuned to the location and behavior of things, we can time when and where to look next for relevant information. (Kirsh 2014: 8)

Kirsh, Clark and Chalmers are explaining that human cognition is intrinsically linked to its environment. This would mean that there must be friction, or an area of oxymoronic philosophical dynamics, where many performers who work with discreet instruments that have minimal links to their environment seem to be unaware that the psychology behind these instruments conflicts with the tenants of extended mind theory, which supports live performance. I am taking the extended mind position that we are not passive observers, but an intrinsic component of our environment, and our thinking processes extend beyond our brain and body into our environment and interact with its contents. They make us smart (Norman 1993), they provide us with creative material and they have unique meaning to each of us as individuals. Outside of the often self-referential EEG musical performance system, there is kinaesthetic empathy or a physical object element. Consider, for example, a musician playing an instrument or interacting with an interface to produce musical sound as a part of a group improvisation. Any resulting improvisation could be described as a manifestation of creative thought. Since the process is immediate, musical improvisation works as an audible or visual example of the extended mind hypothesis because any observer is experiencing embodied cognition in the movements of the musicians they observe and in the reception of the sound they produce. Andy Clark proffers a Parity Principle as a rule of thumb:

If, as we confront some task, a part of the world functions as a process which, were it to go on in the head, we would have no hesitation in accepting as part of the cognitive process, then that part of the world is (for that time) part of the cognitive process. (Clark 2008: 77)

There is rarely parity in a musical improvisation, rather a continuous shift of balance and priority that reflects the unequal partnership described by Kirsh. However, Clark’s parity principle works as a starting point for describing the extent that cognitive processes reach beyond our physical bodies and into, for example, improvised creative musical practice. The act of musical

improvisation or devising in the restricted concrete ecosystem of a small ensemble, which is an extension of cognitive processes into the world beyond the body, behaves as a real-world manifestation of creative thought processes, helping to constitute thought into a kinaesthetic-empathic interaction with musical instruments which in turn becomes sound. It is like the footprints of our thoughts. In removing most external interactions that can be classed as elements of our external thinking ecosystem, many EEG brainwave performances strip away the system that is required to allow us to function as creative artists and musicians. It is as if performers are deliberately removing a part of their brain, and parity is lost.

4. DISCREET INSTRUMENTS

Discreet instruments use various technologies and phenomena, and electromagnetism (hereafter referred to as EM) is one phenomenon that is often used as an unobtrusive tool for exploiting kinaesthetic empathy. I found it helpful that Douglas Kahn published a substantial amount of research into sound artists that use electromagnetism in his book *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts* (Kahn 2013). His extensive research has been a source of information for large parts of this article. EM pervades our universe, which means that it is readily at our disposal for measuring its interactions with humans. Its waves propagate as all forms of radiation, including light (Maxwell 1865); however, hundreds of artists have worked with light and sound – from Daphne Oram's *Oramics Machine* (Science Museum 1959) or Benoît Maubrey's *Peepers* (2006) to David Strang's *Transmission + Interference* (2016). Light sensitive instruments tend to be invasive in the environment and I do not class them as discreet. As a result, I will narrow my focus down to what is known as the micro and radio wave spectrum, invisible to the human eye and prone to interfering with delicate electronics. Most artists who have used this form of electromagnetism in their practice have tended to work in the non-kinespheric areas of sound art, such as brainwave detection, sound walks and installations that passively detect electromagnetic radiation with little or no prescribed movement. Examples include Alvin Lucier and his 1965 *Music For Solo Performer* (Lucier 1982), for alpha brainwaves using EEG, and Joyce Hinterding with her 1995 installation *Aeriology* (Hinterding 1995) in which she wrapped 20–30 kilometres of wire around four pillars to detect electromagnetic radiation. Christina Kubisch is an artist who has worked more closely than others with a limited kinaesthetic, but not kinespheric empathy-based human interactions with electromagnetism. Her induction installations use the bodies of the wandering visitors to the gallery as

capacitors that affect and change the behaviour of the resident electromagnetic field (Kubisch 2011).

