Listening to the mind at play – sonified biofeedback as generative art practice and theory

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THESIS CONTAINS CD/DVD

Ecoute bien pourtant. Non pas mes paroles,
mais le tumulte qui s'élève en ton corps
lorsque tu t'écoutes.

Yet listen well. Not to my words,
but to the tumult that rages in your body
when you listen to yourself.

René Daumal

Abstract

Explorative play affects the root of our being, as it is generative. Often experienced as a thrill, explorative play gradually lures its players beyond their mental or physical limits. While doing so, it affects players well before they can perform intentional actions. To understand explorative play therefore means to understand what happens before intention sets in. But this is problematic: by the time this becomes experienceable it is already clouded by habit and memory. However, thought processes outlined in Deleuze's philosophy of difference reveal important clues as to how habitual thinking patterns may be exceeded, and why explorative play might cause thrilling and vertiginous experiences: when our awareness of the present is intensified, the potential to disturb habitual patterns arises; within this there is a chance to arrive at an 'intuitive understanding' of events where intensities express themselves as non-intentional movement or poetic language.

This notion was investigated through generative art practice. An experimental setting was prepared that allowed for explorative play with a complex system – a biofeedback instrument that sonified its wearer's physiological data in real-time. This instrument was explored in performances as well as participative action research sessions. The insight emerging from the *performances* was that introspection and stillness can enhance practice. The connections to Eastern practices this suggests were followed up and, by investigating the role of stillness in performance practices like Butoh, methods that may radicalise a biofeedback performance came to light. Extending these to biofeedback composition then made listening a central focus of this research and consequently, listeners' responses to sonified biofeedback, the disruption of habitual musical expectations and increased immersed listening became paramount aspects of the practice. Conversely, the insight emerging from the *participative sessions* was that explorative playing with a complex system can allow for a more intuitive understanding of the generative because the emerging play experiences can be internally transformative; producing new ideas and forms, for instance poetic language or improvised movement. Thus overall, the research underlined the benefits of a greater propagation of explorative play.

Keywords

Explorative play, generative ontology, sonified biofeedback, interaction, stillness

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0 - Introduction

This chapter problematises the understanding of 'generative' that feeds into generative art and theory. It is argued that only when generative processes are connected with processes of perception, which take place when generative artefacts are being (re)viewed, is it possible to arrive at thorough understanding of the generative. Since it is maintained that such a connection can be made by engaging in play with a generative system, this research investigates the notion of the generative through explorative play with an instrument that sonifies the physiological processes of the body.

Aims and objectives

The aim of this research was to interrelate analytical processes and processes of perception that take place during explorative play with a complex system. This was to establish, firstly, how the generative powers encountered during play could challenge traditional modes of perception and bring about new experiences, and secondly, how a complex system may act as a catalyst in this process. This aim was to be achieved through a number of objectives:

Drawing upon selected sources from the fields of philosophy, psychology, play theory, performance theory and contemporary music theory, the theoretical foundations of this interdisciplinary research into generative processes were to be established. Then, with a more thorough understanding of the generative, an alternative stance to established modes of practice was to be outlined with the view to enhance future interactive media practice.

A number of generative artworks dealing with play and transformation were to be selected and reviewed.[1] These artworks could encompass generative systems, responsive environments, sound installations or experimental performances. The results of this review were to be documented in form of an online database, while methods found within these practices were to be adopted for the development of this practice.

Through creative practice, an interactive sound environment was to be developed that would allow for performative action and participative play. For this environment, a suitable interfacing device was to be designed, software programmed and sounds composed. The

[1] At the end of the research, this number amounted to sixty-one mostly interdisciplinary artworks (see chapter 2).

emerging 'system' would thus join together live signal processing, sound composition and experimental performance, and illustrate how the debate surrounding experimentation and play within an interactive context could be opened up.

This creative practice was to be progressed in iterative steps and in an open dialogue with practitioners and audience members. Thus the play experiences emerging from interacting with the system were to be evaluated communicatively. For this, a number of action research methods were to be devised, which needed to include direct observation of participants, self-observation, feedback sessions with test audiences and fellow practitioners, and activity-based communication analysis.

Throughout the research, outcomes from practice were to feed back into the theoretical framework and vice versa. Stages of development therefore needed to be documented regularly and submitted for peer review in form of conference papers, test performances or lectures/demonstrations. In this way the ongoing research process could contribute in a useful way to current practice debates in the field.

These aims and objectives set the course for this research, but had to be supported by a theoretical and practical framework that would focus it.

Introducing the research focus

In *What is Generative Art? Complexity Theory as a Context for Art Theory*, Philip Galanter draws useful parallels between complexity theory and generative art.[2] This introduces the reader to thinking about the 'generative' as well as different kinds of generative systems that have been explored in generative art and music in the past. Thus, according to Galanter:

> Generative art refers to any art practice where the artist creates a process, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is then set into motion with some degree of autonomy contributing to or resulting in a completed work of art.[3]

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[2] Philip Galanter, 'What is Generative Art? Complexity Theory as a Context for Art Theory' in *Generative Art Proceedings* (Milan: 2003) pp. 4 ff.

[3] Galanter, p. 4.

Although this is an apt general definition of generative art, and particularly useful for artists working with a wide range of generative processes, it omits a significant aspect: what is the fascination of observing or listening to generative processes in action? If the reception of an artwork completes the work, then surely the crucial difference made by *experiencing* generative processes needs to be integrated into this definition. Since every observer responds differently, the idea of establishing a general perception of generative art is unfeasible. This is not suggested here. The question, rather, is *how* any resonances caused by generative forces at play in these artworks may become 'experience' within their beholders. Exploring this rather philosophical question is worthwhile, as the search for its answer may lead to a deeper understanding of the generative. Moreover, it is a question that can be explored by creative practice with generative systems. What is necessary, therefore, is to set up a research framework that allows the investigation of the perceptual processes that take place in the observer, as well as the generative processes that are being observed.

To begin with the latter, the 'degree of autonomy' that distinguishes generative systems from non-generative ones is just another description for 'self-organisation'. Although scientists in the past have often thought that within generative systems there is a general tendency towards greater disorder over time, Ilya Prigogine has observed that over time, these systems begin to organize themselves in a more complex manner:

> For a long time turbulence was identified with disorder or noise. Today we know that this is not the case. Indeed, while turbulent motion appears as irregular or chaotic on the macroscopic scale, it is, on the contrary, highly organised in the microscopic scale. The multiple space and time scales involved in turbulence correspond to the coherent behaviour of millions and millions of molecules. Viewed in this way, the transition from laminar flow to turbulence is a process of self-organisation. Part of the energy of the system, which in laminar flow was in the thermal motion of the molecules, is being transferred to macroscopic organised motion.[4]

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[4] Ilya Prigogine, *Order out of Chaos* (London: Bantam Books, 1984), p.141. Moreover, Prigogine maintains that the determinism in physics, which considers all processes to be time-reversible and subject to simple laws, does not apply to complex systems (Ilya Prigogine, *The End of Certainty: Time, Chaos and the New Laws of Nature* (New York: The Free Press, 1997)). Since complex systems make up the vast majority of processes in the world, time-reversible processes really are a rarity. This is why Prigogine said that determinism is no longer a viable scientific belief. Prigogine's collaboration with Isabelle Stengers that followed this discovery therefore initiated new discussions between science and philosophy. (Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* ([n.p.]: Flamingo, 1985)).

Therefore, the recognizable patterns that can appear in generative artworks (in the form of sounds, colours, shapes, gestures, behaviours, or a number of objects re-arranging their position (flocking)) can also express different stages of self-organisation, and be used to describe the complexity of the system. Galanter says the more recognisable a pattern, the closer the underlying system is to order; the less recognizable the pattern, the closer it is to random. Somewhere in between order and random, systems reveal the most interesting patterns, which are recognizable, but also very intricate as the patterns themselves are in transition. Systems with these patterns are called complex systems.[5] To an observer, these systems are not entirely predictable, but also not entirely unfathomable, which makes the engagement with them intriguing. Artist Hans Haacke, for instance, once described his experience of working with generative artworks in the following way:

> *...make something which experiences, reacts to its environment, changes, is non-stable...*
> *...make something indeterminate, which always looks different, the shape of which cannot be predicted precisely...*
> *...make something which cannot 'perform' without the assistance of its environment...*
> *...make something which reacts to light and temperature changes, is subject to air currents and depends, in its functioning, on the forces of gravity...*
> *...make something which the 'spectator' handles, with which he plays and thus animates...*
> *...make something which lives in time and makes the 'spectator' experience time...*
> *...articulate: something natural...*[6]

This was written in 1965, at a time when the notion of self-generating systems began to permeate Western culture; not only was systems theory being embraced by corporations and governments (President John F. Kennedy reportedly brought systems analysts into his administration), but also because the notion of a closed system was used by students in the 1968 protests to characterize what they fought against.[7] It thus became thinkable that all

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[5] Galanter, p.8. Galanter here refers to illustrations in Gary W. Flake, *The Computational Beauty of Nature* (Cambridge: MIT Press, 1998).

[6] Haacke in Suzanne Cotter and Guy Brett, eds., *Force Fields: Phases of the Kinetic* (Barcelona: Museu d'Art Contemporani de Barcelona, 2000) (italics in the original).

[7] Donna De Salvo, 'Where We Begin: Opening the System, c.1970' in *Open Systems: Rethinking Art c.1970* (London: Tate Modern, 2005), p.14. Other artists fought against the system by working in public spaces rather than gallery environments (Adrian Piper's *Planned Movements in Space,* for instance, took place in the streets of Manhattan, Robert Smithson's *Spiral Jetty* was built in Utah's Salt Lake). Moreover, political and social activism resonated in many later practices (Mierle Laderman Ukeles' *Touch Sanitation,* for instance, consisted of her shaking hands with 8,500 workers in the New York City Department of Sanitation; Joseph Beuys' *7000 Oaks* was a communal tree planting project).

operations taking place within society – including art – represented elements within a system.[8]

Within art, this new thinking around systems found different ways of expression. While the idea to use computers to simulate complex generative systems may seem obvious from today's perspective, only some artists, like John Horton Conway, actually worked in that way. His *Game of Life*, for instance, a cellular automaton, consists of a collection of cells in a grid.[9] Depending on the initial conditions (how many cells there are to start with, and where they are in relation to each other), the cells live, die or multiply, a process that follows a number of simple mathematical rules.[10] Thus, in the course of the game, the cells form various patterns which will end in one of several possible scenarios: infinite loops of patterns, infinite transformation, and end of transformation. What is intriguing about the *Game of Life* – despite its simple rules – is that it cannot be anticipated at the beginning how it develops and how long it will last. Thus, in this work, the unpredictability and open-endedness of some generative systems becomes easily comprehensible to a viewer.

While computers emerged as potentially useful tools for generative art making, many artists employed other tools. Martha Rosler, for example, used performances and video recordings to connect her thinking about generative systems with social systems. In *Vital Statistics of a Citizen, Simply Obtained*, Rosler's body is being meticulously measured and categorized.[11] This takes place within an atmosphere of scientific objectivity, which emphasizes the futility of any such endeavours and unmasks the discriminatory thinking behind it. Indeed, the objectification that takes place is revealed as a device that exerts social control, as it influences society's predominant image of what makes a 'normal' body. Thus *Vital Statistics of a Citizen, Simply Obtained* not only reacts against the devaluation

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[8] This was the time when performer, producer, writer and publisher Willoughby Sharp said, "The old art was an object. The new art is a system" (Sharp in De Salvo, p.11).

[9] http://www.mindatplay.co.uk/gameoflife.html [accessed 29.07.09]. A cellular automaton is a computer modeling tool that shows how a particular feature can change over time.

[10] These rules are: Any live cell with fewer than two live neighbours dies, as if by loneliness. Any live cell with more than three live neighbours dies, as if by overcrowding. Any live cell with two or three live neighbours lives, unchanged, to the next generation. Any dead cell with exactly three live neighbours comes to life.

[11] http://www.mindatplay.co.uk/vitalstatistics.html [accessed 08.07.09].

of sense exploration,[12] but also challenges the notion that an intellectual idea (like that of a 'normal' body) may have more value than the differences expressed by individual bodies.[13] Rosler's work thus also illustrates how in the 1960s, the senses became "a site for counter-culture"[14] that began to challenge the established socio-political system. Artists then began to work more and more with real world scenarios, in an attempt to move away from thinking about art as an object and towards understanding it as a system.

The *Open Systems* exhibition at the Tate Gallery in 2005 aimed to re-capture that moment, by showing a range of works that were, according to their curator, Donna de Salvo, connected by their reference to generative systems, and their endeavour to "redefin[e] the work of art, the self and the nature of representation."[15] She also observes that artists in the 1960s "at times, literally moved out of the studio, in an attempt to be more *responsive to the world* and to realise concepts or ideas with whatever means necessary"; and that artists wanted to "surpass the idea of the art object as something that has a purely metaphorical relationship to the world and to propose instead that the art object functioned as an analogue or equivalent for *lived experience*."[16] Viewing these artworks forty years later and

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[12] At the time of Rosler's work, art critics like Clement Greenberg for example drove an art debate that predominantly focused on visual artworks, to the neglect of other senses.

[13] This notion, which holds that a body is merely 'mechanical', can be extended to the thought that an individual merely 'functions' within a social system. Both of these notions had been criticized by artists in the 1960s and 1970s. *Fall II, Amsterdam,* for example, is a video recording of Bas Jan Ader riding a bicycle off a bridge and into the water (http://www.basjanader.com/ [accessed 08.06.09]). Ader's seemingly irrational or purposeless behaviour here challenges the notion of predictable and meaningful functioning within a society.

[14] Caroline A. Jones, *Sensorium: Embodied Experience, Technology, and Contemporary Art* (Cambridge, Massachusetts: MIT Press, 2006) p.42.

[15] De Salvo, p.11. The media considered for the exhibition were dance, film, video, performance, sculpture, painting and photography. Considering the theme was 'the use of generative or repetitive systems' one might think that the contribution computer art made to this period of time would also be worth mentioning. The 1968 ICA show *Cybernetic Serendipity* for example began to recognise artists' engagement with systems theory and computer technology. Other important exhibitions, such as *Systems* at the Whitechapel Art Gallery, London 1972, or shows by *Experiments in Art and Technology (EAT)* in New York indicated early on that computer art would become a new practice form that would allow for a further exploration of generative art. Moreover, generative sound compositions also need to be mentioned. Open systems were readily employed by experimental composers like John Cage, who since the 1950s investigated into random events to transgress the limited compositional systems imposed by tonal music. *Imaginary Landscape No. IV* for example was a composition for 12 radios, 24 performers and conductor (http://www.mindatplay.co.uk/imaginarylandscape.html [accessed 29.07.09]), where rhythms and sequences were fixed in a traditional notation. However, the resulting piece remains unpredictable because the actual sound depends upon the place and time of the performance, as well as the broadcast frequencies and radio programs available.

[16] De Salvo, p.13 – 14, emphasis by the author.

in a different socio-political climate posed the interesting question whether these artworks could still be responsive to the world and express lived experience.

This invites a thought experiment, which helps to further the discussion about generative processes and processes of perception. Rather than viewing generative art as a local and temporal phenomenon, during which artists explored generative systems, it might be conceivable to restore generative systems to their own order of time. From this perspective, generative systems would precede any art-historical classification, simply becoming known via those who work with them at the time. Thought in that way, the systems introduced in the *Open Systems* exhibition are infinitely larger than their frame of referencing could ever allow for. This difference in scale and duration has also been observed by some of the artists working with generative processes. For instance, Cildo Mereiles says:

> In 1968, 1969 and 1970 we were no longer working with metaphors (representations) of situations; we were working with the real situation itself... It was work that, really, no longer had that cult of the object, in isolation; things existed in terms of what they could spark off in the body of society. It was exactly what one had in one's head: working with the idea of a public.[17]

These real situations Mereiles refers to are, on the one hand, historical events, epitomised by art, but 'what they could spark off in the body of society' has much larger implications. In this regard, many systems included in the *Open Systems* exhibition preceded and exceeded the show. Some of them will still be in operation in the foreseeable future. For example, the full title of Hans Haacke's piece, *Shapolsky et al.*, which was included in the show, is *Shapolsky et al., Manhattan Real Estate Holdings, a Real Time Social System, as of May 1, 1971.* This piece documents, in maps, photographs, charts, and data sheets, that in 1971, a large proportion of apartment blocks in the lower income areas of Manhattan were owned by one single person, Harry Shapolsky, who transferred these properties between his different businesses for financial benefit. The direct political message in *Shapolsky et al.* led to the cancellation of Haacke's 1971 solo exhibition at the Guggenheim Museum, New York, where *Shapolsky et al.* was to have been shown. Yet the activities of Shapolsky in 1971 – and the cancellation of Haacke's show – are just indicative local interactions within a larger social system. This larger system has not yet ceased to be in operation. On the contrary, it is its nature to keep adapting and transforming

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[17] Mereiles in De Salvo, p.14.

itself in response to changes in Manhattan's socio-economic conditions. Thus one may say that the generative system that Haacke engaged with temporarily found form as *Shapolsky et al,* but simultaneously also exceeded this framework. In that sense, the work was more that could be thought of.[18]

Yet one needs to be cautious here: if it is the hallmark of the generative to be 'more that can be thought of', then what happens to the definition of generative art? All kinds of artworks would qualify and the distinction between generative art and other art practices would collapse. To avoid this, it is necessary to revisit Galanter's definition, which emphasizes that the distinguishing characteristic of generative art is its focus on an *indirect production method,* where artists relinquish some level of control over the work to an autonomous system. Thus in Haacke's case, one might say that the materials prepared for *Shapolsky et al.* document his artistic engagement with the system, but the actions that took place within it – the actual content of the work – remained outside his control.

Core concerns

To define generative art yet further it is useful to examine the kinds of generative systems artists might work with. For this, it is necessary to introduce the notion of 'effective complexity':[19] both orderly systems, which produce highly regular outcomes, as well as random systems, which produce highly irregular outcomes, have a very low effective complexity score. This coincides with our experience of complexity: to an observer, the information produced by orderly system often seems too predictable and banal, while the information content of random systems often appears as excessive and yet unrecognisable (although artists might still employ these simpler systems in generative artworks to achieve particular effects). Systems with a high effective complexity score, on the other hand, are

[18] Since not every generative system is a complex system, 'more that can be thought of' seems to apply more specifically to complex systems. This thought will be followed up later in the contextual review in chapter 2.

[19] Effective complexity describes the "length of a concise [mathematical] description of a set of the [system's] regularities" (Murray Gell-Mann in Galanter, p. 10). This is different from algorithmic complexity, which aims to establish the complexity of a system by how much its internal structure can be compressed. While algorithmic complexity correctly predicts the complexity for ordered systems as low, and the complexity for complex systems as higher, it assigns random systems the highest complexity. This reveals the unsuitability of algorithmic complexity, as it would mean that, for example, "the works of Shakespeare have a Lower AIC than random gibberish of the same length that would typically be typed by the proverbial roomful of monkeys" (Murray Gell-Mann in Galanter, p. 10). Effective complexity therefore employs a second algorithm that corrects the effects of random deviation.

the complex systems introduced earlier. These systems, although operating within a minimum and maximum limit, remain unpredictable in detail or over longer periods of time. They follow cause and effect, but – because they are structurally complex – may appear as behaving somewhat chaotically. The intriguing patterns created by these systems often seem recognizable and yet different and new. These key effects, which become perceptible to audience members, sum up why artists working in generative art consider complex systems to be an attractive choice. The emerging patterns, on the other hand, are even more fascinating when one considers that they represent *changes to the relationships between the parts* within these systems.

At this point one may think that likening a complex system to a 'whole that is more than the sum of its parts' would be appropriate. However, such a reference would be incorrect: a complex system, if running with at least some degree of autonomy, must remain open-ended and thus cannot be perceived *as a whole*.[20] Moreover, the outcomes of complex systems cannot be accurately predicted, because the relationships between its parts are complex: changes are not arrived at by addition – they are exponential. Thus to come to a better understanding of the behaviours of complex systems, it is necessary to look once more at the connection to chaos theory and complexity theory. Both study the same systems: genetic algorithms, neural networks, cellular automata, fractals or emergent behaviours, the weather, fluid systems, social group dynamics, playful improvisations, in short any system that is too complex to accurately predict, but that nevertheless reveals underlying patterns. While chaos theory observes the outcomes of these systems, for example the flocking or swarming of animals, complexity theory explores how and why these systems can behave in such a seemingly synchronised way. Thus complexity theory observes, for instance, how seemingly small events can produce a disproportionately large shift in the system. This is often referred to as the 'butterfly effect', a term arising from the work of Edward Lorenz. It holds that any small event, such as the flapping of the wings of a butterfly, has the potential to create changes, for example changes in the atmosphere. This may have exponential consequences, such as altering the path of a tornado or delaying, accelerating or even preventing the occurrence of a tornado in a certain location. Yet to local observers of such a weather system, the reasons why a tornado forms or why it

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[20] This is why trying to understand complex systems by breaking them down into smaller and smaller parts until these can be understood (the reductionist approach usually taken in science) fails to get to the core of complex systems.

changes its path remain incomprehensible, because these observers can never behold the system in its entirety, or 'from the outside'. Nevertheless, the physical encounter with a tornado forces an emotional response in its observers, even if (or maybe because) its cause seems incomprehensible.[21]

A similar process may take place in generative artworks where audience members are immersed in play with a real-time dynamic system. Like local observers in a complex system, audience members may be able to guess at what will happen next, but may be unable to predict how the system will behave in the longer term. Faced with this uncertainty, they may find themselves exploring the work more through their senses than their intellect. In such situations, receiving explanations of how the system works often may not help to deal with its effect. On the contrary, explanations may deepen rather than lessen the gap between sense experience and intellectual knowledge, which, ultimately, might account for the fascination emanating from such works. However, if a disjointment between sense experience and intellectual knowledge makes the encounter memorable, then the relationship between analytical processes and processes of perception in the experience of generative art is worthwhile examining.