Conversely, John Richards' Dirty Electronics Ensemble devised the work *Still* (Richards 2013) out of a workshop at the Trinity Laban Conservatoire, using the flashes of hacked disposable cameras as an EM sound source; however, this did not explore the relationship between sound and kinaesthetic empathy because the cameras were static and, as objects, were ignored throughout the performance. They were the generative, non-interactive electronic basis of an ensemble piece performed by classical musicians and dancers. Rather than focusing on the kinetic interaction with the instrument, the workshops and performances of the Dirty Electronics Ensemble blur the boundaries between making and composing by interpreting the circuit as a score, expand on David Tudor's idea of composing inside electronics and create a social making environment (Richards 2012).

Since Lucier's *Music for Solo Performer*, EEG detectors have become vastly more accurate in monitoring the electrical activity of the brain, and relatively affordable to many creative technologists. This has resulted in a proliferation of researchers and artists around the globe attempting to affect, manipulate or generate sound using brainwaves. Two recent examples are Marinos Koustosomichalis's *Inhibition* project (2016) and Amble Skuses's *Balancing Act* (2016). Koustosomichalis's work explores performances based around inhibiting concentration and thereby preventing interaction. His instrument is an assemblage of EEG monitors with a processor that analyses the EEG signal and then synthesises sound, all fastened on to headphones resulting in a system that is head mounted and stand-alone. It immerses the wearer in sounds that intend to inhibit their thoughts as EEG signals are detected and countered by sound-generating software in real time. They are made through workshop practice, which requires kinetic interaction with other participants. However, I think it is important to note that this kind of interaction during making is usually a separate and different activity to the kinaesthetic empathy which occurs in the development of sound art performance, as the former is a prescribing, rather than a devising process.² Skuses's work is based upon physical fatigue affecting brainwave activity in a less controlled manner. She stands *en pointe* in red ballet shoes, on crutches, and recites the names of female composers while wearing an EEG monitor. The data from the EEG monitor glitches and manipulates a recorded playback of the composers' names.

²For the purposes of this discussion, I define 'prescribing' as a method that uses a reasonably fixed procedure to instruct participants directly utilising strong intervention, whereas 'devising' is a method, sometimes group focused, of creating through trial and error with minimal intervention, leadership and guidance.

The performances of Skuse and Koutsomichalis focus, to varying extents, on activities within and about the body and do not extend far beyond. Although Skuses's *Balancing Act* could be argued to be less meta-performance because she uses her ballet shoes and crutches to fight gravity, which allows for a small amount of interaction with outside forces. However, the conversation in her performance is with herself, the objects are closer to being statements that set up the performance rather than partners with which she interacts. Her true interaction, or rather reaction, is with the invisible force that is gravity.

Although I have criticised contemporary EEG performances for their lack of interaction beyond the physical body, there are similar problems with human interaction with environmental electromagnetic fields. When performing with large EM fields there is rarely a discernible tangible object to interact with or work with as an extension of the body, which is generally the intention. EM detectors and emitters are usually utilitarian or designed to be pervasive – as in a part of the structure of the building, such as the previously mentioned *Aeriology* by Hinterding – or discreet, as in the case of *88mc Carrier Wave FM* by Robert Barry (MOMA 1968). Barry's work consisted of an apparently empty room containing a hidden radio transmitter. The physical body of a spectator in the room would affect the reception of the signal, as it would disrupt the carrier wave. Because the artist made the instruments (transmitter and receivers) both discreet and pervasive, the ability of those instruments to interact with performers or audience on a psychological level has been reduced. The intent and purpose focuses towards the technology that is used as an actuality rather than how it is utilised in a creative interpretative performance, a distinction that is often not made clear in contemporary areas of technology-based music performance, as it could invoke a hierarchy or a binary separation between practitioners within science and art. Technology-centred performance tends to be based upon structural psychology and appears to operate in congruence with a phenomenon called techno-positivism,³ which is often accused of having a negative effect on creativity (Njenga and Fourie 2010). Intentionally separating techno-positivism from artistic performance that is based on extended mind theory would hinder development of cross-disciplinary collaboration. However, I believe it is important to discriminate in this case in order to discuss extended mind theory in live sound performance. A balance between the needs of the structures of technology and the functions of art is difficult to retain and relates somewhat to Clark's Parity Principle, because the focus of the art is based around the pervasive nature of the EM in the room. As fascinating as the ideas behind the artwork

are, it leaves the feeling it would need the inclusion of an object or instrument with which the audience could interact in order to break out of the confines of conceptual art and become more publicly accessible.

The ability for a performer to affect a field using the movement of their limbs is limited by the sensitivity of the electronics from which the field is being emitted and by interference in various performance environments, which makes EM-based live sound production indeterminate. For example, the ninety-year-old Theremin (later developed into the Terpsitone for dancers) is sensitive enough to movement that it is often still considered an instrument that requires years of practice for the performer to become a virtuoso and its music to be pleasing to the ear. It also suffers from interference in the live environment, where other electronic equipment and venue wiring of varying ages and states of repair can emit enough rogue EM to disrupt its normal functioning and affect its sensitive balance. Furthermore, the bodies of other performers that may share the stage can affect pitch control (Ross 2008; Martín, Martínez, Ricchiuti, González and Franco 2012). From the evidence and my experience as a musician, I speculate that many instrument makers and commercial musicians avoid EM for reasons of indeterminacy and instead work regularly with other movement sensors. These are often accelerometers and pressure sensors that are part of digital systems, have error correction and are calibrated for the task at hand in order to make the creative process easy, accessible and democratic.

In most of the performances I have mentioned, the phenomenon that has been studied has tended to be the electromagnetic field, the device that detects the field or the resultant sound, rather than the interaction of the EM field with the performer and the relevance of kinaesthetic empathy. The artists themselves concentrate on their practice and rarely write about their work in depth. In general, ethnographic documents of their practice is unusual (Nederberg 2013), which might explain why, as Douglas Kahn's book moves into the twenty-first century in its documentation of the proponents of sound art using this phenomenon, they become sparse and, furthermore, the area of intentional physical action that involves kinespheric embodied motion is notably difficult to identify if it is there at all.

5. INSTRUMENTS THAT ARE SOMEWHERE BETWEEN INVASIVE AND DISCREET

Some instruments have small elements of invasiveness as a part of their form, even though they are closely linked to practices – for example, gesticulation – that are associated with discreet systems. Two examples are Alex Nowitz's *Strophonion* (Nowitz 2016) and Michel

³A compulsory enthusiasm about technology as an ideology.

Waisvisz's *The Hands* (1984). The former was created in collaboration with Daniel Schorno (Nowitz and Schorno 2011) and is a legacy instrument to the latter. Both were created at the Studio for Electro Instrumental Music (STEIM). The *Strophonion* consists of two hand-held wireless boxes containing movement sensors, distance sensors and buttons placed upon the surface that manipulate a combination of pre-loaded samples and Nowitz's live extended vocalisations. Nowitz noted that an additional wired connection needed to be implemented by engineers at STEIM as an option in case the performance environment was engulfed in conflicting wireless communication, which could cause interference with its operation. This identification of and solution to the problem was possible due to the close relationship between artist and technologist, something I shall expand on later in this article. Another interesting point to be made about the *Strophonion* was its development into a unique object. Nowitz initially used the Nintendo Wii remote (or 'Wiimote') as a control device and called the instrument the *Stimmflieger* (Nowitz 2008a). Gestures that are afforded by the *Stimmflieger*, which is a white plastic pointing object, are considerably different to those afforded by the *Strophonion*, parts of which interestingly resemble a pine box despite having been subject to an ergonomic design process. The change in embodied performance that results from comparing the use of each instrument is clearly seen and heard in subsequent works through bonding action to the extended voice.

It is possible to compare gestural actions of the *Strophonion* and the *Stimmflieger* to identify a process of development. One could compare performances of *Studies for Self Portrait* (Nowitz 2008b) for *Stimmflieger* with *Eine Raumvermessung* (Nowitz 2015) to find clear differences in stance and gesture that could be attributed to the affordances of the handsets, the one used on *Eine Raumvermessung* being ergonomic while the one used on *Studies for Self Portrait* was not. Nowitz's stance in the latter appears awkward, but comfortable in the former. As these are two completely different compositions, an accurate direct comparison cannot be made; however, it is enough information, taken together with the endeavours of many other musicians, to start to develop a hypothesis that the comfort of an ergonomic glove-like interface does not always create an engaging performance. Without the *Stimmflieger* Nowitz's actions move closer to becoming visible utterances of his creative thought processes, commonly referred to as gesticulation, as if he were performing extended vocals without the instrument. Performing in this way is a mode of operation that he regularly pursues and is worth observing since it makes the postures and gestures that the Wiimotes afford clearly evident.