Philosophical underpinnings

In the 1960s, artists not only engaged with system theory, but also with philosophical ideas that problematised thinking about generative processes. Gilles Deleuze's philosophy of difference, for example, began to link generative processes with processes of perception that take place when artifacts are (re)viewed. Deleuze's work, in particular, made it possible to speak of a generative ontology, a strand of Western philosophy that maintains that our being in the world is defined by the experiences we make, and that all experiences are generated through the senses. According to this strand, the generative cannot be defined by established categories, but is in itself an ongoing productive relationship capable of bringing about the genuinely new.[22] The 'usual' perception of things, on the other hand, is clouded by habit and memory.

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[21] Observers may be able to obtain an 'intuitive understanding' of an event (intuition is here understood in the sense of 'direct knowledge'). This notion will be picked up again in chapters 4 and 5.

[22] This definition of the generative will be picked up again in chapter 4.

Thus, according to Deleuze, habits are so deeply engrained in everyday life that they do not demand attention; for example whilst taking the usual way to work we plan the day ahead. Later on we cannot remember details of the walk, and feel we have not really experienced it. This research argues that engaging in explorative play with complex systems – that remain continuously productive and yet unpredictable – can provide an experience that exceeds habitual reference structures. Contemplating and playing with such generative systems may therefore help to overturn one's habitual perception. However, since shifts of perception can be experienced more intensely by observers aware of this shift taking place, this research was to conduct its theoretical enquiry by means of serial conceptualization. This is a distancing device that can increase researchers' and participants' awareness of processes of perception (someone who becomes aware of observing themselves observing...).

Deleuze's theories on memory, on the other hand, were to be explored by referring to Proust's *A la Recherche du Temps Perdu*, and Wong Kar-wai's renditions of Proust's work for the screen (*In the Mood for Love* and *2046*).[23] This reveals, for example, that the memories overwhelming Proust's central character are often triggered by tastes, sounds or sights taking place in the present. But rather than experiencing the present, Proust's protagonist re-experiences the past. Indeed, one of the key features of Proust's work is whether we can ever see the present as it is, or whether we will always interpret the present through a past experience. According to Deleuze, experiencing sensations through the body encourages a re-intensification from the root of human existence, which can prevent the continuous re-application of habitual patterns of recognition.[24] In other words, it should be possible to disrupt the effect of memory every now and then and to see things afresh, it is just a matter of coming across an event that can provoke such a reaction. This research therefore argues that an intense sense experience, "a kind of spasm, seizure, or shock which

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[23] These works are often perceived as more accessible to a general reader than Deleuze's work: Marcel Proust, *In Search of Lost Time*, Vols 1 - 6 (London: Penguin, 2003), *In the Mood for Love.* Dir. by Wong Kar-wai. (Hong Kong: Tartan. 2001 TVD3349 VFC 22837), *2046.* Dir. by Wong Kar-wai (Hong Kong: Tartan. 2005. TVD3530 VFC 74366). The connection to Deleuze's thoughts on memory is made in chapter 4.

[24] Gilles Deleuze, *Difference and Repetition* (London: Athlone, 1997)

destroys reality with sovereign brusqueness",[25] is such an event. This can provoke a liminal engagement with the present while letting the past recede.[26]

The event referred to here is ilinx (vertigo), a physical play type where players surrender control. Sociologist Roger Caillois describes ilinx as a thrill arising directly from the senses. Although popular examples for ilinx might be fairground rides or bungee jumping, this research argues that the physicality of the experience is less important than losing control. This research thus focuses on vertiginous activities of a much smaller scale: the fundamental physiological functions of the human body, such as breathing or blood circulation. These might be considered as the most common and the most basic activities of human life, as they are performed second by second and yet, they escape conscious control. In this regard, they exemplify the basic concept of a generative ontology: how life is lived through us.

Practice framework

This research maintains that by sonifying players' physiological activities as part of an interactive artwork, it is possible to observe how players experience difficulties in trying to control their own physiological functions, and thus rather than playing, find themselves being played. To fully understand the validity of this strategy, the choice of play pattern, generative system, and method of interacting which frame this practice need to be considered in more detail.

Play, as a method of engaging with a generative art practice is valid in this context, as playing itself is generative.[27] Phenomenologist Hans-Georg Gadamer, for instance, said that when we immerse ourselves seriously in play, the game plays the player. Play

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[25] Roger Caillois, *Man, Play and Games* (Chicago: University of Illinois Press, 2001), p.12.

[26] Anthropologist Victor Turner usefully distinguishes between the terms *liminal* and *liminoid* ('Liminality and Communitas' in *The Ritual Process: Structure and Anti-structure*, (Chicago: Aldine Publishing, 1969), p.94). Liminal is transformative to the point that it overthrows established boundaries, whereas liminoid operates within those boundaries.

[27] Working with the notion of play rather than interaction was important in this research. Amongst research participants, playing was generally perceived as a less purposeful activity than interacting. Thus connecting the research with play could often instill a more open disposition towards it, making it easier to overcome thinking about it in terms of cause and effect.

activities are then not consciously decided on, but emerge. There is no free will that controls play, only an objective reality of the state of play that exists in itself, even without a player. "The players are not the subjects of play; instead the play merely reaches representation through the player".[28] Gadamer's understanding of play exposes similar qualities – self-formation, agency and generativity – as outlined in Deleuze's generative ontology in *Difference and Repetition*. Thus because of its generative nature, play can bring forth its own forms, rules and meanings. How play patterns transform themselves can be observed, for example, during a sports event, where play can shift from rule-based play to foul play to transgressive celebration. Not only the outcome but also the process of play remains unpredictable, which means it must always be played out. As historian Johan Huizinga said, it becomes "its own course and meaning. Play begins, and then at a certain moment it is "over". It plays itself to an end".[29]

But the selection of an appropriate complex system is equally important. A wide range of systems has been used in generative artworks in the past. This includes, for instance, linguistic and structural systems, systems which learn, interactive or behavioural processes, creative or procedural processes, mathematical processes, biological or emergent structures, and evolutionary methods (see Appendix G for more details). However, rather than attempting to construct a new complex system, this research concentrates on the sonification of an already existing one, which is the system of physiological activities of the body. These activities are also called biofeedback. They include changes to the heart rate, stress levels or temperature of a body, and can be easily measured by placing electrodes on the skin. These electrodes can then be interfaced with digitizing devices that forward the signals to a computer, which translates the data into sounds or visuals. The idea of using biofeedback in generative artworks is not new, but has been explored by a number of artists since the 1960s (see Appendix A). However, it was particularly valid for this research, as players who explore their own biofeedback perceive it internally as well as observe it externally. Biofeedback sonification thus connects generative processes with processes of perception, and does so in real time, which helps its observers to obtain an intuitive perception of the processes in action. More importantly still, listening to biofeedback makes the player aware of the gap between sense experience and cognition,

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[28] Hans-Georg Gadamer, *Truth and Method* (New York: Crossroad, 1982) p.103.

[29] Johann Huizinga, *Homo Ludens* (London: Routledge & Kegan Paul, 1980), pp. 8 - 10.

which makes the encounter memorable. However, the kind of sounds or visuals that is created is crucial, as this influences players' experience. Since carefully composed and spatialised sounds can render a play experience more immersive and intense for its players, exploring this in practice is an important aspect of this research. For instance, this practice would not visualize the physiological data, as this could easily distract players from their physiological processes. Instead, players would be immersed in spatialised sound so they could close their eyes and focus more intensely on the biofeedback taking place.

Furthermore, it is also important to consider how the relationship between biofeedback and sound may influence each other. This relationship was initially envisaged as a so-called responsive feedback system, which allows for an open dialogue between at least two equal partners: one (A) who plays and improvises; and a second one (B) who responds and improvises in turn. B therefore would do more than just receive information and generate responses, and A more than just repeat a routine: both partners were to respond creatively to each other. In this way, rhythms and patterns that might develop out of this dialogue would remain unpredictable, and only become known through their operation. This responsive feedback system was to be part of a live performed sound installation that employed real-time signal processing to sonify the biofeedback of the human player. The computer in charge of this could slightly transform how the biofeedback data would be played back, for instance by introducing small variations to the sound timbres. This in turn would impact on the emotional state of the human listener and so on (see figure 1).

Digital signal processing was to play a significant role within this responsive feedback system: biofeedback signals are continuous data streams in the form of a fluctuating electrical voltage. This was to be measured, converted into a stream of numbers, and fed into an interactive programming environment like Max/MSP.[30] Here the sonification would be carried out: the 'Max part' would deal with the timing of events as well as the communication between programming elements, while the 'MSP part' would perform sound compositional processes with the number stream. These processes can include multiplications of frequencies, use of filters, delays, or envelopes. Moreover, MSP can also use the number stream for the synthesis of additional sounds, which can be done, for instance, by using oscillators. Once the number stream was suitably transformed, it was to be converted into an analogue audio signal and played back to the listener. Since digital

[30] More information on Max/MSP is available from here: http://www.cycling74.com/ [accessed 09.08.09].

signal processing allows the generation and modification of sounds in real time, it would be a fundamental part of the practice.[31]

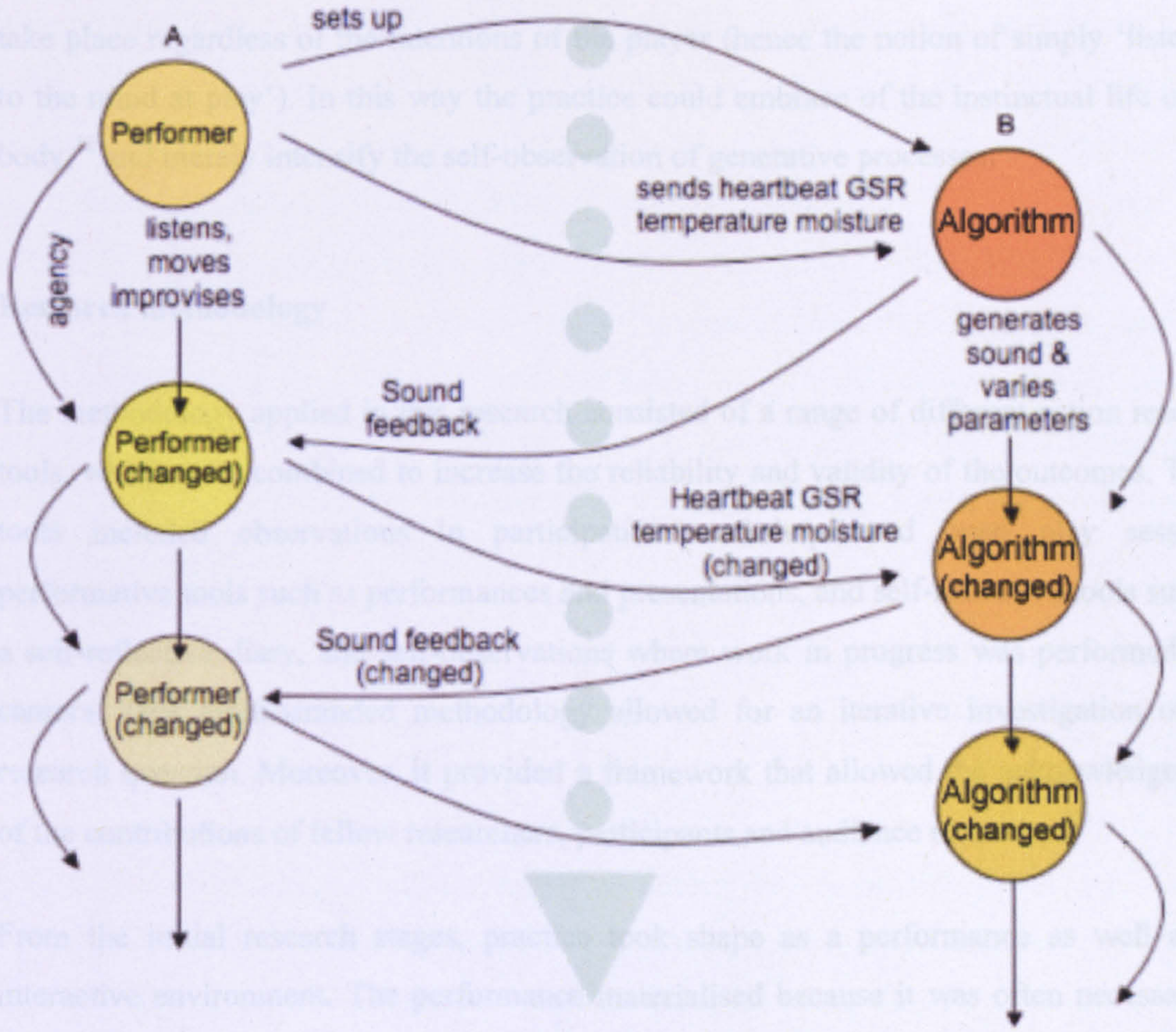

Figure 1: The responsive feedback system originally envisaged.
Illustration by the author.

However, the most interesting aspect that emerged from practice was not how the computer transformed the sound, but how listening to one's biofeedback patterns self-reinforced listening. This is because the biofeedback composition continuously communicates information about its player's emotional state, which the player also feels. Although the player can (within limits) use mental projection, breathing or concentration exercises to alter these emotional states, this is arduous, as every time one loses concentration or new emotions and thoughts enter the mind, involuntary reactions, so-called 'excitations', take

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[31] The compositional methods used in this research are discussed in chapter 7, while Appendix F provides a more detailed investigation of the technology used.

place, which also become audible (this is why the composition was later entitled *Excitations*). Thus, unlike any other musical instrument playing, it is incredibly difficult to purposefully create recognisable or repetitive sound patterns. However, this was not the aim of the work, rather its opposite: to experience how unpredictable changes in the mind take place regardless of the intentions of the player (hence the notion of simply 'listening to the mind at play'). In this way the practice could embrace of the instinctual life of the body,[32] and merely intensify the self-observation of generative processes.

Research methodology

The methodology applied in this research consisted of a range of different action research tools, which were combined to increase the reliability and validity of the outcomes. These tools included observations in participative workshops and open play sessions, performative tools such as performances and presentations, and self-reflective tools such as a self-reflective diary, and self-observations where work in progress was performed to a camera. This multi-stranded methodology allowed for an iterative investigation of the research question. Moreover, it provided a framework that allowed the acknowledgement of the contributions of fellow researchers, participants and audience members.[33]

From the initial research stages, practice took shape as a performance as well as an interactive environment. The performance materialised because it was often necessary to perform the instrument to co-researchers in order to make the interrelation between biological data and sound transparent, and without having to resort to lengthy explanations. Making the interrelation between body and sound intuitive thus became a core aspect of the practice. Then in more advanced practice stages, new ways of playing the biofeedback instrument were discovered, and more interesting sound combinations achieved. Performative activities were often practised to a camera, which eventually suggested the development of a performance. This performance still followed the traditional convention of a performer acting as a proxy for the observer, and thus relied on a compelling sound

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[32] Discussing the value of observation versus self-observation, Jonathan Crary says in *Techniques of the Observer* that in the end, there is no escape from perception and thus we cannot but embrace the instinctual life of the body. (Cambridge, Massachusetts: MIT Press, 1992), p. 77.

[33] Appendix C provides a comparative overview of these action research methods, while a detailed description and analysis is given in chapter 3.

composition and a performer who was experienced in articulating the connection between body and sound. Audience reactions, gathered after performances whenever possible, fed back into the question of whether the interrelation between body and sound was intuitive.

The interactive environment came about from performing the biofeedback instrument with others. This part of the practice allowed participants a first hand experience of the link between body and sound, which generated discussions about the kind of experiences that were emerging in play. The interactive environment developed from this was thus influenced by the feedback from co-researchers and fellow participants. Moreover, it allowed the gathering of qualitative data using direct observations and semi-structured interviewing. In a later analysis of participants' play activities and verbal accounts, different stages of interacting could be noticed. Insights gained from this collaborative aspect of the research therefore also extended the understanding of how the generative may affect perception.

Documentation materials

Accompanying this thesis are a DVD, an Audio CD, and a website. The DVD contains practice documentation materials in the form of video recordings, arranged in four sections. The first section is a recording of the final performance of the biofeedback composition *Excitations*. The video has here been edited to the audio track, which is a live performance of the biofeedback composition. This was recorded on location in a single take. The final performance can be listened to in 5.1 surround sound, which is important for the 'immersed listening' discussed in chapter 7.

The second section is a performance archive, which contains excerpts of a range of earlier performance works in progress. This section has been ordered from past to present. The third section contains a documentation of the participatory research. Here a selection of significant practice moments from the action research workshops and open play sessions were arranged according to different play activities: 'discovering the rules of play', 'discovering with curiosity', 'from control to transgressive play', 'ecstatic play', and 'immersion and stillness'. These materials are discussed extensively in chapter 3. The last section is a brief documentary of the production of the final performance.

The Audio CD that accompanies this thesis contains stereo recordings of a number of relevant compositions that are discussed in the text, as well as a range of examples of work in progress from the *Excitations* composition. These listening examples make the characteristics of the biofeedback composition more easily perceptible and thus help to illustrate the compositional techniques examined in chapters 6 and 7.

Finally, an online database (http://www.mindatplay.co.uk) accompanies the contextual review in chapter 2. In the compilation of this database, links to audio-visual materials were made available whenever possible to allow the reader more direct access to the works discussed. Although by no means aiming for completeness, the database draws together a range of relevant influences that illuminate the context in which this practice operates.

Thesis outline

Chapter 1 introduces explorative play, a play pattern where players transgress mental or physical limits. Understanding this play pattern is crucial, as here the generative processes that are fundamental to play become most perceptible.

Chapter 2 contextualises the research by connecting generative processes with processes of perception. To make this connection, a number of generative artworks were reviewed, concentrating on transformative play experiences. Since the researcher had to participate in explorative play with the works to adequately review them, the need for a continuous shifting between observing and playing is noticed. This reveals that explorative play is internally transformative.

Chapter 3 introduces action research as the methodology used in this research, and shows how several action research tools were triangulated to ensure reliability and validity. Data collected with one of the tools, the qualitative action research workshop, is then examined in a first analysis. This reveals distinct stages of explorative play.

Chapter 4 introduces Deleuze's philosophy of difference as the philosophical foundation of explorative play. This holds that, habitually, we interpret the present through the past. Deleuze's three syntheses of time, however, show that these habitual thinking patterns can

be overcome. Applying Deleuze's concepts to practice reveals that the thrill of explorative play really consists of three types of vertigo, which interrupt players' habitual perception.

Chapter 5 problematises the relationship between observing and playing (introduced in chapter 2) through a second analysis of the action research workshops. This analysis deals with participants' difficulties of verbalising play experiences, and the inevitable construction of interpretative translations.

Chapter 6 introduces the core characteristics of contemporary biofeedback performance and argues that introspection and stillness enhance practice. The connections to Eastern practices this suggests are followed up by exploring other performance practices with affinities to explorative play such a Butoh. It is shown how Butoh methods may radicalize biofeedback performance.

Chapter 7 extends the notion of increased introspection and stillness to biofeedback composition and establishes that the effects of listening are a central concern of such compositions. This makes it necessary to explore what emotional response listening to sonified biofeedback can instil, and how biofeedback compositions may disrupt habitual musical expectations.

After evaluating the performative practice, chapter 8 concludes that explorative play may indeed convey an 'intuitive understanding' of the generative. Moreover, if contemporary culture could perceive explorative play as more than a simple thrill, a greater appreciation for explorative play experiences may take place.

1 - Explorative play

This chapter examines key concepts by Huizinga, Caillois and Gadamer that underline the relevance of play. Through this it is demonstrated that of all play patterns, explorative play is the one that takes its players beyond their habitual mental or physical limits. This is because explorative play, often inadequately described as a thrill, affects the basic emotions of players before any deliberate reaction can take control. Looking at explorative play is crucial for this research, as here the generative qualities that are fundamental to play become not only comprehensible but also perceptible.

What is explorative play?

One might say explorative play takes place whenever someone exposes him or herself to a situation where the outcome is unpredictable. Such play is necessarily physical, as players need to rely on their senses instead of prior knowledge. It is also risky, as they can often only guess what comes next. Sometimes they may willingly deviate from what they know to try out new things; sometimes they may only be able to react to whatever comes their way. While all of this rings true, it does not yet convey why explorative play should be of great importance. To really understand this, it is necessary to enquire into the nature of play.

Play is often defined as an activity children pursue in order to learn for life. However, this viewpoint is strongly influenced by a Puritan work ethic, which assigned play a purpose and separated it from its radical and subversive root.[1] In fact, the Puritan perspective ignored many facets of play, in particular addictive, nonsensical and tumultuous play; as well as the fact that adults play just as much and as intensely as children.[2] Therefore only

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[1] An example of can be found in Max Weber's *The Protestant Ethic and the Spirit of Capitalism*, originally published in 1904 (published online at http://www.ne.jp/asahi/moriyuki/abukuma/weber/world/ethic/pro_eth_frame.html [accessed 5.11.08]).