Many instrument makers seem to be concerned primarily with control, and the solution sought is often to find greater technical accuracy through technology-based

research rather than using the idiosyncrasies of EM systems to creative ends. This is clear in the development of the *MIMU* glove by Tom Mitchell for the Western popular musician Imogen Heap in 2011 (Mitchell and Heap 2011: 465–8). Mitchell later produced additional research into creating robust wireless systems for the live environment in which the glove operates (Mitchell, Madgwick, Rankine, Hilton, Freed and Nix 2014). In this instance, I believe they saw EM interference as a problem that needed to be solved rather than an opportunity for indeterminate creative exploration. There are other issues with data gloves, or glove-like interfaces. As a kinaesthetic-empathic device, they are mostly utilitarian and one could argue that they fall into the same category as EEG sensors. They are mainly used as interfaces that allow a person to access a virtual environment; however, there have been attempts, such as the *MIMU* glove, Laetitia Sonami's *Ladys Glove* (2001), or Michel Waisvisz's *The Hands* to bring them into live stage performance as a tool for controlling discreet musical systems. As an interactive device, they remove objects from our real-world environment rather than connect with them. Even though I accept that Sonami's glove was intended to have feminine physical presence, I would still consider both instruments are an antithesis to external thinking theories and are limited in their exploration of the operation of creative thought beyond the physical body.

6. INVASIVE INSTRUMENTS

I have categorised human hands, head and various technological accoutrements as discreet, I will now address some practitioners in the performing arts and dance who I consider use the human body, as a whole, as an invasive instrument. Since 2011 I have been working in collaboration with contemporary dancers because I regard the discipline as an excellent forum for exploring kinetics and sound. I have found, through anecdotal evidence, that contemporary dance can often be inward looking by investigating bodily expression with little pause for external interaction, or at the very least being self referential in terms of its remit. This is problematic because, like EEG sensors and data gloves, its practice does not regularly explore extended mind theories; instead the expression of sound in dance is often focused on the exploration of embodiment, which misses many essential elements of external cognition. There are some practitioners, such as Elizabeth Streb, Jessie Marino and Jonathon Burrows, who have touched on the relationship between movement and sound from a dance and performing arts perspective, but they are in a minority. Streb (2010) has spoken of her curiosity regarding body impact noise and other sounds generated through

the practice of dance, which include instructions being called out towards, and between, the dancers during the performance. In her work, these instructions become a part of the performance, connecting sound and kinetics, alongside body impact sounds, to create a soundscape where the dancers are in control of what the audience hears. Her practice borders on stunt work and circus choreography, and breaks the accepted paradigm that dancers must move to music that is pre-determined, scored or recorded, inspiring her to describe music as the enemy of dance (Streb 2010). One criticism that I will make of Streb is that, through observing work that is documented on video, she still regularly uses pre-recorded music in conjunction with her body impact sounds, so there is much more that she could explore in this area. Performing a work that focuses on combining the creation of body impact sounds and audible commands through kinetic body action and choreography into a work of composed movement and sound would be an interesting contribution to the discipline of sound and kinetics.

Jonathon Burrows has produced works for duets; for example, *Both Sitting Duet* (2002) and *The Quiet Dance* (2005) with Matteo Fargion. Both works investigate kinaesthetic empathy and kinetic body movement, democratic roles within the performance, interaction, balance and humour, while utilising performer-generated acoustic sound as a device employed to augment all the aforementioned themes. The sounds include slapping, breathing and vocalisations, and are organised as products of tight choreography. They are mediated by the body and, like Streb's work, they give much of the control of the sound to the dancer. Both works are presented as a series of pedestrian interactions that go much further into the field of acoustic sound and kinetics than the work of Streb – in the case of *The Quiet Dance*, by limiting the pre-recorded sounds to field recording of birdsong.

Jessie Marino has produced a number of performance art-based duets in collaboration with Natacha Diels in the performance duo called On Structure. A particular work of note is *Rot Blau* (Marino 2009), a duet that, amongst other themes, explores sound and kinetic movement. The piece involves two performers who gradually, throughout the duration of the performance, swap places while sitting at a table with a clear surface. The sound is produced through a series of physical pragmatic, or concrete, gestures that create acoustic sound from the contact between their metal tipped gloves and the hard-top surface of the table. The illusion of exchanging places is achieved by the swapping of accoutrements in the form of the separately coloured gloves, wigs and lights.