[2] The influence of the Puritan work ethic on play cannot be underestimated. For example, Raphael Koster (*Theory of Fun for Game Design* (Scottsdale, Arizona: Paraglyph, 2005)) argues against it, saying that the fun of playing games is not age-related but stems largely from the human ability to *learn patterns*. The art of making games engaging therefore consists of providing patterns at the right level of difficulty: if the pattern is too obvious players become bored, if it is too complex players become frustrated. The patterns also have to progress at the right pace: e.g. simple ones have to update at a faster pace than more complex ones. Moreover, Brian Sutton-Smith (*The Ambiguity of Play* (Yale: Harvard University Press, 1997)), who devotes one of his seven rhetorics of play to the notion of 'play as progress', points out that the notion of play as

in an educative capacity, play was morally acceptable. This Puritan sanitization of play was opposed by Johan Huizinga, who reinstated the cultural importance of play, even raising it onto the level of religion: "it is a mystic unity. In play as we conceive it the distinction between belief and make-belief breaks down. The concept of play merges quite naturally with that of holiness."[3] Huizinga maintained that in contrast to work and art, play is *meant* to be unproductive. It necessarily uses up time, energy, skill, ingenuity and sometimes money. It happens in its own time and place, with players being free to leave at any time. It also generates its own rules; and it is because of this that the outcome of play remains unpredictable until the end. To oppose the Puritan thinking further Huizinga said play is an activity that is entirely voluntary, arising from a desire for play. He insisted that the 'instinct for play' is a fundamental and irreducible concept, which means human beings simply *must* play.[4] So far, Huizinga's definition of play seems to capture the nature of explorative play rather well. However, after making his argument for play, Huizinga then attempts to show how the law, philosophy, poetry, religion and war – what he called 'civilised forms of human activities'– arose from play as contest. From then on, he almost exclusively focuses on contest and neglects other play forms.[5]

To balance Huizinga's emphasis of contest, play theorist Brian Sutton-Smith points out that there is an "anthropological record of the great dominance of cooperative forms of play over competitive forms in most earlier tribal societies". In anthropological terms therefore, extensive competition is not a fundamental play form but a recent phenomenon. If Huizanga were right, this would make the law, philosophy, poetry, religion and war equally recent phenomena. Is this thinkable? Sutton-Smith also observes that the games a society plays are usually based around its core principles, and thus "in our own individualistic society, [only] affluence and the need for originality [have made] [...] competition affordable".[6]

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learning for life – as well as the school system that employs it – is in anthropological terms only a fairly recent invention.

[3] Johann Huizinga, *Homo Ludens* (London: Routledge & Kegan Paul, 1980), p.25.

[4] Huizinga, p.7 f.

[5] This may have happened because of a general preference of contest-based structures in Huizinga's time, which may have anticipated the arrival of ever more competitive work environments, recreational pursuits and entertainment forms later on.

[6] Sutton-Smith, p.104.

Huizinga's work, written in the wake of the economic upturn, may therefore merely reflect a phase of extending global competition that culminated in the space race and the Cold War. Today's waning affluence of the Western world and the rise of socio-ecological problems should therefore be matched by a change of focus in terms of play; and indeed there are indications that this might be the case. In video gaming, for instance, where individual combat and action games have been the most popular play forms for many years, cooperative play is experiencing a slow but steady revival.[7] However, while it may be the case that economic ups and downs in Western societies are mirrored by increases and decreases of contest-based play, this perspective does not help in the definition of other, non-contest based play forms such as explorative play. To advance this, it will therefore be necessary to examine play from an altogether different angle.

In contrast to Huizinga, sociologist Roger Caillois distinguishes between four play patterns: agon, alea, mimicry and ilinx.[8] Agon is contest-based play that occurs in competition, sports or social hierarchies. It requires an active player who often displays his mastery of a physical skill. Alea is based on chance. Like a roulette game, it requires a passive player. Mimicry is concerned with simulation. Its realm includes masks, theatre, drama, and travesty. It requires active players who impersonate, and use their imagination. Mimicry also involves spellbinding illusions and make-believe. It is magical, enticing and seductive, but not disorientating. Ilinx finally is based on disorientation and vertigo. Caillois says: "in ilinx, [the player] gratifies the desire to temporarily destroy his bodily equilibrium, escape the tyranny of his ordinary perception and provoke the abdication of conscience."[9] Here finally is the description of a play pattern that comes close to explorative play, particularly since here the role of perception and physical sensation is

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[7] Cooperative video gameplay, which allows players to fulfil objectives as team mates, has been gaining in popularity, simply because, as players say "playing a game with a dedicated team can often be much more rewarding than playing alone. You share victories, defeats, you can make plans" (http://arstechnica.com/gaming/news/2009/01/co-op-gaming-is-here-to-stay-ars-helps-you-find-players.ars [accessed 14.07.09]). Competitive gameplay still exceeds co-operative options by far, but lists of cooperative games are growing (see for instance http://www.james-scott.co.uk/coop.php [accessed 28.07.2010]). Cooperative play is also being discussed more. For example, Co-optimus, a web site dedicated to co-operative video game play, currently has 2792 members on its forums (http://www.co-optimus.com/ [accessed 14.07.09]).

[8] Roger Caillois, *Man, Play and Games* (Chicago: University of Illinois Press, 2001). Agon (Greek: ἀγών): contest, debate, conflict; alea (Latin: alea): die, the rolling of dice; mimicry (Greek: μίμησις): imitation, representation; and ilinx (Greek: ἶλιγξ): whirlpool, whirling. Although Caillois describes these four individually, in practice they are often combined.

[9] Caillois, p.44.

emphasized. One may therefore think Caillois' ilinx could provide the ideal vehicle to connect the philosophical ideas supporting this research with creative practice and vice-versa. However, before this can even be considered it is important to address Caillois' moral concerns in connection with ilinx. According to Caillois, ilinx is a negative game that corrupts its player. This is exposed at various points in the text. To begin with, ilinx and alea are described as destructive forces:

> In each of the [two] major combinations [mimicry-ilinx, agon-alea] only one category of play is truly creative: *mimicry* in the conjuring of masks and vertigo and *agon* in regulated rivalry and chance. The others [ilinx and alea] are immediately destructive. They result in inordinate, inhuman, and irremediable excitations, a kind of frightening and fatal attraction, the import of which is to neutralize creative influence.[10]

Caillois' choice of words ('inordinate', 'inhuman', 'fatal') reveals how undesirable he considers ilinx and alea to be. A main source of Caillois' aversion is that neither of them require any conscious effort on part of the player.[11] For instance, he says

> In *ilinx* [...] there is submission not only of the will but of the mind. The person lets himself drift and becomes intoxicated through feeling directed, dominated, and possessed by strange powers.[12]

It remains unclear what these strange powers might be, but their mentioning here indicates how desperately Caillois wants to mark ilinx as 'other' and outside of socially acceptable behaviour. He later says ilinx is not art, and not even part of wider culture:

> Games of simulation [*mimicry*] lead to the arts of the spectacle, which express and reflect a culture. The individual pursuit of anxiety and panic [*ilinx*] conquers man's discernment and will. He becomes a prisoner of equivocal and exalting ecstasies in which he believes that he is divine and immortal, ecstasies which in the end destroy him.[13]

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[10] Caillois, p.78.

[11] Caillois' valuing of effort is interesting, as it is reminiscent of the Puritan work ethic discussed earlier.

[12] Caillois, p.78.

[13] Caillois, p.78.

Caillois thus clearly views ilinx experiences as immoral, and not contributory to a healthy human being or indeed a healthy society. Developmental psychologist Donald Winnicott, on the other hand, holds the opposite view, and says that *all* play activities are important.[14] Indeed Winnicott's core concern is the transitional object phase, during which infants between four and twelve months begin to develop an understanding of self and their environment. Here infants play between illusion and reality; and although Winnicott does not specify any particular play patterns or play content, he clearly does not oppose any disorientating physical (ilinx) play. On the contrary, his case studies express an appreciation for the kind of play where 'moments of magic and omnipotence intersperse with moments of loss of control'.[15] Winnicott also says that 'playing is itself a therapy' even when it becomes frightening. It is "always a creative experience [...] and it is a basic form of living".[16] According to that, ilinx play would constitute a necessary part of the development of a healthy and creative self; and through that, a healthy society.

In addition to his moral concerns, Caillois' writing is often permeated by a transcendental philosophy, a thought model based on two levels.[17] This becomes obvious when he contrasts *ideal* forms of play, which are educative and refined, with *real* play, which is chaotic, inconsistent and unpredictable. Caillois distinction between ludus (rule-based games) and paidia (tumultuous, open play)[18] exemplifies just how deeply transcendental thinking permeates his work:

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[14] Donald W. Winnicott, *Playing and Reality* (London: Routledge, 2005).

[15] Winnicott, p.64.

[16] Winnicott, p.67.

[17] Transcendental philosophy is based upon Plato's concept of two planes: the real, which concerns the world and direct sense experience, and superior to that the ideal, which concerns the realm of ideals and divinity. The ideal cannot be transcended through the senses or reached by worldly measures. Although reflections of the ideal can be found within real objects, the ideal is only knowable indirectly, through intuition. During the Middle Ages scholastic philosophers then applied Plato's concept of transcendence to describe the nature of god. Immanuel Kant subsequently defined god as the 'transcended' and the 'transcendental' as the innate principles that enable the mind to make perceptions and experiences. He therefore maintains that innate principles exist prior to sense experience. Transcendental philosophy had (and has) a far-reaching influence on the arts and sciences in the Western world.

[18] Caillois refers to ludus (Latin: ludus): structured, rule-bound games, and to paidia (Greek: παιδεία): child-rearing, education. Yet Caillois uses the word paidia to indicate unstructured and spontaneous play activities.

> *Ludus* proper [...] is complementary to and a *refinement of paidia,* which it *disciplines* and *enriches.*[19] [...] Games discipline instincts and institutionalize them. For the time that they afford formal and limited satisfaction, they educate, enrich and immunize the mind against their virulence.[20]

Here paidia is tainted as a corrosive force of limited social value, while ludus is elevated to an ideal. This thinking in two planes needs addressing in general, but particularly so since explorative play might be more readily associated with paidic rather than ludic activities. Therefore to begin with, Caillois' argument for the distinction between the two is not well founded.[21] He proposes, for instance, that rule-based play emerged from children exploring pain, and says the desire to avoid pain led to the invention of rules. He states that disturbance and tumult [paidia?] is the starting point for what "can readily become a taste for destruction and breaking things".[22] However, there is no trace in *Man, Play, Games* that could convincingly link paidia in childhood with anti-social behaviour in later life. Then during his criticism of paidia, Caillois fails to mention that paidic play also has its virtues. For example, participating in carnival celebrations can – within limits – restore a feeling of personal freedom.[23] This is because tumultuous play temporarily masks the presence of established social hierarchies and rule-based proceedings. Thus obligations that govern 'normal' life come to be irrelevant, the monotony of the everyday ceases, and the experience of the present is intensified. All of this can contribute to a more balanced emotional state and thinking about the future. Most importantly, however, Caillois fails to

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[19] Caillois, p.29, emphasis by the author.

[20] Caillois, p.55.

[21] Other valid criticism has been made about Caillois' distinction between ludus and paidia. For instance, Raphael Koster (*Theory of Fun for Game Design* (Scottsdale, Arizona: Paraglyph, 2005)) says: "I also differ with Caillois in that I tend to believe that paidia activities generally have MORE rules, not less; the spectrum there is essentially about how descriptive the game is of its own rule set (to use the Zimmerman/Salen approach to describing it). Paidia generally *"imports" rule sets derived from a vast array of cultural assumptions*, whereas ludus games are ones that have been tightly defined down (and which nonetheless have an assortment of rules that are implied but not stated that are part of the cultural practice of game playing)." (http://www.raphkoster.com/?p=116 [accessed 07.01.2008], emphasis by the author).

[22] Caillois, p.28.

[23] Although carnival is an often-quoted example for paidia, it is important to remember that nowadays it resides within a rule-based society as well as within a restricted timeframe. Carnival celebrations such as the Notting Hill Carnival in London, for example, are not spontaneous events, but carefully orchestrated and monitored situations. Rather than initiating real social change, they merely act as emotional outlets for its participants, which might in turn help to maintain the social status quo. On the other hand, mass protests or spontaneous mass celebrations, contain more of paidia's revolutionary powers.

say that in real play scenarios, ludus and paidia are almost always interwoven.[24] To think of them as real and ideal states does not advance the understanding of play, especially since neither complete chaos nor exclusive adherence to rules are possible (let alone desirable). Caillois' elevation of ludus over paidia overlooks the fact that these terms themselves are not fixed, but merely mental constructs. Paidia and ludus could therefore easily be thought of as different expressions of one single generative process, which takes place in play.

The explorative player's subjectivity

Caillois evaluated play from a sociological viewpoint, asking what kind of play is ideal, what kind of play is right. Remembering this makes his argumentation understandable. However, in order to define explorative play in itself it needs to be thought afresh. The aim of this enquiry, to gain an insight into how transformation affects players in explorative play, will therefore be achieved by researching into how players verbalise their experiences. John Cage's observations on transformation, for example, were as follows:

> The principle called mobility-immobility is this: every thing is changing but while some things are changing others are not. Eventually those that were not changing begin suddenly to change and vice versa ad infinituum.[25]

This may sound paradoxical at first, but things often only *seem* to be constantly fixed or in flux ('some things are changing while others are not'), because of the reference points that are used. When by force of habit the same reference points are used – for example life experiences – it becomes overlooked that from other perspectives, these constants simply do not exist. Engaging in explorative play therefore means to become more aware of how

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[24] In a soccer match, for example, players and supporters cannot but celebrate tumultuously after scoring. These moments of paidia mark the emotional highlights of an otherwise rule-based game. Paradoxically, more and more rules emerge in an attempt to fix these moments beyond rule-based play. The British Football Association, for instance, recently introduced new rules in an attempt to regulate the celebration style following a goal. According to these, a player is no longer allowed to take his top off in public: "A player who removes his jersey when celebrating a goal must be cautioned for unsporting behaviour" (2004: Law 12 – Fouls and Misconduct). This rule is based on the observation that chaotic behaviour often follows ripping off the shirt. By suppressing the signal, the Football Association hoped to restrain outbreaks of paidia. However, the new rule was not successful. Therefore since 2006, a yellow card follows the caution. (http://www.fifa.com/classicfootball/history/law/historylaw4.html [accessed 03.01.08]). This point also shows how play is most intense around its boundaries, especially where these are generated or broken.

[25] John Cage, *Silence, Lectures and Writings* (London, Marion Boyars, 1999) p.154 f.

transformation takes place. However, this comes at a price: the deeper players get immersed, the further they venture away from the security of fixed reference points.

In *Truth and Method*, Hans Georg Gadamer makes two further observations that aptly describe explorative play: firstly that play cannot be subjected to free will and secondly that being possessed by play is a fundamental human feature. With the first observation, Gadamer opposes commonly held notions about individual freedom and subjectivity in play, which were originally expressed by writers of the Romantic period. For the purpose of this enquiry, this is particularly interesting. Schiller, for instance, wrote that "Man only plays when he is in the fullest sense of the word a human being, and he is only fully a human being when he plays".[26] What he meant by that was that man is only free when sense experience (the sensual drive) and rational thinking (the formal drive) are balanced by play. In effect, this summarized his reaction to Kant's work on the sensual and formal drive. In contrast to Kant, who placed the formal drive (and with it moral and common law, social duty) above all else, Schiller wanted to elevate the importance of sense experience (and with it basic human needs and desires) and reduce that of reason. This is why he introduced play as a third drive that would balance sensual drive and formal drive. According to Schiller, play then enables human beings to live in harmony with both nature and society; this in turn restores man's freedom, which then finds its expression in the creation and appreciation of art. Gadamer's argument, on the other hand, is that the qualities of play are to be found in the play experience itself and not in ideals of formal beauty emerging from it. Play may thus be the basis for art and creative expression, yet it is not concerned with the aesthetic values of any output it produces. Moreover, Gadamer fiercely opposes the idea of a freely acting subject, and says play is not an exercise of anyone's subjectivity, but a thing with its own order and structure that takes hold of its players:

> All playing is being-played. The attraction of a game, the fascination it exerts, consists precisely in the fact that the game masters the players [...] whoever "tries" is in fact the one who is tried. [...] What holds the player in its spell, draws him into play, and keeps him there is the game itself.[27]

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[26] Friedrich Schiller, *On the Aesthetic Education of Man in a Series of Letters*, trans. by Elizabeth M. Wilkinson and Leonard A. Willoughby (New York: Clarendon Press, 1982), 15.9.

[27] Hans Georg Gadamer, *Truth and Method* (New York: Crossroad, 1982), p.106.

In other words, play can never be controlled by an individual. To make this absolutely clear, Gadamer says play exists even without a player:

> Play has its own essence, independent of the consciousness of those who play. Play also exists – indeed, properly [...] where there are no subjects who are behaving 'playfully' [...] the players are not the subjects of play; instead the play merely reaches representation through the player.[28]

He then addresses another misinterpretation of Schiller's 'man is only a full human being when he plays', which is 'when he is not playing he attends to more important things'. It is a misinterpretation as it re-introduces thinking in real and ideal states of being. To avoid this, Gadamer stressed that play is not a wilful expression of anyone's subjectivity – or indeed a matter of choice – but a larger concept an individual can never fully hold. This clearly defines it as a fundamental human feature. With this second observation then, Gadamer not only frees play from all purpose and intent – "it happens, as it were, by itself"[29] – but also eliminates any false opposition between play and seriousness:

> The player himself knows that play is only play and that it exists in a world determined by the seriousness of purposes. But he does not know this in such a way that, as a player, he actually *intends* this relation to seriousness.[30]

According to this passage, players are conscious that they are playing but only once they forget this, play can manifest itself fully. Then, once they play, players are so seriously involved in it they enter a state of self-forgetfulness. Gadamer says: "play fulfils its purpose only if the player loses himself in play".[31] It is important not to think of this surrender to play as a process that *reunites* play and player, as this assumes that they were once separated. This would lead once more to thinking in opposites.[32] Gadamer's surrender

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[28] Gadamer, p.92.

[29] Gadamer, p.105.

[30] Gadamer, p.102f.

[31] Gadamer, p.102f.

[32] Therefore, rather than as a difference in kind it might be possible to think of this as a difference in degree: throughout their lives, human beings remain connected with play; it is only the intensity of this connection that varies. From that perspective, the difference between adults' and child play is not great. Games might evolve to more advanced stages (skill-based games) or might be replaced by a substituted form (competitive sport instead of physical combat), yet other forms of play seem to remain fairly unchanged (physical or emotional thrills).

to play also does not mean to act without reason or conscious decision-making. Although players are not fully present as they are preoccupied with play, they are far from drifting passively. The emotional state of immersion Gadamer refers to might therefore be comparable to a person experiencing creative flow.

Influenced by psychologist Abraham Maslow's concept of self-actualisation, Mihaly Csíkszentmihályi says that subjects in creative flow can have peak experiences.[33] During this, individuals are not motivated by external goals or rewards; their pay-off is the actual experience. Csíkszentmihályi then further characterises creative flow as action and awareness merging together and consciousness narrowing itself. Individuals also become increasingly less self-conscious and increasingly forgetful about realities outside the task they perform. Still they make coherent demands for actions and their feedback, and feel in control of the environment that is affected by their actions.[34] However, these characteristics may equally apply to a person in explorative play. Making this connection is helpful, as it outlines what one might expect to observe in a play research session. Whether explorative play can then actually be achieved in such a session depends much on whether participants are able to shed feelings of self-consciousness and surrender themselves to play in the presence of a researcher.[35] While participants may become less self-conscious the more intensely they play, perhaps eventually forgetting about the situation and what might be required of them, this is not expected to be easy. On the other hand, once fully engaged in play, players might become so unconcerned that they begin to reveal details in a way they might deem inappropriate in other circumstances. Finding a correct emotional distance that is acceptable for researcher and participants is therefore a core problem. This makes it

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[33] According to Maslow, peak experiences are "transient moments of self-actualization" (*The Farther Reaches of Human Nature* (New York: Viking Press, 1971), p.48). A peak experience is felt as "a self-validating, self-justifying moment which carries its own intrinsic value with it. It is felt to be a highly valuable – even uniquely valuable – experience, so-great an experience sometimes that even to attempt to justify it takes away from its dignity and worth. [...] In the peak-experience there is a very characteristic disorientation in time and space, or even the lack of consciousness of time and space. [...] This kind of timelessness and spacelessness contrasts very sharply with normal experience. The person in the peak-experiences may feel a day passing as if it were minutes or also a minute so intensely lived that it might feel like a day or a year or an eternity even. (Abraham Maslow, *Religions, Values, and Peak Experiences* (New York: Viking Press, 1970) online at http://www.druglibrary.org/schaffer/lsd/maslowa.htm [accessed 28.07.2010])

[34] Csíkszentmihályi in Sutton-Smith, p.184 ff.

[35] One research method where the explorative players' state of mind is paramount is the observation. As explorative play targets the players' senses directly, it may circumvent any intentional or habitual (re)actions, and expose instead participants' involuntary thoughts and actions.

necessary to attain a better understanding of the – often implicit – modes of communication that define intersubjective interactions and emotional distance.