Performance art trio Pollyfibre, led by Christine Ellison, turns the making process into performance art. In their work *Live Cut* (Ellison 2013) they used tools,

amplified with contact microphones then treated with audio processing, to manufacture faux vinyl records on a workbench that was arranged in the manner of a production line. This work was strong in identifying and making creative use of agency between sound and action. It created a noise that was congruent with the actions of the performers in a manner that, like Marino's *Rot Blau*, was closer to being pragmatic than embodied.

Keith Rowe and Adam Bohman work from the table top in a kinespheric manner with their 'sound tables' that consist of a collection of sounding objects. In Rowe's case these are mostly electronic and in Bohman's case they are mostly acoustic. Rowe's considered and regular use of EM sensitive devices, including a radio, motors and electric guitar, draws his work closer to performance using kinaesthetic empathy than most live electronic table-top music performers. This is because of the proximal nature of EM, although this is not the main focus of his work. Other performers who have worked on table-tops include Hans Koch and Leafcutter John. The table-top performances of all four of these artists are clearly kinespheric but their lack of choreography and focus on agency of sound through movement shows that kinaesthetic empathy is not their primary area of interest.

Elements that are common to the work of Burrows, Marino, Pollyfibre and Streb are the agency between acoustic sound and kinetics and their creative exploration of this phenomena through objects and performance. Marino, Pollyfibre, Rowe and Bohman also use tables as an invasive instrument. The lack of obsession with the latest technology to realise their work demonstrates a curious perspective on sound art drawn from dance and the performing arts. They are able to dedicate creative thought to themes such as humour and democratic roles through sound-related action that I would argue gives a larger vocabulary of performance devices for the expression of performed musical ideas. Such practice avoids concern for the potential failure of their technology, and as a result one could argue that less technology allows for greater creative freedom of expression with the body. However, the downside of less technology is a more limited sound world that becomes concrete and bonded to the sounding objects used by the performers. These include the body impact sounds of Streb, the kinespheric body impact sounds and vocalisation of Burrows and the concrete bonded sounds of Pollyfibre and On Structure.

I also identify a link between the Dirty Electronics Ensemble's workshop practice of making circuits as scores and the performed production lines of Pollyfibre. They both address the same theme of breaking down boundaries between production and art that stems from Gabo and Pevsner's *Realist Manifesto* (1920). Pollyfibre take the kinespheric element of production and appropriate it as sound art performance that

results in a product, whereas Dirty Electronics has created a social making environment with the intention of blurring, or even eradicating, the boundary where instrument building ends and devised composition begins. They both address, and suggest alternatives to, the hierarchy between making, composition and performance.

7. CONCLUSION AND FINAL THOUGHTS

It is difficult, and possibly counter productive, to create solid binary definitions of invasive and discreet instruments. Some fall somewhere in between, such as the wooden version of the *Strophonion*, others re-write the definition of, and relationship between, an instrument and artistic work, such as *88mc Carrier Wave FM*. Due to their invasive nature, instruments with a strong physical presence make better performance tools in devised, indeterminate and improvised performance. They allow the audience to experience the collective extended mind of the musicians through the agency in human–instrument interaction because of the manner in which an ensemble acts, like an organism. For solo performance, Nowitz's *Stimmflieger* and Waisvisz's *The Hands* work because they are, generally, used to manipulate voice samples. They use the human body, whose gestural actions are intrinsically linked to vocalisations of the person inside, or for directing gestural thoughts, shapes and ideas. The body's natural propensity for the embodiment of thought and speech makes them ideal for this specific sound world, hence they do not need to be overtly invasive because this is a role of the body. However, if a performer is not using their body as an invasive performance instrument, then these hand-based instruments do not have the properties to compensate for this deficiency. These are performance-specific instruments with a predilection to work in congruence with vocalisation, and would not work as smoothly for other sound sources, styles, instrumentation or idioms. This is somewhere where discreet instruments such as data gloves are weak because when applied to live electronic music they are often used to control sounds and systems that are not congruent with vocalisations; for example, drums and percussion, synth pads or simulating the manipulation of mixing desks and other control interfaces. I suggest composers restrict the sound worlds that these interfaces control to those that closely represent vocalisations. EEG systems are even weaker for live performance as they present no physical gesture, although it could be argued that is not what many composers intend; yet they still place themselves onto the stage where they can be seen and then make up for the lack of gestural agency with projections, lighting or other devices that are substitutes for performance. In the live environment EEG-based performances are more congruent with acousmatic performance and should be treated as such.