Psychologist Eric Berne differentiates these interactions by their intensity. According to Berne, intimacy is its most intense form. People need intimate physical contact – so-called 'strokes' – to avoid emotional deprivation. However, social, psychological and biological hierarchies often prevent the experience of such continued psychical intimacy. This makes people strive perpetually for its attainment. Although adults have learnt to accept strokes in their symbolic forms instead of physical contact – for example praise instead of direct sensual stimulation – the craving for it remains strong. Social games are therefore the next best replacement. These consist of a role scripted by ourselves, for example being a clown, clumsy or unlucky. Then this role is repeatedly acted out, preferably in connection with people who are inclined towards the opposite: being controlling, skilful, or fortunate. The actions that are played out turn into moves within a ritual. Wasteful moves become eliminated with repetition. Thus over time, social games can be played with great efficiency and to great satisfaction. They can provide psychological stability, biological advantages, existential advantages, internal and external psychological advantages, as well as internal and external social advantages. In spite of this, social games are not necessarily enjoyable or recreational. Berne says they are only played when intimacy is unobtainable:

> Because there is so little opportunity for intimacy in daily life, and because some forms of intimacy (especially if intense) are psychologically impossible for most people, the bulk of the time in serious social life is taken up with playing games. Hence games are both necessary and desirable, and the only problem at issue is whether the games played by an individual offer the best yield for him.[36]

Less intimate than games are social pastimes. These include gossip and chat, conversations that structure time, or give strokes to parties concerned. These also have the purpose to pre-select others who could become suitable game partners, acquaintances or friends. The most superficial forms of social contact then are conversational procedures and rituals. Although not very satisfying, these still have psychological advantages over no social interaction at all.

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[36] Eric Berne, *Games People Play* (London: Penguin, 1964), p.55.

Berne's work highlights the difficulty of undertaking qualitative research that involves close engagement with participants.[37] Just like any other verbal exchange, conversations in a research session are satiated with conversational procedures and rituals, selective chat and individual social games. The researcher here needs to separate social interplay from explorative play, while trying to follow any relevant larger play structures, for example the fluctuations between ludus and paidia. However, this is not the end of it. Signs of shifting degrees of intimacy might also be important: participants deeply immersed in explorative play may no longer want to engage in social games, chat or conversational rituals. Motivated by the creative flow they experience, they may moderate social distance and engage more directly with the researcher. The halt of chat and social games might therefore indicate that players are becoming more deeply immersed, whilst the picking up of it might indicate a period of deep play has come to an end.[38]

On top of that, neither the subjectivity of the researcher nor that of the participant can be understood as fixed. In *Problems of Dostoyevsky's Poetics*, the Russian philosopher Mikhail Bakhtin develops the concepts of *polyphony* and *unfinalizability* in connection with play, which are helpful here.[39] Unfinalizability means that a person can change at any time, and thus is never fully revealed or known in the world. In addition to this, each person is also influenced by others, and thus it is never clear who is speaking. Polyphony, on the other hand, means that a subject is a rather fluid entity, who is influenced by cultural roots and people that have been met. Fictional characters are often being acted out under different social circumstances. More complex still, changes can affect any of these

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[37] Researchers are never neutral, but the less experienced they are, the easier it is for mistakes to occur. Trained qualitative researchers are skilful in guiding the dialogue in the intended direction, whilst remaining open to more eccentric reactions from participants. For creative practitioners wanting to integrate qualitative methodologies into practice it may be useful to employ a qualitative researcher to conduct interviews and observations for them. Another option is to train in qualitative methods and to distance oneself from the work as much as possible. This will help to analyse conversation transcripts better as well as to conduct improved practice feedback sessions.

[38] It is also vital to recognise that negotiating degrees of intimacy is an intrinsic element to any research exploring group play.

[39] Mikhail Bakhtin, *Problems of Dostoyevsky's Poetics* (Ann Arbor, Michigan: Ardis, 1973). Bakhtin's writing generally holds great value, but particularly so since in contrast to other semioticians, Bakhtin examined not only the structure of communication but also its content. Rather than looking exclusively at the mechanics of speaking, he also examined what meaning a particular expression may hold for a particular voice. This is particularly helpful for research into play – for example in the analysis of collaborative practice dialogues or feedback sessions.

characters and influences, and thus many selves reach representation in many voices.[40] Bakhtin says,

> There is in all our minds an internal dialogue of voices, just as in play and festivals there is a dialogue between the different characters, some of whom change their shape as the dialogue proceeds. Thus play can be both heavy and light, ritualistic and playful, earnest and frivolous. There is an ever changing heteroglossia of voices, and the realm is not polarized but always fluid.[41]

Analysing the communications that take place during play is thus a difficult task, one that may never be resolved in its entirety. Moreover, Bakhtin reminds us that the term subjectivity always needs to be used in the understanding that a subject is in constant transformation, and that the human being who speaks is never quite the same.

The attraction of explorative play

So far it has been shown that explorative play is not a wilful activity, but rather a human characteristic that finds expression through its players. Moreover, participants immersed in explorative play are not 'drifting aimlessly', but experiencing a change of perception and being in flow. This makes explorative play already an interesting experience. In order to fully grasp the attraction of explorative play, however, it is now necessary to briefly return to Caillois' description of ilinx.

Caillois says that ilinx can easily be brought on by physical activities, for example rollercoaster rides or extreme sports. Rollercoaster rides are usually understood as targeting

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[40] Bakhtin found good examples of polyphony in the characters that populate Dostoevsky's work (hence the title of *Problems of Dostoyevsky's Poetics)*. For example, in his chapter 4, Bakhtin introduces carnival as a fundamental concept that breaks or inverses 'normal' conventions, and allows many voices to interact freely together. He here places Dostojevsky's work into a history of 'carnivalized' literature, which has three main characteristics: a focus on the immediate present rather than a historical past; greater emphasis on experience and imagination, and less emphasis on legends; and finally, a deliberate mixture of styles and genres (p.88 f). Bakhtin maintans that Dostoevsky drew on this carnivalistic root to overturn social conventions and social distance within his novels, to construct mésalliances, eccentricities, mockery, parody and profanations, all of which find their expression in the dialogues and, perhaps more strikingly, in the many voices contained within each character.

[41] Bakhtin in Sutton-Smith, p.128.

exclusively the basic emotions:[42] For example, on starting the ride, fear causes us to sweat, the heartbeat increases and we feel nervous. When swinging upside down, the ride's increased gravitational forces work on the body, which releases endorphins, and we experience pleasure. However, these two emotions account only for the short periods of the ride where the direct connection between senses and experience is actually made. Omitted here are the more complex thought processes that happen beforehand and afterwards. For example, we fear when we *remember* the shock of the last ride or *anticipate* the potential danger of this ride, which becomes pleasurable when we *imagine* the pay-off. By imagining this we already experience some of it. David Huron, professor in music cognition, says

> It is not the case that we simply think about future outcomes; when imagining these outcomes we typically are also capable of feeling a muted version of the pertinent emotion. We don't simply *think* about future possibilities; we *feel* future possibilities.[43]

Thus in addition to the basic emotions that simply flood in, there is a cognitive aspect to this type of play, which involves memory and anticipation. Indeed, the aspect of time is important: while the physical part of explorative play focuses on the present, its cognitive part fluctuates between past and future. Explorative play can therefore also produce another kind of disorientation, which accompanies and completes the physical thrill.[44]

Rollercoaster rides operate on the senses like a shock, and thus subtleness and intrigue may not be the first characteristics that come to mind when physical play experiences are being discussed. However, physical play experiences come in much greater variety. Somewhat

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[42] According to Dylan Evans (*Emotion: The Science of Sentiment* (New York: Oxford Paperbacks, 2003)) there are three types of emotions: basic emotions such as joy, anger, distress, fear, surprise or disgust that take hold in an instant. They are innate, which according to Evans in this context does not mean 'to be born into it', but to have all conditions in place for the emergence of these emotions (which also means that basic emotions remain less affected by cultural differences or cognitive capacities). These emotions are notoriously difficult to control (only training in disciplines such as types of martial arts, dance practice, yoga or biofeedback increases this control). Then there are higher cognitive emotions such as love, guilt, shame, embarrassment, pride, envy or jealousy. They are less innate, and need to be cultivated. Finally, there are culturally specific emotions that exist only within a particular society, for examples the Japanese 'Amae', which is 'comfort in another person's complete acceptance' (p.2f.), or the New Guinean 'being a wild pig' (p.13ff.).

[43] David Huron, *Sweet Anticipation: Music and the Psychology of Expectation* (Cambridge, Massachusetts: MIT Press, 2007), p.8. Huron refers here to Damasio's clinical studies.

[44] This will be discussed in depth in chapter 4.

unexpectedly, Caillois refers to whirling dervishes;[45] and although whirling is obviously performed under very different social and cultural circumstances than rollercoaster rides, the same method may apply: a pronounced physical activity is performed, which works directly on the basic emotions.[46] The fact that this example seems so far-fetched[47] merely illustrates that the popular understanding of ilinx experiences as a thrill is far too limited, and that a changed perception of reality can be achieved through all kinds of physical activities. Its degree may even be less important than the fact that the performed activity is new or unusual. This means that explorative play experiences can be much more accessible and subtle. In *Camera Silens,* for example, a participant sits alone on a chair in a sound proof room, listening only to his own body functions.[48] Working with the threshold of silence is very different from a fairground ride or whirling; and yet it can be equally thrilling. The musician David Toop says:

> Playing on the threshold of silence can turn your body into a war zone of cramps and tremors, provoke clumsiness and mental panic, push your concentration levels beyond all previous limits, expose every flaw of structure and execution and finally turn a docile audience into a howling mob.[49]

It varies from person to person when experiences become thrilling, which is why it is impossible to design a play environment that satisfies all participants equally. Brendan Walker recently investigated what makes an experience a thrill.[50] The study was based on

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[45] Caillois may not be the best point of reference on altering one's perception through physical activity. A better guide may be provided by Yoga teachings that emerged between 5000 BC and 300 AD, for instance. The links between postures (asanas) and mental states are clearly mentioned in the yoga sutras by Patanjali (II-29, II-46 to II-49). To the West this knowledge became much more accessible through Bellur Krishnamachar Sundararaja Iyengar's *Light on Yoga* (London: Thorsons 2001), particularly because he described the health benefits of several hundred yoga postures in great detail.

[46] According to dervish practitioners, whirling evokes elated feelings and joy. This emerged in a discussion following the performance of the Suleyman Erguner Ensemble and the Whirling Dervishes of Turkey (May 3 & 4 2005 Queen Elizabeth Hall II, Royal Festival Hall, London).

[47] What the cognitive aspects of whirling (a spiritual practice!) may be remains difficult to gauge for a non-practitioner; and thus – unless Caillois was a dervish practitioner himself – him quoting this as an example for ilinx seems ill thought out, particularly in the light of Caillois' previously discussed moral views on ilinx.

[48] http://www.mindatplay.co.uk/camerasilens.html [accessed 09.07.09].

[49] David Toop, *Haunted Weather; Resonant Spaces, Silence and Memory* (London: Serpent's Tail, 2004), p.251.

[50] Brendan Walker, *Chromo11: Volume One: The Taxonomy of Thrill* (London: AERiAL Publishing, 2005)). Walker, a researcher at the Royal College of Art, explores whether and how designers can control their users' emotional engagement. After fifty qualitative interviews he concludes his study with a formula ('The Walker

questionnaires developed by Zuckerman,[51] who maintained that thrill seekers are influenced by their sociological environment as much as by genetics. Novel stimuli cause both arousal and anxiety, but the threshold depends on the character of the individual.[52] Thrill seekers take more risks than other people because they need higher levels of stimuli to experience arousal, which is linked with increased experience of pleasure.

This research is not about thrill seekers and will not explore fairground rides. However, knowing that the excitement threshold of explorative play varies is useful, as this can be built into the work, for example, by letting the play experience respond to the individual thrill threshold of each player. This means that practitioners do not need to plan *play* in more detail. On the contrary, they need to facilitate a more flexible *structure* where players can negotiate their own thrill threshold (and in that way plan less). Indeed, a practice dealing with explorative play cannot have too rigid a structure, as this already limits the potential outcomes. Only if the structure itself remains emergent can different play forms and contents take shape. This may sound complex, but is quite common practice in other subject areas such as movement improvisation (Butoh dance) or musical improvisation (free jazz). In order to arrive at such open-ended and flexible structures, some guided facilitation and decision-making remains necessary, but the main part of the work is developed *collaboratively* with its players. In such a situation, interweaving creative practice with qualitative research methods may be helpful to set a framework, yet this can only be successful if the qualitative research does not simply generate approval of the completed practice. The important difference is that practice allows for continuing participation, and that the feedback loop into the work remains open. However, explorative play also has its ethical limitations. This is because it tries its player in physical, but also psychological, terms. While explorative play may open many intriguing possibilities for research, it also opens the possibility for emotional manipulation and misplaced trust. To avoid this it is necessary to establish and adhere to a research framework, to mutually agree

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Thrill Factor'), a tool to design thrilling experiences. Generally the study gives a good insight into individual experiences of thrill. However, the formula seems to initiate the return to a top down design strategy. These two elements are in opposition to each other: users' emotional engagement is complex and diverse, but the top down design approaches cannot account for this.

[51] Marvin Zuckerman, *Behavioral Expressions and Biosocial Bases of Sensation Seeking* (Cambridge: Cambridge University Press, 1994).

[52] Zuckerman here refers to Eysenck's optimum level of stimulation theory, and Hebb's optimum level of arousal theory.

on a code of conduct, to involve participants in informed decision making throughout the research sessions, and to end play if there are any doubts about participants' well-being.

A definition of explorative play

Play is a self-forming force that reaches representation through its players. Explorative play then allows players to escape habits and memory and to change their outlook on life. The characteristics of explorative play are as follows:

- Explorative play is neither a contest, nor chance-based, skill-based, or based on the best representation. Explorative play is an existential thrill that targets the player through physical sensation. It fascinates, because it oscillates between what might be considered safe and unsafe. Therefore there needs to be enough fear involved for play to be considered risky, but also enough of a pay-off in the form of an adrenaline rush, elated feelings, relaxation or joy.
- The fear involved is connected with the exposure to something new, but even more so with experiencing loss of control. This concerns physical balance as well as mental stability. As a result of this loss of control, explorative play exposes the physiological reactions and basic emotions of the player.
- The risk involved is connected with a change to the player's habitual perspective. Explorative play is closer to paidia than ludus and therefore attempts to break through social conditioning and trained responses, such as formal phrases, behavioural conventions, moral interpretations or clichés. Consequently, this kind of play resonates in its player: by challenging habits and beliefs, it affects the player's identity.
- Explorative play is a basic human characteristic that cannot be prevented or controlled. It seeks out its player in the encounter of something new or unusual. However, because of differences in the individual emotional thresholds, it works differently with each player.
- Explorative play targets the senses. While popular examples for it are fairground rides and bungee jumps, explorative play can work more subtly and still challenge perception.

- Explorative play also contains a cognitive aspect. Thus it involves the loss of balance in more ways than the physical.
- Participants are immersed in the present and may experience creative flow. This may involve a loss of awareness of time passing or external circumstances.
- Explorative play is not teleological, since once a direction is set, the range of possible outcomes is already limited. Instead, the direction can change, which means the outcome remains emergent, only revealing itself whilst being played.

2 - A practice and its audience

This chapter contextualises the research by connecting generative processes with processes of perception. To make this connection, a number of generative artworks were selected and reviewed from a participant's perspective. This review, which is documented in the form of an online database, elucidates that the interdisciplinary nature of this research exceeds thinking in disciplines and timelines. It also reveals that the researcher had to participate in explorative play with the works to adequately review them, which overturns notions of a divide between observers and players. However, playing itself induced shifts in perspective that stemmed from being the observer as well as the producer of sensation. These shifts reveal that explorative play is not only outwardly creative, but also internally transformative.

On reviewing generative practices

This research looks at generative art practice and theory from a particular angle: it enquires how the generative may connect with processes of perception. That is also the basis for this contextual review. However, the review structures conventionally applied in the contextualisation of art practices are problematic here, because what needs to be reviewed is a series of generative systems. Timelines, for example, often feature in contextual reviews such as *Multimedia from Wagner to Virtual Reality*,[1] but since generative processes are open-ended, they do not fit comfortably within timelines.[2] Timelines can also subliminally convey a sense of purpose on the part of artists ('artists wanted to attain X, and did Y to achieve this'), yet not all human endeavours are purposeful and goal-driven: in timelines, processes of seemingly aimless exploration are usually ignored. Yet these processes are important in explorative play, and at the centre of this research. Moreover, the socio-cultural context that surrounds the viewing of generative artworks is often part of their ecology, and thus without reflecting on how they were encountered, where, when and by whom, a vital part to their understanding can be lost. For example, Jem Finer's *Longplayer*, a 1000 year-long composition, can only be accessed in its current state, and at the moment of its encounter, as nobody can behold the piece in its totality. Its "movements

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[1] http://www.artmuseum.net/w2vr/timeline/timelineWagner.html [accessed 11.05.09]. This site is based on a book of the same title, edited by Packer and Jordan (London, New York: Norton, 2001).

[2] To add to the problem, the continuity such a timeline evokes is often illusory. For example, when we interpret past events from the present, they may appear to us as a teleological flow of events. However, to make this so, we occasionally 'construct' causalities to fill the gaps in this timeline ('a *must* have been the cause for b').

are calculable, but are occurring on a scale so vast as to be all but unknowable".[3] This highlights why some generative artworks can question conventional perceptions of time and resist a linear review.

Since timelines are problematic, it may be conceivable to contextualise generative artworks by examining them from within art historical disciplines. However, this is also fraught with problems, as knowledge emerging from beyond the discipline is often ignored. While references to disciplines may be initially useful to communicate the general idea of a practice to its readers, these then need to be immediately transgressed. Thus, for example, the description for *Longplayer* reads:

> While [Longplayer] found form as a musical composition, it can also be understood as a living, 1000 year long process – an artificial life form programmed to seek its own survival strategies. More than a piece of music, Longplayer is a social organism, depending on people – and the communication between people – for its continuation, and existing as a community of listeners across centuries.[4]

The main part of this passage argues how the artwork exceeds the limitation placed on it by its original categorization. This makes it seem futile to try to categorize generative artworks according to disciplines when they themselves transgress such categorizations.

It might be conceivable, on the other hand, to contextualise generative art practices by reviewing their techniques and methods, which may reveal interesting insights about our relation to these techniques and methods. In *Techniques of the Observer*, for example, Jonathan Crary concentrates on the camera obscura and photography.[5] He dispels the notion of a simple historical continuity from one to the other, and reveals a rather more complex connection that involves different ways of seeing (and thus thinking), and the tools used. However, in the case of generative artworks that involve explorative play, conducting such an analysis seems difficult because there is a lack of critical distance. It is much harder to observe phenomena while one is immersed in them. This also applies in the wider sense. For example, within art practices that use media technologies, discussions

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[3] http://longplayer.org/what/overview.php [accessed 06.06.09].

[4] http://longplayer.org/what/overview.php [accessed 06.06.09].

[5] Jonathan Crary, *Techniques of the Observer* (Cambridge, Massachusetts: MIT Press, 1992).

about uses of technologies are often taken over by talking about their effects on existing practices. Performance critic Philip Auslander, for example, states that in contemporary Western culture, performative representations have come to be preferred over live performances, a shift made possible because of advances in media technologies.[6] While such discussions have their place, they would not be helpful for the contextualisation of this research. Here the focus is on observing transition in itself.

Therefore, the core question is, if explorative play with generative artworks can transgress our habitual thinking of time as a causal chain and render categorisations based on external similarities meaningless, what method of investigation does a contextual review of generative artworks need to apply in order to remain true to the content it intends to analyse.

An excentric database of generative art

To maintain the integrity of the generative artworks reviewed, it can be helpful to imagine them as a non-hierarchical cluster of elements. The most suitable review structure for such a cluster would be an open database, itself a non-hierarchical cluster. In such a database, elements can enter or leave, and whatever set of elements is present at any one time constitutes the cluster. Since such databases are never complete but in constant transformation, they may also be called generative.

The use of databases for contextual reviews is not a new idea, but one that has gained popularity in recent years (see list in Appendix B). In part this might be a response to increasing concerns about the appropriate archiving of digital artworks, but also an appreciation of the fact that open databases can adequately reflect the non-hierarchical and generative processes that take place within art movements. However, not all artwork databases are truly open. In some cases, they still adhere to traditional art historical conventions. They list, for example, artworks by discipline, artist, date of creation and

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[6] *Liveness: Performance in a Mediatized Culture* (London: Routledge, 1999). See also chapter 6.

technique, and downplay the fact that entries are carefully selected.[7] Yet there are alternatives: communicative curating styles and self-entry, for example, can be helpful if one wants to reflect the open-ended and non-hierarchical character of the entries in the way they are listed. This is the curatorial approach employed in databases such as the *Rhizome ArtBase*,[8] a member-supported organization that is committed to open-access structures. The *Rhizome ArtBase* thus shows that communicative curating and self-entry is viable. However it may require the continued involvement of many users. *Rhizome,* for example, contains over 2400 artworks and a vast number of members. Moreover, it has now been in operation for ten years. Although this research identified the use of a database as essential for the contextualisation of this practice, initiating a self-forming database was not possible within the constraints given.

The *Mindatplay* database that accompanies this research (http://www.mindatplay.co.uk) therefore admits to this limitation. It consists of sixty-one mostly interdisciplinary artworks, which all engage with generative processes and processes of perception (figure 2 shows a sample entry). The search for artworks to be included took place from 2000 to 2007. In this time, a number of relevant exhibitions, research centres and conferences were visited. Some of the more well known ones are the *Sonic Boom* exhibition, the *ZKM* research centre for media art, the *Ars Electronica* festivals, the *ISEA* (Inter-Society for Electronic Art) conferences, the *documenta*, the *Parip* (Performance as Research in Practice) conferences, the *Transmediale*, the *E-performance* conference, the *WFAE* (World Forum for Acoustic Ecology) conference, and the *CADE* (Computers in Art and Design Education) conference. On these visits, artworks were observed or directly participated in. This was important, as the emphasis of this research is on sense perception in explorative play.