The body as a whole is a strong and invasive sound-generating instrument. Burrows and Streb have used this to seamlessly combine movement with sound. However, when the focus of performance is on appendages it loses its power to be invasive and becomes discreet. This is where other instruments, such as tables and tools, can be introduced to support invasive practice. Pollyfibre and Marino use tables and sounding objects in their invasive performance system that, I suggest, has as much in common with Bohman and Rowe as Burrows and Streb. They seamlessly combine movement and sound while interacting with the objects in their environment as instruments. As I mentioned earlier, there is a strong reference to a production line system in the work of Pollyfibre, Marino, Bohman and Rowe and combining all these aspects presents a method of interpreting work as a performance. The status of the human body as seemingly discreet and invasive at the same time, dependent on context and how it is used makes it unique, powerful and indispensable as a musical instrument.

There needs to be a greater awareness of the differences between extended mind theory and structuralism in relation to sound performance. There also needs to be a greater awareness of how each of these philosophies connects to and underpins different types of instrument and performance. For example, the *Strophonion* is discreet but performed as invasive, whereas *Aeriology* is invasive to the space with 20–30 kilometres of cable but inherently discreet in its application. These performances are not only defined by the kind of instruments used, but also by how the performer uses them, by which philosophies they are underpinned and in which sound worlds they exist.

In contrast to the relationship that invasive instruments have with extended mind theory, a performance of discrete instruments, even when used in an ensemble, is not effective in presenting the ensemble as an organism that can be seen and heard. This means that when discrete instruments are used in instrument-specific performances, their inability to connect with their environment through physical means suggests that they will fail to engage with an audience. All performers need to pay attention to kinaesthetics and their relationships with their immediate environment or develop their bodies as invasive instruments.

There are other less prominent issues that I have touched upon in this article that I feel should also be addressed. Collaborations, and the methods used for their documentation, are very important and, in my experience, intimate and long-term cross-disciplinary collaborations in their various forms are rare. The value of such relationships is something that I have been exploring in my own practice, especially the interaction between sound and movement as this relates directly to gesture and communication with an

audience who, in contrast to acousmatic performance, can see, as well as hear, the performer. Collaborations exist within a relationship spectrum that exhibits varying degrees of intimate connection. They also utilise the many different types of communication that exist when negotiating the different levels of expertise between the actors in each discipline. These communications are often achieved by using objects as agents between each actor. This allows for a strong connection to be established between the act of collaborating and extended mind theory, and as such supports the practice of creating performances in the real world using invasive instruments.

The collaborations that created the *Strophonion*, the *MIMU Glove* and their related performances have, within them, clear distinctions between the roles of technician and artist. This defining of boundaries can be restrictive to the development of new human kinetic invasive gestural instruments, as clear definition of roles suggests that the collaborators have not immersed themselves in each other's disciplines. Practising across disciplines can broaden, for example, the understanding of the maker about the needs and working practices of the performer. The makers dance and the dancers make through negotiating levels of expertise. However, Mitchell and Heap, Schorno and Nowitz have gained success in one aspect, and that is of the long-term nature of their relationships that can, to a certain extent, alleviate the negative effect of defined boundaries by, for example, learning the lexicon of one's collaborator. Unfortunately, there is little in terms of in-depth ethnographic or auto-ethnographic documentation of their collaborations and their importance to the creative process. This form of documentation is an area where I believe the arts has the potential for communicating and giving context to ideas and experiences that established academic formulas that the tradition of Western art music is just beginning to consider. For example, Alistair Gordon's account of building a recording studio during the 2001 race riots in Bradford, UK, and the sense of community he experienced during that time (Gordon 2012). I would encourage more technologists to cross the boundary into creative performance practice and participate, and then to auto-ethnographically document their experience.

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