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[7] One example where traditional criteria are still in use is the *Database of Virtual Art.* Here curatorship is more pronounced, as only individuals who satisfy the admission criteria may post materials: "We hope for your understanding that in order *to ensure the documentary and scientific standard* we need to adhere to some *admission criteria.* Qualifications for the assignment of an account are the number of exhibitions, of publications on and by an artist, and of public presentations. We also ascribe high importance to artistic inventions like for example innovative interface, display or software solutions. *Please take these standards into account when applying...*" (http://www.virtualart.at/common/ startWork.do [accessed 20.11.2006] emphasis by the author).

[8] Members include new media artists, curators, critics and enthusiasts. (http://www.rhizome.org/artbase/ [accessed 11.05.09]).

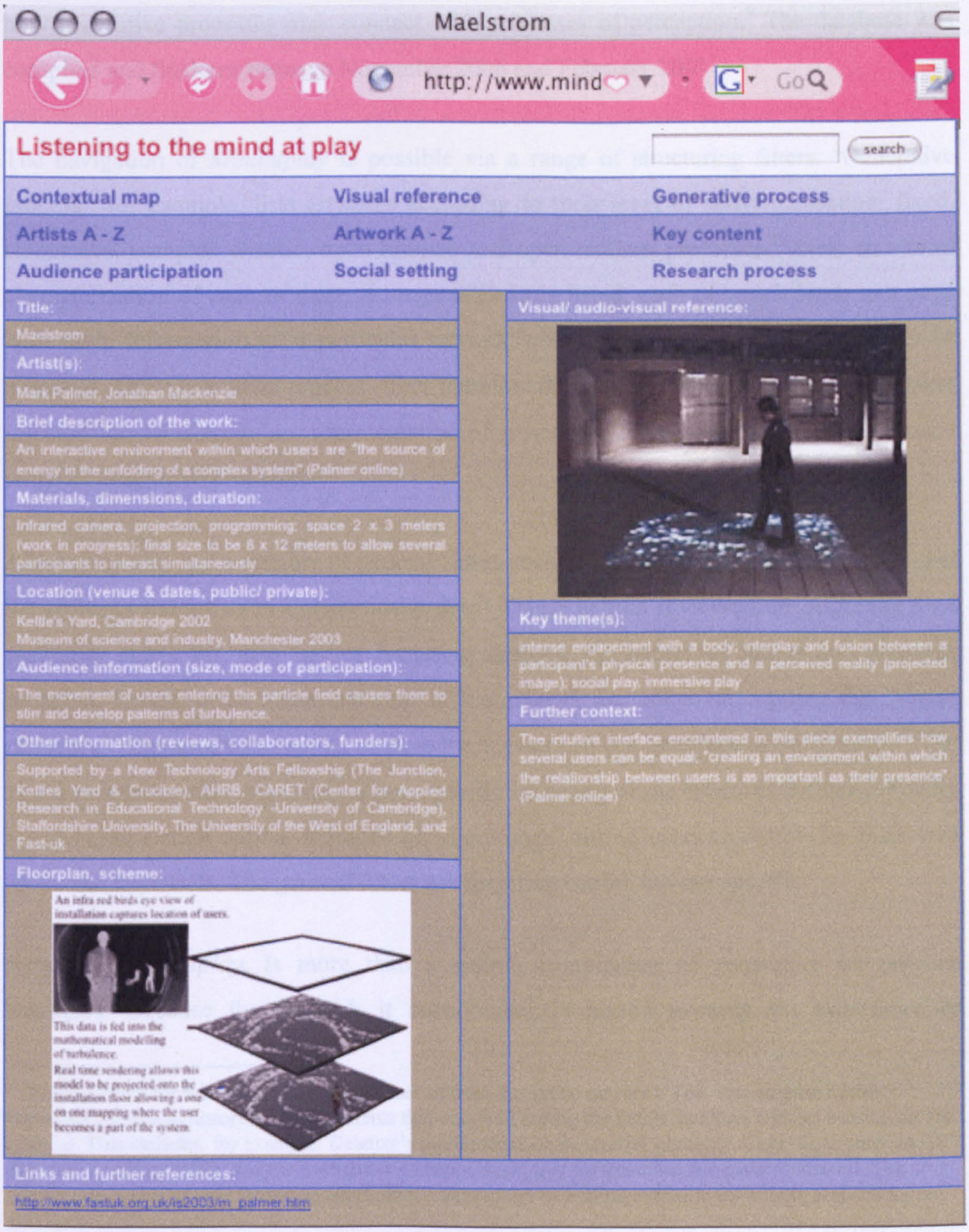

Figure 2: A sample database entry from the *Mindatplay* database of generative artworks (http://www.mindatplay.co.uk/maelstrom.html). Web site and illustration by the author.

Following that, secondary sources such as catalogues, reviews, databases and artists' web sites were consulted for background information on the works. Documentary materials in audio-visual form were made available whenever possible, to allow the reader a more direct engagement with the work. Each artwork was described, and discussed in the light of

how generative processes may connect with processes of perception.[9] The database was compiled and finalised between November 2006 and February 2007.

The navigation of *Mindatplay* is possible via a range of structuring filters. 'Generative process', for example, lists artworks according to their level of self-organisation: fixed, responsive, complex chaotic, open liminal, and open random processes.[10] Next to a brief characterization of each of these, a range of links is listed, each of which leads to a page with more information on a particular artwork where the corresponding process can be observed. The 'Generative process' filter therefore demonstrates that those works that were selected for *Mindatplay* are representative of generative art, as they span across a wide range of generative processes.

Mindatplay also has a number of general filters such as 'Artwork A-Z' or 'Artist A-Z' that list artworks and artists in alphabetical order.[11] This is helpful if viewers are searching for a particular entry, but also invites browsing through the names of artists and artworks included. If both artist name and title of the artwork are unknown, visiting the 'Visual reference' page might be helpful as here the viewer can see an image of each work.[12] The visual references also encourage a non-specific browsing of the artworks included. Finally a text-based search option, included on every page, allows users to search for their own terms and keywords. The general filters are therefore useful, but not specific.

However, *Mindatplay*, is more than a simple compilation of generative art practice examples. Because the research it consolidates is biased towards *the experience of*

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[9] The timeframe for this review was broadly set as from the 1960s onwards. This was because of the important social and historical developments that occurred during the 1960s that have a direct bearing on this practice. This includes, for example, Deleuze's publications on generative ontology, Cage's non-intentional approach to composition, and the emergence of happenings, live performance and participative art. The 1960's also saw computer as well as biofeedback technology becoming available for artistic projects for the first time.

[10] http://www.mindatplay.co.uk/byprocess.html [accessed 31.07.09]. This filter was inspired by reading Philip Galanter's 'What is Generative Art? Complexity Theory as a Context for Art Theory' (in *Generative Art Proceedings* (Milan: 2003) pp. 4 ff.). However, the names used to describe these generative processes on the *Mindatplay* web site are not scientifically exact; they rather reflect how an audience member might describe them.

[11] Artists A-Z: http://www.mindatplay.co.uk/byartist.html,
Artwork A-Z: http://www.mindatplay.co.uk/bytitle.html [both accessed 31.07.09].

[12] http://www.mindatplay.co.uk/byimage.html [accessed 31.07.09].

generative art, the database required an excentric angle. Therefore *Mindatplay* has a number of additional viewing filters, which are 'Contextualising map', 'Social setting', 'Research process', 'Audience participation' and 'Key content'. These filters arrange the content of the database in such a way that four key observations can be made, which contextualise the direction of this research. The first of these observations, revealed by the 'Contextualising map' filter, is the interdisciplinary nature of most generative artworks included in the database. This supports the claim that analysing generative art by art historical strand does not get to the core of it. The second observation problematizes the fluctuating role of the researcher, which is revealed by the 'Social setting' and 'Research process' filters. Here enquiring into the social setting in which these artworks were encountered highlights the effect of framing on perception, while reflecting on how the researcher engaged with the works begins to dissolve the conventionally perceived divide between researchers and players. The third observation ('Audience participation') then scrutinises some of the methods of engagement that were applied within the generative artworks. This problematizes the conventional understanding of participation and interaction. The last observation then begins to examine the perceptual processes that take place in the researcher in greater depth. This is summarised by the filter 'Key content'.

To prepare the ground for a later full discussion, these four observations will now be introduced in greater depth.

The interdisciplinary nature of generative art

Reviewing an artwork already constructs a context around it. Therefore to extract the context relevant for this research, appropriate viewing filters for the *Mindatplay* database had to be devised. However, while the use of filters is still common practice, it has lately been surpassed by the use of semantic maps. This is because semantic maps, unlike filters, do not remain fixed but change according to the actions of the database users. Thus they are themselves self-forming net structures.[13] Moreover, semantic maps are capable of

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[13] *Visual Complexity* (http://www.visualcomplexity.com/vc/) is a site by Manuel Lima, Senior User Experience Designer at Nokia's NextGen Software & Services. Many different visualisations of complex systems are listed here. Interesting entries include, for example, Magnus Rembold and Jurgen Spath (http://www.visualcomplexity.com/vc/project_details.cfm?id=303&index=40&domain=Knowledge%20Networks), Schoenerwissen/OfCD (http://www.visualcomplexity.com/vc/project.cfm?id=241) and Ciro Cattuto (http://www.visualcomplexity.com/vc/project.cfm?id=231 all accessed 11.05.09).

prioritising the connections users make between artworks over art historical disciplines or techniques. Interior similarities of works thus become more important than exterior similarities, and interdisciplinarity shows as a fundamental feature of the map. In many art databases like *Netzspannung,* for example, the semantic map has a central position.[14] What is more, the research team behind *Netzspannung* maintains that only an interdisciplinary perspective can allow for new knowledge to arise.[15]

The importance of an interdisciplinary review and its potential to generate new knowledge was also recognised in this research. However, because of the restricted time available, *Mindatplay* had to implement a simpler visualisation than a semantic map. Even if this visualisation would not change in response to viewers' actions, it still had to express the interdisciplinarity of its entries. The 'Contextual map' (see figure 3) that was eventually used thus roughly 'charts' the relationships between the different entries of *Mindatplay.*[16] The circular *Mindatplay* map employs three distinctively coloured regions to represent digital practice, sound installation and performance art. The colour scheme was devised in such a way that the three colours would bleed into each other to such an extent that there were hardly any monochrome areas left. This was to communicate that most of the artworks reviewed in the database were interconnecting several disciplines. Moreover, sixty-one smaller circles represent the entries of the database, whose titles are revealed when rolling over them with the cursor. The more centrally a circle is placed, the more interdisciplinary the work.

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[14] http://netzspannung.org/archive/?lang=en [accessed 11.05.09]. The *Netzspanung* interface offers four alternative ways of accessing individual entries. The 'Classic view' uses a list form. Visual information here provides the main access to the contents of the database. These contents (project descriptions, events, articles) can then be arranged and sorted further according to different criteria. The 'Archive browser', on the other hand, presents categories (people, subject matter, keywords, latest additions) in alphabetical order. The 'Randomizer' does away with hierarchical organisation completely while the 'Semantic map' draws out perceived connections between entries.

[15] http://netzspannung.org/archive/?lang=en [accessed 11.05.09]. *Netzspannung* was developed by the Media Arts Research Studies' (MARS) Exploratory Media Lab, a part of the Fraunhofer Institute for Intelligent Analysis and Information Systems (IAIS). (http://www.iais.fraunhofer.de/index.php?id=2&L=1 accessed 11.05.09).

[16] http://www.mindatplay.co.uk/map.html [accessed 31.07.09].

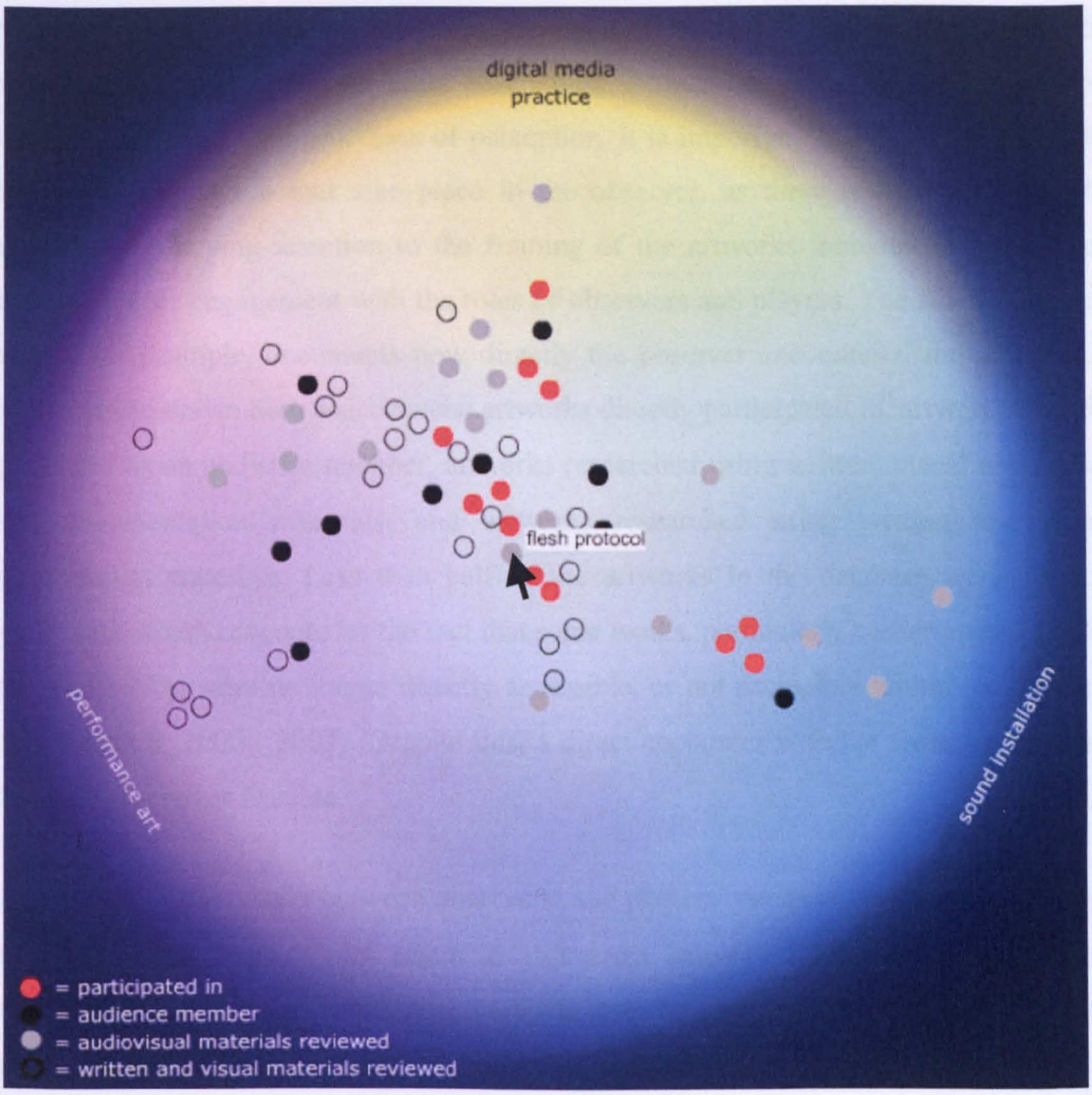

Figure 3: The overall map of the *Mindatplay* database (http://www.mindatplay.co.uk/map.html). Web site and illustration by the author.

The style in which each circle is drawn finally reveals whether the researcher had a direct or indirect experience of the artworks it represents. This distinction was important as it shed light onto the research process and started to problematize the role of the observer.

The fluctuating perspectives of researchers and participants

In *Techniques of the Observer*, Jonathan Crary states that observers are those who see what is new or different, but do so from within a prescribed set of possibilities.[17] This set of possibilities is the cultural frame, to which observers are so intrinsically connected that

[17] Crary, p. 6.

they are no longer aware of it. Thus, the cultural frame places its conventions and limitations over the phenomena under observation.[18] Since this research wants to connect generative processes with processes of perception, it is important to become aware of the processes of perception that take place in the observer, as these restrict what will be observed. Thus paying attention to the framing of the artworks included in *Mindatplay* allowed a deeper engagement with the roles of observers and players. The filter 'Research process', for example, documents how directly the observer encountered the artworks.[19] The distinction drawn here was between artworks directly participated in, artworks directly experienced as an audience member, artworks researched using written, visual and audio-visual documentation materials, and artworks researched using written and visual documentation materials. Less than half of the artworks in the database were directly experienced, which accounts for the fact that some works, particularly earlier ones from the 1960s and 1970s, were no longer directly accessible, or not accessible within the duration of this research (2000 - 2007). Despite this, a direct encounter with the work was valued, and sought whenever feasible.

The notion of crossing over between observers' and players' perspectives is interesting, but not new.[20] For instance, Crary refers to arguments between Newtonian scientists and phenomenologists about whether observers can ever be objective, whereupon he quotes Goethe replying that human beings are both 'producers as well as observers of sensation'.[21] This phrase finds remarkable resonances in this research, as playing with the biofeedback encouraged players to self-observe the biofeedback produced by the body. Moreover, direct

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[18] This cultural frame can be quite obvious, for example researchers like Lev Manovich have come to appropriate the language of the DJ (*The Language of New Media*, Cambridge, Massachusetts: MIT Press, 2001) to talk about interactive cinema.

[19] http://www.mindatplay.co.uk/byexposure.html [accessed 02.08.09]. Also the filter 'Social setting' distinguishes between traditional fine arts venues (galleries, art museums, studios, theatres), festivals (such as the *Ars Electronica*), concerts and events, site-specific installations at artist-defined locations, research environments (at universities, art and technology centres or museums), commercially available artworks (recordings, games, DVDs, printed materials), online artworks, and publicly archived artworks (http://www.mindatplay.co.uk/bylocation.html [accessed 02.08.09]). Looking at the listing reveals that, although there is a spread, most artworks included in the database were exhibited at traditional fine arts venues or festivals.

[20] The term cited by Crary for this crossover is 'observer-consumer'. It describes someone who is observing what is going on, but also deeply immersed in the action. This term is helpful to some extent, but not as resolved in itself as the term play. Therefore for the remainder of this research, play or playing was used.

[21] Crary, p.77. Interestingly, Crary leaves this discussion by saying since we are not able to access phenomena objectively, we can only embrace the instinctual life of the body.

experience, reflective introspection and self-observation often provoked simultaneous, but contradictory thoughts and emotions. This made the engagement with the work vertiginous, which was reinforced when, for example, participants recognised that their self-observations were not objective, or that they could not control the thoughts and sensations arising. This temporary loss of control made playing with biofeedback strangely fascinating.[22] Thus in addition to role fluctuations between 'being observers' and 'being players', there were also fluctuations while playing. These oscillated between the self-observing processes of perception and those of simply being played. Therefore whilst reviewing the context for this research, a greater awareness of the interchanging perspectives of observers and participants came about. This marked the beginning of a deeper enquiry into how observing and playing may be connected with generative processes, which will be revisited later on in this thesis.[23]

The methods of engagement: participation and interaction

Similar to the way in which conventional notions of observing and playing were addressed by the reflective review, the methods of engagement that are applied in the generative artworks also came under scrutiny. This concerns participating and interacting.

To a contemporary observer of participative generative art, it may seem that audiences engage with these works when participation is constructive, when it furthers communication, or when it at least draws attention to oneself. For example, in *Mesmerization: The Spells that Control Us*, Gee Thomson explores some of the values and fears that motivate younger citizens today. He concludes that subversive and playful behaviour is often not motivated by hope for political change, but the fear of remaining anonymous.[24] This, according to journalist Carl Bernstein, brings forth an 'idiot culture

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[22] What separates this kind of play from a mystical experience is that players know the connection between body and sound. Thus here rational knowledge only "coincide[s] with a perceptual intuition of the multiplicity and perishability of life" (Crary, p. 62).

[23] The discussion continues in Chapter 5.

[24] *Mesmerization: The Spells that Control Us: Why We are Losing Our Minds to Global Culture* (London: Thames & Hudson, 2008).

that hones the art of empty gestures.'[25] While these observations capture some aspects of contemporary culture, notions of participation and interaction are here used interchangeably. To understand audience members' behaviour better, it will be helpful to look at these terms in greater detail.

Participation is about decision-making and ownership. For a player to perceive a sense of empowerment, participation needs to be transformative, bring social change or social exchange.[26] However, either of these two goals requires active and voluntary involvement, which is only perceived as purposeful when it is effective. Sherry Arnstein's research, published in the 1960s, already connected kinds of citizen participation to degrees of empowerment.[27] Using the image of a ladder, Arnstein revealed how little of what is labelled participation actually is empowering (see figure 4).

While in the 1960s Arnstein's insights may have inspired direct action and social change, it is a somewhat different climate today. Changes have taken place since the 1960s, but they did not materialise as they were envisaged. Observing this, art critic and curator Paul Ardenne says the recognition of illusionary visions as such may help to come to terms with seemingly unresolved social revolutions, and to put "the great dreams [...] away in the attic of nineteenth-century ideological curios".[28]

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[25] Bernstein laments the rise of 'sleazoid info-tainment', where "for the first time in our history the weird and the stupid and the coarse are becoming our cultural norm, even our cultural ideal" ('The Idiot Culture', *The New Republic* June 8, 1992, p. 22 - 28).

[26] This has been demonstrated by research into presence and virtual representations, for example the paper '"Real" Presence: How Different Ontologies Generate Different Criteria for Presence, Telepresence, and Virtual Presence' in *Presence: Teleoperators and Virtual Environments* Vol. 8 (1999) No. 5, pp. 538 - 548, MIT Press.

[27] Sherry R. Arnstein, 'A Ladder of Citizen Participation' in *JAIP*, Vol. 35 (July 1969), No. 4, pp. 216 - 224 downloadable from http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html [accessed 15.05.09].

[28] Paul Ardenne, Pascal Beausse and Laurent Goumarre, *Contemporary Practices: Art as Experience* (Paris: Dis Voir, 1999), p.44. In connection with this Nicolas Bourriaud says recognising illusionary visions as such may finally lead human beings to "learn [...] to inhabit the world in a better way, instead of trying to construct it based on a preconceived idea of historical evolution" (Bourriaud, *From Relational Aesthetics* (1998) pdf downloadable from www.creativityandcognition.com/blogs/legart/ wpcontent/uploads/2006/ 07/Borriaud.pdf [accessed 1.06.09] (no page no.'s)).

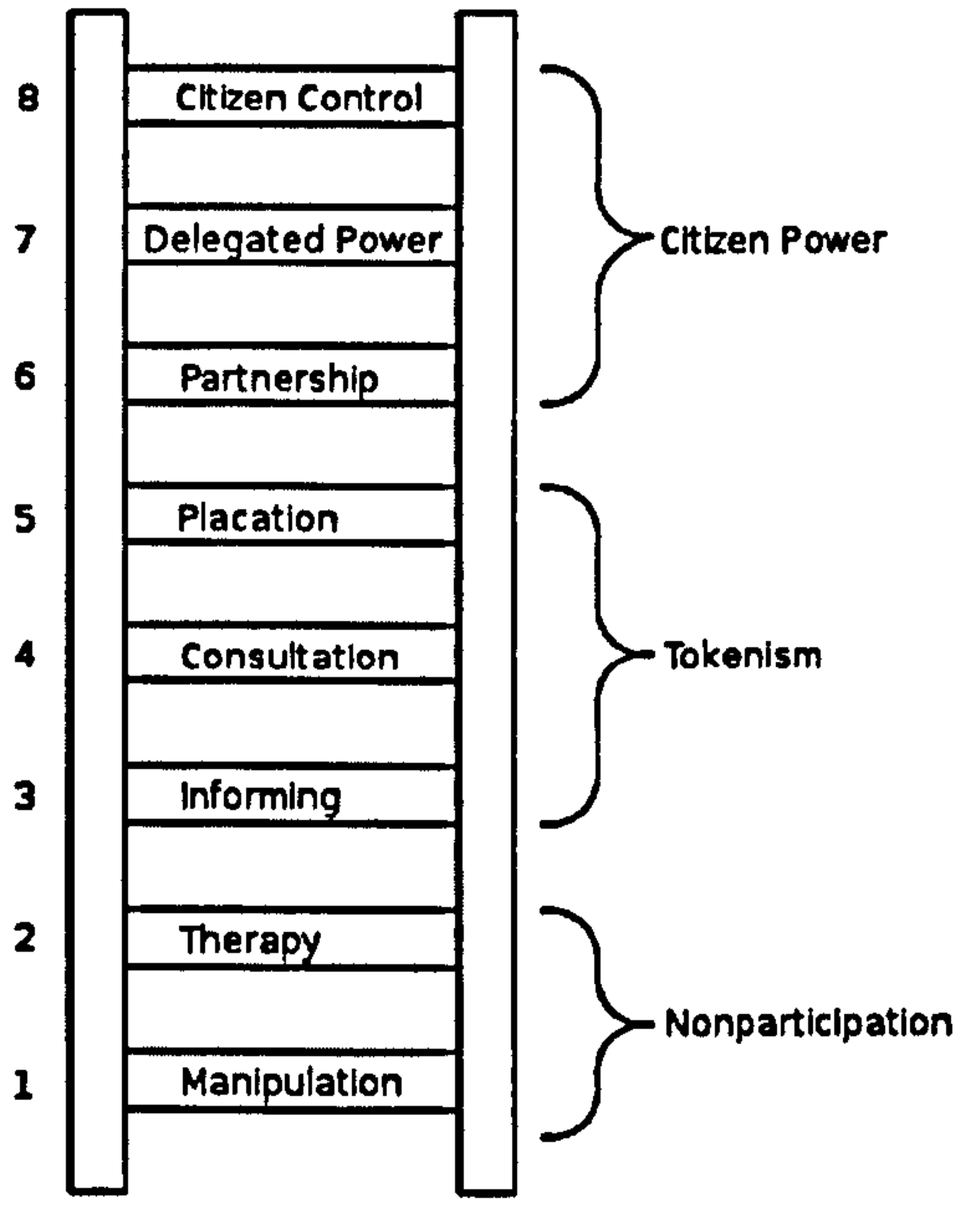

Figure 4: Arnstein's ladder of citizen participation.
Illustration by Sherry R. Arnstein.

Maybe because of this disillusionment, today's citizens are more wary of disempowering participation, and cynical about bringers of change; for them, only the name of the game has changed, but they feel as disempowered as before. Therefore not surprisingly, quite a number of recent artworks consist of small acts of rebellion from within an urban and semi-urban life; this is picked up, for instance, in Gillian Wearing's *Signs that Say What You Want Them to Say and Not Signs that Say What Someone Else Wants You to Say.*[29] Artworks like this also draw attention to the quality of participation within Western culture. When it appears that "the present-day social context restricts the possibilities of inter-human relations all the more *because* it creates spaces planned to this end",[30] a substantial inconsistency is exposed, that becomes perceptible in wider society as well as in art: while it appears as if interpersonal exchange is encouraged, the planning and organising of this

[29] This work, carried out between 1992 - 93, comprises of over 50 framed colour photographs. Here Wearing asked passers-by to write down what was on their mind. She then photographed them holding their statement (with their permission). Wearing's work is often quoted in connection with Relational art of the 1990s. Like the 1960s, this art movement still explored the realm of human interactions and living experience, albeit in a different manner. Bourriaud, who coined the term 'Relational art', defined it as an encounter. According to Bourriaud, the aspect most amplified by increased urbanisation and mobility is that contemporary living *forces* intensive encounters upon the individual. Visual experience becomes complex, as the links that create encounters have become immaterial. What holds society together is a collection of disparate elements, and a "collective elaboration of meaning" (Bourriaud, online (no page no.'s)).

[30] Nicolas Bourriaud, *Esthétique Relationelle* (Dijon: Les Presses du Réel, 1998) p.31.

process already sets out its limits. How these limits are set is revealing, as attempts that try to shape social relations into desirable behaviours can often end up creating token participation that does not empower its participants. Therefore exhibition audiences today may engage less enthusiastically with interactive works than at a time when the media technologies were eagerly embraced because of their potential for democratic decision-making and exchange.

However, according to architect and artist Usman Haque, the meaning of the term interaction has also shifted over the past years.[31] Interaction originally described a *responsive* exchange between partners, where the action of one partner causes a dynamic exchange with the other. In other words, there is not a ready answer for each input; like in an open conversation, answers are iteratively, collaboratively and socially constructed. This makes responsive interactions creative. Nowadays however, Haque points out, interaction has often come to mean *reactive*, where the partner or artefact provides a linear and causal response to the input received. The exchange that takes place here is more like a pre-programmed cycle of call-and-response that is being executed. Yet reactive interaction is not inferior to responsive interaction; either are valid responses under different circumstances. In fact, a more reactive interaction is often required when certain features of an artwork are to be kept unmodified. In the first concept of *Excitations,* for instance, it was anticipated that the interaction in the piece would consist of the performative actions of a performer and the responsive interactions of a computer, while the complex system under scrutiny was the biofeedback taking place in the performing body. Practice soon revealed that performer and computer overshadowed the biofeedback processes. Therefore to reveal the changes happening in the body, the interactions of performer and computer had to be restricted, although not to the point where they would only be reactive.[32] Thus in this case, less responsive interaction strengthened the piece.

However, describing interaction as either responsive or reactive generally does not go far enough. This was realised when the methods of engagement, used in the artworks in *Mindatplay,* were analysed in the filter 'Audience participation'. From this analysis, three

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[31] Usman Haque, 'Distinguishing Concepts: Lexicons of Interactive Art and Architecture' in *Architectural Design (AD) 4Dsocial: Interactive Design Environments* Vol.77 (July/ August 2007) No. 4, pp. 24 - 31

[32] In the end, the composition made selective use of random processes, and the performer occasionally improvised movement or engaged with audience members. This is followed up in detail in chapter 6.

major themes emerged, which could be divided further into subthemes.[33] The first theme was 'audience members as observers in artist-defined locations'. Here the focus of the interaction was on watching and listening, and the immediacy of the experience (focusing on the here and now). This could make itself felt as an emphasis of spatial and sensual experience. 'Active' interaction and improvisation was not encouraged, the works rather focused on a 'passive' interaction where any responses on the side of the audience expressed themselves internally. Then the second theme, 'audience members as participants in artist-defined locations', was characterised by 'active' interaction, communication, externalised responses and collaborative ownership of the work. Here audience members would typically become participants in a live event. This encouraged improvisation, but also contemplation. As before, the emphasis was on immediate experience and direct sense experience. The third theme finally was 'Audience temporarily and/or spatially remote'. Here interaction was still 'active', but temporally or spatially removed from the location of the live event. This made for a remote or delayed experience of the work, which may encourage contemplation rather than improvisation on the side of the participants.

Analysing the different interaction possibilities with these works revealed their underlying complexities, which interestingly, could not all be anticipated by the makers of the works. Sometimes these complexities rather seemed to emerge from the works themselves. Interactive installations like *Sensuous Geographies,* for instance, had little interaction planned.[34] The work was a performative space, in which participants, partially blindfolded and each assigned a particular sound, could move whilst listening to the sounds being spatialised. According to artist Sarah Rubidge, the installation thus drew participants' attention to the "subtle effects sound can have on the body itself, and from there to the geography of physical sensation which permeates human movement". Complexity was allowed to emerge rather than being defined, and thus participants exploring sound and movement in *Sensuous Geographies* could generate intriguing sound performances by themselves.

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[33] http://www.mindatplay.co.uk/byaudience.html [accessed 02.08.09].

[34] http://www.mindatplay.co.uk/sensuous.html [accessed 02.08.09].

The nature of the experiences generated

A similar observation emerged from trying to analyse the artworks in the *Mindatplay* database by 'Key content'. A number of themes were identified, which describe some of the internal responses taking place while interacting. These themes include, for instance, awareness of perceptive processes taking place, awareness of the illusion of consciousness, self-observation of non-verbal communication patterns, awareness of one's presence in a particular location, awareness of being dis-located, awareness of another's physical presence, self-observation of immersive play, or self-observation in social play. However, many artworks elucidated more than just one response. *Intimate Transactions* by The Transmute Collective, for example, was one such multi-layered work.[35] This interactive installation allowed two people in separate locations to interact with each other using only their bodies. For this a 'bodyshelf' was utilized, a support structure with a built-in array of sensors that detected shifting balances of bodyweight and different types of backpressure. This data would be used to move an avatar within a virtual play space. The effects of this kind of interacting could be summarised as follows:

> The bodyshelf focused the player on physical interaction and sense exploration, which increased the awareness of 'being here'. However, the player was also conscious of the dislocation of the other player. Thus 'being here' also meant being absent from the partner. This impression was increased by not being able to communicate verbally. However, the interplay between presence and absence also expressed itself in relation to the imaginary space where shared play took place. Again the player's attention shifted between the sensations of the body and the interactions taking place within the play space. On top of that there was a sense of unpredictability of what might happen, as only playing would allow the player to obtain a better idea of the partner, and whether shared play would turn out as competitive or cooperative.[36]

This account of having taking part in *Intimate Transactions* suggests that the responses to interacting evoke complex thoughts and emotions, which affect participants on many levels.[37] But even this complexity that arises from interacting still fails to capture what draws audience members towards interacting in the first place.

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[35] http://www.mindatplay.co.uk/intimate.html [accessed 02.08.09]

[36] This passage is an excerpt from the author's research diary. *Intimate Transactions* was visited at the ICA, London, in November 2005.

[37] http://www.mindatplay.co.uk/bykeyword.html [accessed 02.08.09]

Even in artworks where the engagement with the piece is non-participative (as the outcome of the engagement is already fixed), interacting can still seem appealing. To understand why this may be the case, it is helpful to return briefly to explorative play. Actions in explorative play are essentially passive. This is maintained by Gadamer who opposed the idea of a freely acting subject, and said that play is not an exercise of one's subjectivity, but a thing with its own order and structure, which takes hold of the player. A definition of interaction therefore also needs to consider it as a passive movement, and relate it to what it does to its player. Interactions therefore can be externally effective, but also internally transformative. In this regard, artist Anne Sarah Le Meur points out that it is the internal effect of interacting that allows participants to connect with an artwork on a deep emotional level. She concludes that for the engagement to deepen, an artwork needs to encourage contemplation.[38] Connecting interaction with contemplation in this way not only shows that internal transformation is a valid aspect of interacting, but also that it is a vital one. In fact, it provides the link to the core aspect of this research.

According to psychoanalyst Donald Winnicott, play transforms the very root of our being.[39] Through play we make our first experiences of the world, and through play we later shape our identities. Winnicott's observations are founded on research about the transitional object phase, during which young children use transitional objects (such as teddy bears) to perform a transition "between subjectivity and objectivity, between primary creativity and the projection outwards of what had been introjected."[40] Since then, the transitional object phase in psychoanalysis has come to be understood in three ways: as "a phase in a child's normal emotional development; as a defense against separation anxiety; and, lastly, *as a neutral sphere in which experience is not challenged – an area of play and illusion.*"[41] The last definition suggests that the transitional object phase is much more than

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[38] Anne Sarah Le Meur, 'Into the Hollow of Darkness: Realizing a 3D Interactive Environment', in *Leonardo*, Vol. 37 (2004), No. 3, pp. 204 - 209.

[39] Donald W. Winnicott, *Playing and Reality* (London: Routledge, 2005).

[40] According to Winnicott, a young child encounters its world by interacting playfully with people and objects, using her senses. Once the child begins to realise the difference between 'me' and 'not-me' it experiences the loss of control, omnipotence and magic. A phase begins where it employs radical questioning through the senses: 'not-me' can only be real if it survives destruction; for example a relationship that survives separation is considered as real ('mother is away, but she still loves me'). Once the paradox of separation and continuing existence is understood, the child reaches a new level in its development (Winnicott, p. 120ff).

[41] http://www.answers.com/topic/transitional-object-psychoanalysis?cat=health [accessed 02.08.09]

a developmental phase in childhood, and indeed in his preface to *Playing and Reality*, F. Robert Rodman says with his work on transitional objects, Winnicott really revealed the "*neverending* oscillation between the inner and outer worlds."[42]

Winnicott's work is certainly important, but not only because he explored play experiences that affect human beings throughout their lives. Crucially for this research, the vertiginous kinds of play Winnicott describes in connection with the transitional object phase do not sound dissimilar to the descriptions of explorative play. Winnicott states, for instance, that "the thing about playing [in the transitional object phase] is always the precariousness of the interplay of personal psychic reality and experience of control of actual objects. This is the precariousness of magic itself".[43] This would also apply to explorative play. An association could, for instance, be made to the protagonist in Proust's *A la Recherche du Temps Perdu*, who often fluctuates between his feelings for Albertine and his attempts to control her.[44] While more work needs to be done to show the parallels between Winnicott's work and explorative play,[45] the importance of investigating into explorative play might already have become discernible. For Winnicott, play in the transitional object phase is fundamental because it allows children to be creative, which is important for the development of a healthy psyche: "It is in playing and only in playing that the individual child or adult is able to be creative and to use the whole personality, and it is only in being creative that the individual discovers the self".[46] Moreover, only creativity and play make life worth living:

> It is creative apperception more than anything else that makes the individual feel that life is worth living. Contrasted with this is a relationship to external reality which is one of compliance, [...] Compliance carries with it a sense of futility for the individual and is associated with the idea that nothing matters and life is not worth living. [...] Living creatively is a healthy state [...] compliance is a sick basis for life.[47]

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[42] Winnicott, p. xii.

[43] Winnicott, p.64.

[44] Marcel Proust, *In Search of Lost Time*, Vol 5 (London: Penguin, 2003). This explains why Proust describes Albertine first as 'the prisoner' and later 'the fugitive' in the title of this volume.

[45] This discussion will be continued in chapter 4.

[46] Winnicott, p. 73.

[47] Winnicott, p. 87 f.

This passage emphasizes how vital it is to think about the kinds of social interactions and play experiences that are initiated in art. Token participation and interaction are problematic, because when there is no transformative participation, play experiences cannot be empowering, and when there is no transformative interaction, play experiences cannot be creative. However, art debates do not always consider the creativity and expertise that resides on the side of audience members, which projects a considerable divide. Even artists do not always investigate what kinds of experiences the works they helped to bring about initiate. Moreover, audience members' accounts rarely feature in audience surveys.[48] Thus the connections between interacting in generative artworks and processes of perception remain largely obscure.

It is therefore necessary to explore the qualities of the exchanges that come about when participants engage in play. However, as these play exchanges are often complex and generative in themselves, they need to be observed and reflected upon *as they take place*, which suggests that the use of action research is required and appropriate in this context. Therefore the action research methodology employed in this research is the focus of the following chapter.

[48] A good example for this is a research report by the Arts Council of England (Fenn, Bridgwood, Dust, Hutton, Jobson and Skinner). *Arts in England 2003: Attendance, Participation and Attitudes.* Arts Council of England Research Report 37, carried out by the Office for National Statistics (ONS) 2005. Downloadable from http://www.artscouncil.org.uk/publications/publication_detail.php?sid=13&id=429 [accessed 01.06.09]). The aim was to find out "who is attending what kinds of events and how often, what types of people take part in a range of artistic and cultural activities, and how the public feels about the arts and how they should be funded" (Fenn and others, p. 3). What is problematic with reports like these is the quantitative approach to attendance, participation and attitudes. Attendance was measured via ticket sales, and in the wording of the report it became clear that attendance was predominantly understood as passive consumption. Participation was measured as consuming art, buying art, or taking part in its production. Finally attitudes were measured through to agreeing to statements such as 'the arts play a valuable role in my life'. There was no scope for assessing the qualities of social interaction or individual experiences that were initiated through artworks.

3 – Research methodology

This chapter introduces action research as the methodology and shows how several action research tools were triangulated in order to ensure reliability and validity. It is argued that qualitative feedback gained from direct observations and interviewing during action research served to deepen the insight into the nature of explorative play experiences. How this operated is demonstrated on one of the tools, the qualitative action research workshops, where participants engaged in explorative play with the biofeedback instrument. Insights gained from the workshops not only fed back into the thinking about methodology, but also prepared the development of a biofeedback performance practice.

Introduction to action research

The main vehicle driving this research was creative practice, a process that could be described as a progressive conceptionalising of an idea that involves many instances of acting, reflecting and questioning. Thinking about creative practice in this way reveals, however, great affinities between creative processes and processes of action research.[1] The term action research, first used by psychologist Kurt Lewin in the 1940s, is a qualitative research method used within education, organizational management and the social sciences. It assumes that knowledge can be generated through collaborative action, which ultimately leads to better informed, more manageable or sustainable actions.[2]

In this research, which was driven by the researcher's agenda of transforming the thinking about explorative play through generative art practice, action research was employed as a continual learning tool that would improve creative practice through practice and, in particular, by allowing the researcher to work through a series of reflective stages that

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[1] Rewriting the research question as an action research question, 'how will listening to the mind at play through creative practice with sonified biofeedback affect the understanding of generative art practice and theory', reveals the affinities between creative practice and action research.

[2] Since its first appearance, action research has developed into many different strands, which renders it necessary to introduce it a little more. Apart from how it was used within this research, action research can be also applied as a cooperative enquiry. In that case, participants would be directly involved in research decisions, which was not the case here. It can also be used as participatory action research, whereby participants' agendas would drive the action necessary to solve a problem (maybe in this case: to 'improve' their play), or, it can be applied to establish what participants know about an action (for instance explorative play). Neither of these two latter strands applied here.

would develop the practitioner's expertise.[3] These stages included researching and performing actions, assessing their effects and changing and re-researching actions. However, progressing through these stages was not a simple movement: every stage influenced others, and thus when experimentation and reflection led to a deeper understanding of one action in question, this also always initiated another, deeper investigation of the problem in general. In all of this, the consultation of audience members, participants, and fellow practitioners was crucial, not only to assess the *effects* of creative practice but also to develop practice in such a way that it would make the complexities of explorative play *intuitively perceptible*. Only with continuing feedback was this realistically possible.

Applied in this way, action research can bring about a deeper insight into complex phenomena such as explorative play experiences, which need to be played out in order to reveal themselves.[4] Moreover, because action research acknowledges the complexity of its own approach (it requires, for instance, active moment-to-moment theorizing, or data collecting and inquiring in the midst of the phenomena under scrutiny), it lends itself to revealing not only the complexities that affect explorative play, but also the complexities that affect thinking about explorative play. In this way it allows for an in depth study that pays particular attention to the distinctiveness of the actions under observation.

The methodology developed for this research therefore consisted of a range of different action research tools, which were combined to increase the reliability and validity of the outcomes. The tools included observative action research tools such as workshops and open play sessions, performative tools such as performances and presentations, and finally self-reflective tools such as a self-reflective diary and self-observations where work in progress was performed to a camera (see figure 5).

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[3] This is why action research is sometimes described as "a process of living one's theory into practice" (Center for Collaborative Action Research http://cadres.pepperdine.edu/ccar/define.html [accessed 15.04.09]).

[4] It becomes obvious why other methods such as quantitative tools would be inappropriate here, as experience cannot be quantified.

Action research tools:		
Observations	**Performances**	**Self-reflection**
Action research workshops, (structured participation)	Work in progress performances	Self-observation (performing to camera)
Open play sessions (multiple participants)	Presentations, lecture demonstrations	Self-reflective diary

Figure 5: The six action research methods used to structure and evaluate creative practice (abbreviated from Appendix C). Illustration by the author.

The triangulation of these six tools made it possible not only to investigate the research question from different angles,[5] but also to open out the traditional artist role: self-reflection, for example, was expanded by audience feedback (which was gathered with work in progress performances, presentations and lecture demonstrations), and even more so by the knowledge generated from observing others playing. In this regard, the chosen methods complement each other and form a developmental set (for a full table see Appendix C). Triangulation, therefore, allowed valuing the perspectives of participants, fellow practitioners, mentors and audience members, and helped obtain a more significant, critical and holistic view of the research. To explain how this was achieved, it is necessary to briefly introduce each individual research tool.

Action research tools

The first of these was a pilot series of *action research workshops*, which were held at London Metropolitan University during April 2005. The workshops represented a structured and intense period of investigation, during which participants were introduced to a biofeedback device that translated their heart rate and stress levels into sounds. These sounds reacted to participants' physical and mental activities. Direct observation was

[5] To evaluate feedback given, a range of qualitative strategies such as direct observations and semi-structured interviewing were employed across these tools.

employed to monitor how participants would operate the biofeedback instrument and play with the sounds. Although the workshops were valid, significant and appropriate, in retrospect the scope of the workshops was too wide, which resulted in too much data being recorded. This made it necessary to select a representative data sample for later analysis. Furthermore, while the workshops succeeded in introducing participants quickly to the biofeedback device, opportunities for free improvisation and open play were not as abundant as in open play sessions. On the other hand, because of their coherent and in-depth approach, the workshops revealed key insights that many of the other tools did not yield. Hence it is important to examine these outcomes in greater detail later on. Documentation of the workshops is available in form of session outlines, preparation documents, video recordings where participants play or give feedback, observation notes, sets of codes for data analysis, session matrices, as well as evaluative and reflective writings.

The next research tool to be introduced is the *open play session*. The first of these was held at the *PARIP* international conference, Leeds, June 2005. After the highly structured workshops, the pace and scope of this one-hour session was to be directed by the participants in order to provide more opportunity for open play. Once made comfortable with the biofeedback instrument, participants were therefore left to experiment and immerse themselves in play. Participants' actions were monitored through non-participant observation, which is documented partially in video recordings, and partially in field notes. The session generally revealed that many play activities occurred spontaneously and developed their own dynamics, often playing themselves to an end. However, the influence of interpersonal exchanges on play could also be observed, which meant that because of the dynamic group situation, play could not always deepen. A further play session, held at the Newport School of Art in October 2008, then used a semi-structured approach, where some activities were scheduled but the pacing was directed by the participants. The two most significant outcomes of this session stemmed from an activity where the sensors were passed from participant to participant. This made the differences between each participant's mental states immediately audible and the workings of the biofeedback intuitively perceptible. Inviting participants' involvement in the sound composition then got them more deeply connected with biofeedback practice. Interestingly, rather than sonifying different states as pitch changes, they sonified them as rhythmic changes, which

may have coincided more with their listening expectations.[6] Thus generally, open play sessions emerged as an important research tool because they allowed specific insights on group play.

A further tool was *self-observation*, which took place at various periods during 2005. These were similar to a sweatbox scenario, where movement experimentation, play, and verbalized reflections-in-action of the researcher are recorded on video and later analysed.[7] Documentation of the self-observations is available in the form of video recordings and field notes. The main advantage of self-observations was that they allowed the researcher to see the performative actions from the perspective of an audience member. This was particularly helpful early on in creative practice, when the visual aspects of the performance needed to be developed and the link between body and sound needed to become more easily perceptible. Another advantage was that self-observations allowed to proceed at the researcher's pace and intensity. The researcher also had maximum control over the recordings, which emerged as a useful preparation for the final recording of practice much later on. Despite these benefits, self-observations ceased to be experimentative the further the practice progressed, as critical reflection began to grade the work into more and less effective practice moments. While this initially helped to improve the quality of practice, it later drove it towards entertaining the audience with a set of actions. Once the stagnation this produced was realised, the focus on less purposeful play returned. From then on, work in progress performances took over as a developmental tool from self-observation, particularly since performances provided greater opportunities for external feedback.

Work in progress performances were a further action research tool. These usually lasted between five and twenty minutes, and were followed by short question and answer sessions. Performances were held at the *Fresh! Performance Festival*, South Hill Park, Bracknell, May 2005; *East End Collaborations*, London, September 2005; *E-performance* international conference, Sydney, December 2005; *Time, Flesh and Nerve* event, London,

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[6] The group consisted of white male music students in their twenties.

[7] Reflecting-in-action is defined as 'reflective conversation[s] with the materials of a situation' (Donald Schoen, *The Reflective Practitioner: How Professionals Think in Action* (Farnham: Ashgate Publishing, 1983, p.78).

July 2006; and the *Florida Electro-Acoustic Music Festival*, April 2008. Documentation of these events exists in the form of preparatory documents, video recordings, and feedback from research mentors. Whenever verbal feedback was received from the audience, it was documented in field notes. Unfortunately the after-performance feedback sessions would not always allow for extensive discussion of audience feedback. This was therefore compensated by reflecting on the video documentation of the performance in light of the comments made. Performances thus emerged as an invaluable action research tool, especially since each performance could build on the reception of the previous one. In the best case, a performance could achieve deep audience engagement, and a sense of intimacy and immersion. In the worst case it would fail to engage its audience. A sense of this became already perceptible *during* the event, as performers often 'feed off' the audience. Nevertheless, failures are often the catalysts of further progress, and so reflecting on each performance would eventually reveal clues as to how the core of practice may become more intuitively perceptible. Thus although risky, working in a series of performances was highly appropriate and valid. The main outcome from using this tool was that the performances progressed from a concern with movement to a concern with the mental state of the performer, as only then could the fluctuations in the biological data become intuitively perceptible.[8]

The action research tool that served all others, by recording thoughts and ideas as they came about, was the *self-reflective research diary*. This therefore contains – although not in this order – analysis of related artworks and conference papers, important points read in literature, reflections on training events attended, sketches of work in progress, performance scores, flowcharts detailing the interactivity, brainstorming of technical and conceptual solutions, schemes and technical specifications of equipment used, contact details of suppliers, reflections on performed actions and play, reflections on feedback received, cross-references of research stages, metaphors through which practice might be communicated, and general hypothesis of practice. The wide range of materials shows that the diary was effectively the hub of the action research, as it recorded all the complex and intertwined thought processes when they occurred. This made it highly useful. However, it also produced a huge amount of data. Before some of this could be distilled into research

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[8] This is discussed at length in chapter 6.

outcomes, it needed to be evaluated and triangulated with other research tools to ensure validity and reliability.

Fed by all other tools, but especially the research diary, were *presentations, demonstrations and performance lectures.* The first of these were given at internal research events at London Metropolitan University: to the *Sound and Music Technology Research Group* and the *Fine Art Research Group* during May 2005, and to the *Group for Research in Interactive Media* in June 2005. In November 2006 work in progress was presented to the University of the West of England's *Creative Media Research Group* and more recently at the Bristol Institute of Technology's *CODA* symposium (May 2008). A further guest lecture was also given at the Newport School of Art in October 2008. These presentations and lectures consisted of a twenty to forty minute talk, and a short question and answer session afterwards. Most of the earlier presentations also included a live demonstration of the biofeedback sensors. This was seen as an important element, as the questions arising afterwards often helped to gauge how intuitive a simple demonstration of the instrument had been and how much of the research still needed to be explained. However, the demonstrations were also problematic, as the local facilities were often not suited to playing back subtle and slow biofeedback sound patterns. Due to the low sound quality, some of the demonstrations failed to convey the fascination that listening to biofeedback sounds can instill and were therefore eventually replaced with pre-recorded materials. Questions and discussion points that arose in the post-presentation sessions also gave some indication of whether the main points of the research were conveyed successfully. However, in these relatively short feedback sessions, it was often not possible to enter a full discussion. Despite these drawbacks, presentations and lectures were an appropriate and valid research tool, especially as they provided useful opportunities to effectively reflect on and hypothesize different aspects of the ongoing enquiry.[9] Presentations and lectures are partially documented in video recordings, partially in field notes.

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[9] These presentations were later often worked into conference papers and presented at the following events: *E-performance* international conference, Sydney, December 2005; *Mindplay* international conference, London, January 2006, *UK Music Acoustical Network conference*, London, September 2006, *World Forum for Acoustic Ecology*, Hirosaki, Japan, November 2006, and *CADE 2007* international conference, Perth, Australia, September 2007.

From this list of tools, the action research workshops stood out as the most unusual tool that generated the deepest insights.[10] Not surprisingly, it catalyzed the development of practice and also furthered the theoretical understanding in this research. How this was possible will now be examined in further detail.

Planning the action research workshops

The main purpose of the workshops was to deepen the understanding of certain aspects of practice and to drive their further development. These aspects relate to the question of how to disrupt existing audience expectations in such a way that players' attention would shift onto the generative processes revealed by the biofeedback. Observing participants at play with their own biofeedback sounds thus allowed for a deeper insight into how they dealt with unusual experiences.[11] Knowledge generated from this later influenced practice and its conceptualisation.[12] However, the workshop format was not only chosen as it allowed for observation of participants' experiences as and when these took place, but also as it provided the opportunity to understand participants' ways of thinking through a discursive dialogue. Moreover, as workshops usually foster a collaborative research atmosphere, they represented a way in which participants' contributions to the research could be appropriately acknowledged. Workshops could also be conducted in a relatively informal manner, which sometimes helped to distract participants from thinking they had to 'perform to a standard' and allowed them to focus more on experimenting and reflecting.[13]

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[10] Action research workshops may be common in other disciplines, but they still exceed the usual working practices of creative practitioners.

[11] Workshops were to generate knowledge from participants' actions, verbal accounts as well as non-verbal communication, which in this case meant participants' engagement in movement improvisation and contemplation.

[12] For action research purposes, the question underlying the workshop was conceived as follows: 'If a play space was set up where participants' explorative play could be observed and their descriptions of their experiences could be monitored, in what ways, if any, will the information about this help improve a performative practice concerned with explorative play?'

[13] To ascertain rigour, the preparations for the workshops included completing a one semester taught module in qualitative research methods at master's level at London Metropolitan University (February - July 2005), tutorials with qualitative researchers, and attending relevant events, such as presentations of the UK Evaluation Society (http://www.evaluation.org.uk/ [accessed 15.07.09]).

The workshops were planned as two consecutive three-hour sessions for each participant. Three hours may seem like an excessive period of time, however, it included time for equipment calibration, short breaks, negotiating consent on recordings and discussing participants' feedback. Therefore the actual playtime with the biofeedback device was closer to one hour.[14] Although the sessions were structured by activities, the structure and pace of progression was responsive to participants' needs. The first of the two sessions usually began by introducing participants to the session and letting them get accustomed to using the biofeedback sensors. Basic instructions on how to control the sound – either through movement or focusing the mind – were provided. After that the session focused on how participants played with the sounds. The second session allowed more time for participant-led exploration of the sounds and improvisations. During both sessions, data was collected using non-participant observation techniques, which meant that although present to facilitate, guide and observe, the researcher did not take part in play or improvisation. This was done so participants would not follow the researcher's example but had to develop their own responses to the tasks. How these responses came about was then observed by monitoring participants' actions, as well as by conversing with participants about it whenever a suitable opportunity arose.[15] Data generated by either method was documented in field notes and occasionally in video recordings, which was particularly suitable to capture participants' actions during intense play spells.

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[14] Control is a problematic issue when sharing personal data with others, especially when potentially invasive technologies such as biofeedback devices are used. It was therefore important to clarify the nature of the workshop with participants and to agree on issues surrounding the control of data. Thus participants were informed that the workshops formed part of a PhD study and, in particular, that it was intended to work with physiological data generated by the participants. This data would not be used for medical assessments. Participants were also informed that they would be observed using sensors and giving verbal feedback, parts of which would be recorded on video, but only when they consented to do so. In video recordings, participants could ask for their identity to be concealed or could refuse the public screening of their clip. Any statements made would remain anonymous. Participants were free to leave workshops at any time. On completion of the study, only data where consent was given to do so may be published as a documentation of the workshops. No other data would be collected or stored. However, even with these arrangements in place, it was questionable whether participants could ever consent in advance to using something they did not know much about. As the understanding of what they were expected to do only came about by actually doing it, participants' consent was never taken for granted. 'Clarifying the nature of the workshop' was therefore understood as an ongoing negotiation.

[15] Short spells of unstructured in depth interviews were conducted throughout the workshop sessions. These took place whenever participants wanted to share some of their experiences. Although seemingly spontaneous, the researcher used a topic card to ensure the research questions were covered. If this was not possible during the session, semi-structured interviews were conducted at the end.

The participants in this pilot study were nine specialist-researchers: movement practitioners, media arts practitioners or sound practitioners. While the workshops were usually conducted as one to one sessions that enabled the participant to engage deeply with explorative play, occasionally two participants shared a workshop. This allowed the researcher to see how playing in a group might affect explorative play. Prior to the workshops it was assumed that these specialist-researchers would be most interested in those aspects of the work that connected closely with their own area of specialism, but that they might still comment on other aspects, albeit from a more general perspective.[16] However, practice revealed that this notion was misplaced. Most participants wanted to engage with the work as a whole, and not with specific aspects of it. Moreover, when it came to explorative play and improvising, participants either improvised or not, regardless of their specialism. Therefore participants' readiness to immerse themselves in play emerged as an aspect that had greater influence on play than previous improvisation experience. The difference in attitudes becomes clear in the accompanying video documentation (DVD: section 'Participatory Research'). The section 'Discovering the rules of play', for instance, shows participants who found it initially hard to improvise, while the section 'Discovering with curiosity' shows participants ready to immerse themselves in play.[17]

Reflection in action

Although the workshops followed an outline of structured action, it was soon realised that there were differences in pace between participants, which could extend or contract the prepared schedule. While some participants reached explorative play quickly, others came

[16] This was trialled in workshops with more than one participant, where one person would act as the audience, while the other would perform with the device.

[17] Another issue concerned the importance of the associations to do with technology or research that participants usually voiced at the beginning of the workshop. In most cases, these seemed to be only culturally imposed, i.e. participants felt they 'ought to' express some of the commonly held concerns, before exploring what was really at stake in biofeedback practice. While it was important to note these concerns, focusing too much on them sometimes gave them unnecessary exposure, or as one participant pointed out, 'now that you said that, I am starting to worry about it'. On the other hand, there was not much that could stop a player who really wanted to play. Practice also showed that the amount of instruction required varied from participant to participant. With hindsight it would have been more successful to demonstrate rather than to explain, as this can often directly convey the core of the answer rather than tire the questioner with abstract concepts.

only close to it at the end of the workshop. However, observing whether and how explorative play took gradually hold revealed a finer pattern of observable stages of play, which might be entitled play curiosity, getting prepared, first explorations, finding one's self, fine-tuning of control, contesting control, explorative play, ecstatic play, and fatigue. These stages give more detail to the originally outlined progression from rule-based to explorative play (see figure 6).

Expected development of play (prior to workshops)				
Beginning of play	→	Rule-based play	→	Explorative play → End

First analysis: play actions								
Play, curiosity	Getting prepared	First explorations	Finding one's self	Fine-tuning of control	Contesting control	Explorative play	Ecstatic play	Fatigue

Figure 6: Expected progression of play and a finer pattern that emerged in the action research workshops. Illustration by the author.

Still, the nine stages of play are an abstraction. It is not intended to say that each participant spent equal amounts of time in each stage, or that progress was linear. Some participants repeated stages along the way, and others could not progress beyond a certain point. Nevertheless, this abstraction is useful, as it expresses the general direction of play. Moreover, the nine stages of play provide a useful structure for the description of the particular patterns of each play stage.

Emerging patterns of play

The beginning of play was concerned with establishing a rapport between participant and observer. This took place by progressing through a mixture of communicative rituals, information exchange and negotiation of consent.[18] This stage was important, not at least

[18] Different play elements interspersed throughout the workshops, from mind play, the most private form of play, to interpersonal games (see Brian Sutton-Smith, *The Ambiguity of Play* (Yale: Harvard University Press, 1997, p. 4 for a list of play forms that range from private to public). Participants, for instance, behaved playfully by initiating and abandoning different interpersonal games with each other or with the observer. This additional layer made the workshops a complex structure.

because occasionally there was a great difference in expectation. Some participants anticipated an experiment in a research laboratory, however, the action research space, where participants were expected to contribute to the research by actually playing, was quite different.

Once these expectations were addressed, roles outlined and consent agreed, participants got dressed into the equipment and began to explore what it felt like wearing the first of two sensors. At this stage, first associations were often voiced: some participants felt highly body-conscious, uncomfortable, or under scrutiny; others made little of it and wanted to start exploring immediately. Then, as participants' engaged in their first explorations, the connection between body and sound became established. This was a crucial prerequisite for the remainder of the workshop. At this stage, some participants asked for instructions or tasks that would make this connection more obvious, while others preferred to find out by themselves. A core concern that entered play around about then was how to gain control (this was also called 'finding one's self' by some).[19] According to participants, control meant being able to predict the outcome between a change in the body and sound. To gain control, participants usually moved, then listened to the sound and refined this process through trial and error. Sometimes correlations between movement and sound were discovered by chance. If movement failed to reproduce the expected sounds, participants usually slowed down and simplified their actions. While most participants thus gained control quite quickly, others only pretended to do so, which became clear when the sounds did not correlate at all with their movements. However, once participants had gained at least some control, they were introduced to the second sensor. This one could not be directly controlled by movement, but reacted to participants' stress levels. Specific techniques such as breathing exercises or mental imaging could be applied to effect a change in the sound. However, these tasks are hard to do – especially under observation – and therefore at this stage, most participants said controlling sounds through physical effort was more interesting than through mental effort.[20]

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[19] Participants thought they had to control a representation of themselves, like we usually do with an avatar in a virtual environment, or a mouse pointer on a computer screen.

[20] An interesting observation could be made in workshops with more than one participant: the rapport with the fellow participant greatly influenced whether their play turned competitive or collaborative. In competitive situations, the focus was on achieving a higher level of control or giving a more skilled improvisation than the co-participant. Collaborative play, on the other hand, came about when participants appreciated the differences of each other's responses.

Participants then usually wanted to fine-tune their control of the sounds by repeating movements or mental images. Again, they said they felt in control when they could intentionally reproduce the same sounds. By then they were usually more at ease, although still aware of wearing attachments to their bodies. Some explored a wider range of movements or began to project their actions to an imaginary audience. Others began to speculate aloud about how they might gain better control. However, controlling biofeedback sensors is not an easy task, and thus sooner or later a point of saturation and mental fatigue set in. Some participants said full control was too difficult, others said it was impossible. It seemed like their intention was temporarily exhausted.

Yet, this stage of exhaustion emerged as an important threshold that allowed for another kind of engagement to take over.[21] Thus after a period of rest and reflection, participants recommenced their explorations. However, this time they *contested* the rules they set up in their previous play and instead, began to develop their own improvisation 'styles': movement sequences, verbalising memories and personal traumas (birth, death, loss, sickness), musing, improvising musically with the sensors (playing an invisible instrument), improvising vocally (humming, singing, reciting) or playing mental games, often only visible in their changing facial expressions. This noticeable change of play focus indicates that saturation and fatigue may have important roles in play, as they can signal to the observer the closure of one play spell, and at the same time provide for the player the necessary ground for the (re-)emergence of another.

In this explorative play stage, the biofeedback sensors that were previously cast aside assumed a new function.[22] While participants explored them afresh, they said they were highly aware, daydreaming and drifting, listening to the sounds and yet not directing them. The control of the body-sound link became less and less important as they became more

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[21] It could be observed in the workshops how play arose 'from the ground up', and thus one might suggest that participant's exhaustion and boredom prepared the ground from which explorative play later emerged. Interestingly, John Cage also observed that disinterestedness and nothingness allow for things to appear. He even postulated, "the responsibility of the artist consists in perfecting his work so that it may become attractively disinteresting" (John Cage, *Silence, Lectures and Writings* (London, Marion Boyars, 1999), p.64).

[22] This is reminiscent of Donald W. Winnicott's writing on children testing their play objects: only when objects survive their 'destruction' during rough play are they accepted as real. (*Playing and Reality* (London: Routledge, 2005), p.120ff).

immersed in listening to the sounds. Some then observed that while normally they improvise movement to an existing piece of music, here they improvised and heard the sounds of their improvisation, albeit with a short time delay. As before, by moving more slowly, participants could synchronise the sound better with their movement, which in turn helped to achieve a more immersed state. At this stage, participants usually shared their experiences openly: some talked continuously, others only made occasional accentuating remarks, yet others preferred to communicate non-verbally through gestures and looks.

Letting the sound feed back further into the improvisation then led some participants on to ecstatic play,[23] where they were still moving but stopped talking, and some even turned away from the observer. This was later described as the most mesmerising play stage, where any awareness of sensors, tasks, observational setting, body-consciousness or time had disappeared. Then, with some participants, a period of stillness and immersion took hold, where there was only very little external movement. At that stage it seemed that participants observed the emergence of their own play. But this could not be sustained indefinitely, and so sooner or later saturation and fatigue ended play.[24]

Selection, analysis and evaluation of data

The main problem the research workshops created was that they were over-planned, and thus generated too much data. This made it necessary to analyse and evaluate data selectively. The criterion for the inclusion of materials into the analysis, therefore, was their closeness to play: those materials that documented play in action were kept for later analysis, while retrospective materials, where participants were already removed from the actions they refer to, were disregarded.[25] However, the somewhat smaller data pool that remained still preserved the variety of the original data, in the sense that the materials still

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[23] This stage was called ecstatic play because it was reminiscent of being in creative flow (see chapter 1).

[24] This does not represent a failing to keep participants engaged in play, but merely is a natural point of closure. As Johann Huizinga said, play 'contains its own course and meaning. [It] begins, and then at a certain moment it is "over". It plays itself to an end' (*Homo Ludens* (London: Routledge & Kegan Paul, 1980), p. 9).

[25] This discarded data was a series of interviews conducted after the play in the workshops had come to an end.

documented participants' thoughts, feelings, movement explorations and continuous modification of actions throughout the workshops. The data analysis that followed then scrutinized this collection of materials in order to identify any underlying codes. Although one might think that the research questions that helped to prepare the workshops would already provide suitable codes, this is not the case, as these would have ignored the kinds of knowledge participants revealed by actually playing.[26]

The codes that emerged revealed, for instance, that the phenomena affecting participants during the later play stages were more difficult to interpret, as participants were often in creative flow, self-absorbed and oblivious to their surroundings. For participants in these stages it often seemed easier to *perform* their reflections in action than to actually *communicate* them verbally. This hints at a major problem: descriptive language in a context of sense exploration creates a disjointment. Although participants tried to explain what they had experienced, they felt they could never quite express it adequately enough. Other modes of communication often appeared more intuitive to them.[27] Therefore the analysis of the later play stages, where there was less verbal communication, relied much on the data captured in the video recordings. The accompanying video documentation (DVD: section 'Participatory Research') summarises the observable play stages of the workshops, but does so with greater focus on the later stages of play. In particular, the sections 'From control to transgressive play', 'Ecstatic play' and 'Immersion and stillness' reveal details of these later play stages. Figure 7 shows how the video documentation correlates with the previously described nine stages of play.

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[26] While these codes emerged from the data, this research did not seek to establish a hypothesis from the ground up. It was already guided by a specific context and framework. Therefore research methodologies related to grounded theory did not apply.

[27] This insight will be developed further in chapter 4, where it will be examined in connection with a vertigo brought about by explorative play.

First analysis: play actions								
Play, curiosity	Getting prepared	First explora-tions	Finding one's self	Fine-tuning of control	Contesting control	Explorative play	Ecstatic play	Fatigue

Video documentation (DVD: 'Participatory Research')			
Discovering the rules of play & discovering with curiosity	From control to transgressive play	Ecstatic play	Immersion & stillness

Figure 7: the sections of the video documentation in relation to the nine stages of play.
Illustration by the author.

Analysis also revealed that the progression of play from rule-based to explorative was more complex than anticipated. The transformation was not usually a simple switch, but rather a volatile phase where participants began to overstep boundaries that had regulated their play so far.[28] At these threshold stages it remained unpredictable whether or not a full transformation into another kind of play would eventually take place. This observation reiterated that the nature of explorative play is not teleological. This also had to be reflected in the summary of the analysis. Moreover, the amount of time players spent in these threshold stages indicated that in practice, rule-based and explorative play do not exclude each other, but are experienced as a continuum. Again this had to be reflected in the analysis. Therefore the play that took place in the workshops was eventually conceptualised as nine stages rather than two opposing forms (rule-based and explorative play). This was done since a finer pattern and the notion of stages can express the continuum and complexity of play in a better way.

Reviewing the methods of data acquisition and data analysis in hindsight confirms that the workshops were planned and carried out in a coherent fashion. This means that the data generated as well as the outcomes derived from it are high on internal validity. Moreover, triangulating the workshops with other action research tools later on increased their external validity and made their findings more reliable.

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[28] In reality this continuum is affected by other factors such as interpersonal game play, external disturbances, and time limitations. Here the other elements have been temporarily disregarded in order to concentrate on explorative play with greater clarity.

Action research in the context of wider practice

Although it was never intended to use the results of the workshops to make predictions about the behaviour of larger populations (such as 'digital media audiences in the UK', for instance), or to deliver an 'objective' account of play experiences, this research may still hold great value for other researchers and practitioners in the field, particularly those investigating collaborative research practices and practice-based research as a methodology. Four observations shall therefore summarize the outcomes of the action research workshops.

The first and most general, observation concerns the difference in appreciation that came into play when participants could intuitively perceive the link between body and sound. When such a link could be *intuited*, participants listened to the sound as it emerged, possibly discovering patterns within it. When the link had to be *constructed*, on the other hand, they expected to identify and be able to repeat particular sound patterns. However, this was often disappointing. Thus the link between performing body and sound was more perceptible when it arose from an intuitive, and not an analytical understanding. Whether and how such an intuitive understanding could be furthered was later investigated through biofeedback performance practice and sound composition.[29]

The second observation holds that the traditional role separation between authors and recipients of creative works needs to be regarded with scepticism. The workshops revealed that despite a planned role separation, this could not be strictly maintained during the research.[30] Imagining something from someone else's viewpoint, for example, is a technique we often find useful, and so not surprisingly, this was also applied in the workshops. Thus at times the researcher became drawn into the action and came closer to obtaining a participants' viewpoint, at other times participants came closer to being co-researchers or even observers. That this kind of role reversal *did* take place flags up the

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[29] This point will be picked up again in the development of practice (chapters 6 & 7).

[30] Observing play in action really showed that it was necessary to differentiate between roles that were assumed during spells of psychological game play, and roles assumed during the exploration of play. For this research we clearly needed to focus on the latter.

necessity to think about roles in a more fluid manner.[31] But if adhering to roles is impossible in action research practice, research validity can really only be achieved through a collection of cross-referenced viewpoints, which may be called the 'communicative validation of practice'. This validity not only transcends preconceived role boundaries, but also the notion of what constitutes knowledge: by acknowledging the *sharing* of play experiences as a knowledge-generating process, it designates communication and exchange as quintessential traits of a practice concerned with play.

The third observation reflects on the researcher's changing perspective throughout the duration of this enquiry. To be able to expound on this, it is necessary to briefly outline three different viewpoints: immersion, perspective and absolute view. Participants, *immersed* in play, experienced at least some of the play phenomena whilst being 'dazzled' by their senses.[32] This means that although at times participants could self-observe the processes of play taking place, at other times these processes appeared as the outcomes of a series of unpredictable events.[33] Observers, on the other hand, had a *perspective* on things, which allowed them to deduce relative truths from play events (observers attempt to reduce their subjectivity by merely monitoring the processes taking place; thus it can be said observers have a monad perspective on things).[34] The notion of an *absolute view* finally might be imagined as a birds eye view onto the processes taking place (this used to be associated with divine powers, or since Descartes, linked to scientific investigation).[35] In this research, the participants' experience is the phenomena under examination. Since here *the producer of sensations is also their observer* (which accounts for the dazzlement of the

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[31] Not least since the notion of changeable identities is now deeply embedded within Western culture. This is expressed, for instance, in the identities we construct for ourselves both in on- and offline communities.

[32] Dazzlement is a term Jonathan Crary borrows from Foucault's *Madness and Civilisation: a History of Insanity in the Age of Reason*. With this word Crary wants to characterize a notion held by Kepler, Newton and Descartes that says that knowledge cannot be derived from introspection, as it is blinding and maddening (*Techniques of the Observer* (Cambridge, Massachusetts: MIT Press, 1992), p.139).

[33] The concepts of rule-based or explorative play were never introduced to the participants. As far as they were concerned, they simply encountered the problem of how to control the biofeedback device.

[34] Crary refers to Michel Serres (*Le Systeme de Leibniz et Ses Modeles Mathematiques*) to explain Leibniz' monad perspective. According to Serres, this can be illustrated by a cone. Looking into a cone from its tip, all other points seem arranged in an orderly manner. This is the observer's view. However, from any other point – and these are participants' views – they seem to be arranged in a complex and confusing way. The observer perspective can therefore resolve what seems to be disorder (Crary, p.50f) while a participant cannot.

[35] A fuller account of this is provided in chapter 2.

senses), research necessarily has to employ self-reflection *as well as* direct observation. Moreover, in order to intensify creative practice, the researcher had to gradually abandon the observer position and become a fellow participant. Only this transformation expands and deepens the knowledge that can be attained. So far, however, the analysis of the action workshops presents only the insights of the observer, and not yet the insights of the participants, and thus a shift of viewpoint must take place, as described in the following chapters.[36]

A final observation questions how processes of action research may be adequately represented in reflective writing. In the past, action research has provided the thought basis for a range of theories. However, processes revealed by action research practice differ greatly from theories about action research. David Kolb's theory of experiential learning, for example, is of the latter kind.[37] This describes learning as a cyclical process that consists of four major stages: action, experience, reflection and conceptualisation (see figure 8).

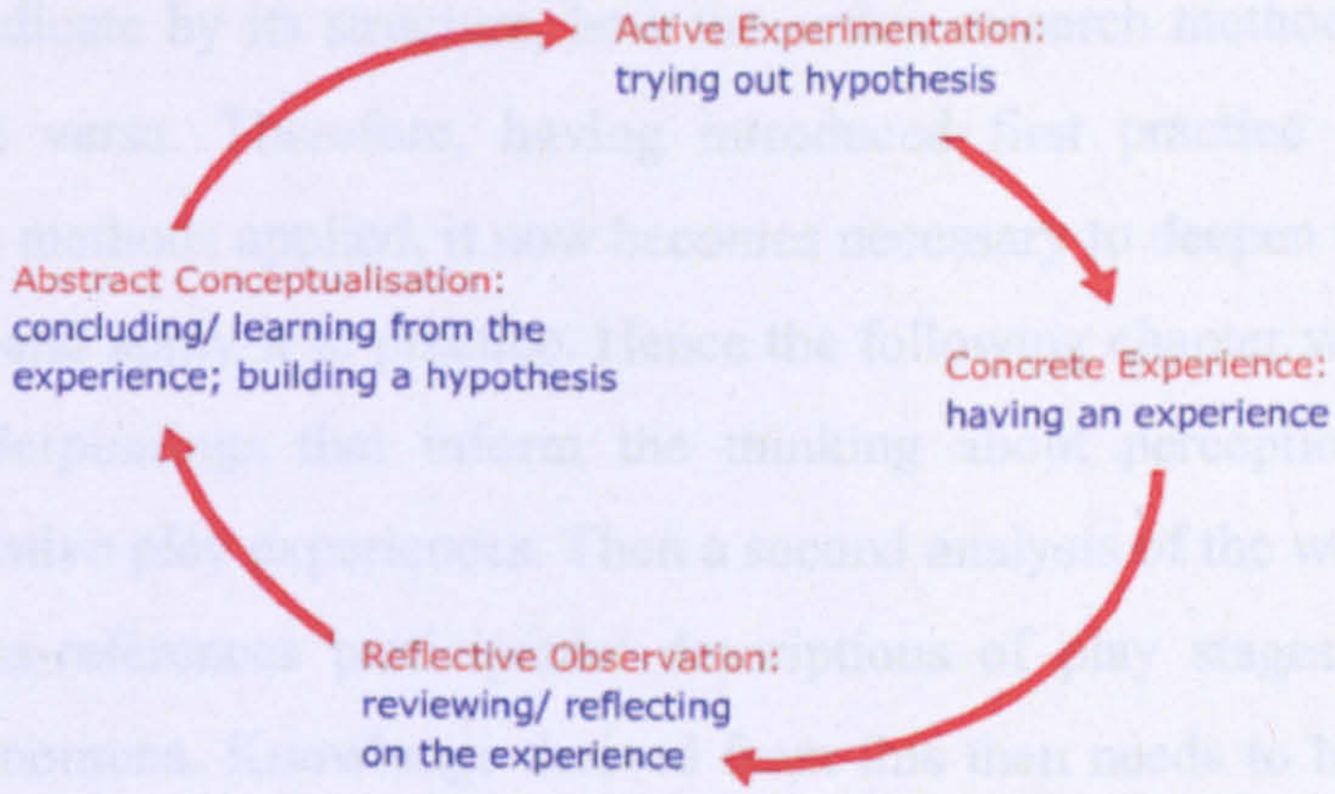

Figure 8: A typical visualisation of Kolb's learning cycle.
Illustration by the author.

Although Kolb's theory is often referred to as a model for creative practice, there are important differences between this model and creative practice in action. These differences

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[36] This forms the core of chapters 6 and 7.

[37] David Kolb, *Experiential Learning: Experience as the Source of Learning and Development* (Upper Saddle River, New Jersey: Financial Times/ Prentice Hall, 1984)

highlight how the abstractions that are built into Kolb's theory limit its usefulness.[38] The first point of criticism therefore concerns Kolb's notion of learning in stages. This does not sit well with the reality of thinking, where a number of processes can occur at the same time while others might be skipped. Then some stages, such as reflective observation, are so complex that they produce their own mini-cycles, which implies that the linear progression inferred by Kolb's cycle does not really happen. It is also misleading to assume from the circular illustration that experience, reflection, conceptualisation and experimentation are meant to take up equal amounts of time. In practice, some of these stages may take months, while others may happen in instants. Most importantly however, Kolb's theory ignores situatedness – the internal and external influences that frame and affect actual research. Once immersed in the research, situatedness is often hard to identify, but it is important since it provides a fuller – and thus more valid – research context.

Recognizing the importance of situatedness in this research had consequences, one of which is that the processes observed in action research had to be adequately represented in the reflective writing. The thesis, for example, could not only present the research results, but also had to indicate by its structure, how the action research methodology influenced practice and vice versa. Therefore, having introduced first practice observations and reflected upon the methods applied, it now becomes necessary to deepen the understanding derived from this and apply it to practice. Hence the following chapter will investigate the philosophical underpinnings that inform the thinking about perception, and how this impacts on explorative play experiences. Then a second analysis of the workshops can take place, which cross-references participants' descriptions of play stages with a thematic index of play phenomena. Knowledge derived from this then needs to be deepened again through further practice in biofeedback performance and sound composition. Eventually, the thesis can conclude with a consideration of the possible impact of this research on future practice.

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[38] Kolb's theory neglects, in particular, to consider how experience is always already influenced by selective perception, memory and habit. This is why experiential learning was not considered in the conception of the action research methodology.

4 - Perception and the nature of things

This chapter introduces Deleuze's philosophy of difference as the philosophical foundation of explorative play. This holds that sensations are the basis for experience. However, knowledge arising from experience is never absolute, as it is impossible to articulate the present without already interpreting it. Therefore understanding the limitations habit and memory impose on perception is fundamental. However, Deleuze also shows, in three syntheses of time, how habitual thinking patterns can be overcome. Applying this to practice reveals that the thrill of explorative play really consists of three types of vertigo. Once these interrupt players' habitual perception and intensify the present, players can attain an 'intuitive understanding' of the essence of play.

Deleuze's philosophy of difference

This research wants to show how an explorative engagement with generative art and music affects the senses. Therefore, the philosophical thought basis that informs this research must also concentrate on sensation and experience. Gilles Deleuze's philosophy of difference is a useful starting point here. In *Difference and Repetition*,[1] Deleuze runs through the history of Western philosophy in order to undo the dominant transcendental thinking that, according to Deleuze, stops us from comprehending things in their true nature. However, Deleuze not only problematizes the effects of transcendental thinking,[2] he also succeeds in connecting a range of concepts by Henri Bergson, Baruch Spinoza and Friedrich Nietzsche in such a way that they become core elements within a philosophy of difference.[3] This philosophy maintains that being is a constant generative force (called

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[1] Gilles Deleuze, *Difference and Repetition* (London: Athlone, 1997)

[2] For example, Aristotle's classifications of nature still have an effect today, particularly when things are grouped according to external similarities (peaches and apples are both round), and differentiations are made based on these similarities (a peach skin is different from an apple skin). However, these classifications are problematic, as they often prevent a comprehension of what is unique within each element. After highlighting the problem caused by such thinking, Deleuze begins to tackle its origins, which is Plato's philosophy. Platonism makes a distinction between knowledge obtained through the senses and knowledge obtained through the intellect. This later found its place within Kant's transcendental idealism, which asserts that knowledge obtained through our senses is deceptive. Descartes' interpretation of this thinking then initiated a considerable devaluation of sense experience and a disproportionate preference for the intellect, down to the notion that the only thing one could ever be certain of is thinking: 'I think, therefore I am' [cogito ergo sum]. Since then, the devaluation of sense experience had major repercussions in science, academia, religion and popular culture. Just one example of that is the Puritan work ethic that valued thoughtful productiveness over sensory play (Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, 1904 (published online at http://www.ne.jp/asahi/moriyuki/abukuma/weber/ world/ethic/pro_eth_frame.html [accessed 5.11.08])).

[3] At the core of Deleuzian philosophy is the notion of difference in itself, which shall be briefly summarized here. In chapter 1 of *Difference and Repetition*, Deleuze defines difference in itself as "something which

'substance' by Spinoza) that is indivisible; whereupon it could be said that an animal has life in the same way as a man. Since in a philosophy of difference there is only one plane of being, sensation is the only pathway to experience. Deleuze acknowledges that habit and memory interfere with sense experience (here he refers to Bergson's *Matter and Memory*), but then outlines how this can be stopped: an encounter with the genuinely new, for example, can interrupt habitual perception. Finally, he introduces Nietzsche's eternal return as the one core process that tests (and if necessary breaks) any false intellectual constructs that might have been adhered to.[4] Deleuze calls this test a raw encounter with difference. Whenever it takes place, new ideas come into being, which drive us to conceive new ways of thinking.

Deleuze's philosophy of difference is not new, but based on a number of thoughts that have been previously introduced into Western philosophy. However, *Difference and Repetition*

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distinguishes itself – and yet that from which it distinguishes itself does not distinguish itself from it. [...] It is as if the ground rose to the surface, without ceasing to be ground" (Deleuze, *Difference and Repetition*, p.28). Deleuze then sets out to critique the four notions of difference that are predominant in Western philosophy, and says that difference has not yet been thought 'in itself'. Thus the difference between two things that are united by a higher category (an orange is different from an pear but both are fruit), a concept introduced by Aristotle, is not difference in itself but *opposition*. Nor is it – as Plato said – pointing out the departure of something from an *ideal* (unlike a true hero, he chose self-preservation over self-sacrifice). Further, it also is not – as Leibniz had it – an infinitely small and *inessential* event that causes our experience of reality to split into many possible parallels (had he not missed his train that night he would have never encountered her); nor is it – as Hegel had it – simply *contradicting* and *negating* any larger uniting identity. Although Deleuze shows that Hegel's and Leibniz' thinking go some way towards recognising the importance of difference, they still consider difference through the concept of identity. Then Deleuze sets out how a philosophy of difference, which precedes any notion of identity, can be thought. Referring to Duns Scotus, he says being is univocal. This means that existence is owned by every living thing in the same way and comes before existence-as-identity. For this very reason, being itself can never be subjected to identification. The things that are, are not answering to external or pre-existing criteria of difference, but evolve and differentiate *themselves*. Thus "individuation properly *precedes* matter and form, species and parts, and every other element of the constituted individual" (Deleuze, *Difference and Repetition,* p.38). These 'things that are' follow a nomadic distribution (they continuously re-distribute themselves) rather than a sedentary distribution (they fall into a pre-determined order and become fixed) (Deleuze, *Difference and Repetition,* p. 36). In order for difference in itself to become a philosophy in its own right, it should never be thought through identity – not even as opposition, contradiction, or negation of identity – but as affirmative in itself. For this reason Deleuze refers to Nietzsche's principle of the eternal return, and characterizes it as the one process where being is not connected to identity. Here being is pure being (or: difference in itself). It is important to remember that the eternal return has nothing to do with conscious choice. There is no awareness of it taking place: the eternal return is a passive process, driven by the continuous motion of becoming. In fact, placing a conscious 'subject' at the centre of the eternal return means to completely misunderstand the philosophy of difference. Later on in this chapter it will be shown how the effects of the eternal return can be perceived in works of art, literature, drama, ideas and thoughts; in short any manifestation of creativity that escapes the cycle of representation.

[4] While this process may appear as destructive, it is so merely from the position of identity. The eternal return is the basis for a Nietzschean positive nihilism, which affirms the self-renewing processes of difference in itself. Thus from a position of difference, it is creative.

weaves them together in such a rigorous way that the detrimental effects of transcendental ideology are exposed while the benefits of a philosophy of difference are clearly established.[5] A philosophy of difference is particularly helpful for a generative art practice, as from it it is possible to derive an ontology that may be called generative. Such a generative ontology would maintain that our being is not defined by traditional hierarchical categories (where beings would be characterised according to similarities and differences) but that being is in itself an ongoing productive process capable of generating the genuinely new. The things and ideas that emerge while the creative process continues are therefore not end points, but temporary instantiations of this process.[6] The differences in form or content that can be observed *between* things and ideas are individuating characteristics, however, these are only secondary to existence, which may be imagined as a self-renewing force in continuous motion.

When such a generative ontology is connected with play, explorative play emerges as the most relevant play pattern,[7] mainly because the physicality of explorative play concentrates on sense experience rather than intellectual thought. For example, if some of the sensations encountered in explorative play are new or unusual, players' habitual perception is interrupted and their experience of the world transformed. However, because of the intensity of this type of play, having experiences is not a matter of choice, but happens before players know it. Thus it can be said that explorative play cannot but alter perception.

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[5] Deleuze described this way of working as 'buggering' other philosophers, giving them a child they cannot deny (Gilles Deleuze, *Negotiations* (New York: Columbia University Press, 1995), p. 6). This is also expressed in this following statement: "The history of philosophy, rather than repeating what a philosopher says, has to say what he must have taken for granted, what he didn't say but is nonetheless present in what he did say." (Deleuze, *Negotiations*, p. 136).

[6] Instantiation: a computer science expression that means to make a real object from an abstract object. Here it is used to express how the creative process might bring something into being, or make something perceptible.

[7] A generative ontology is opposed to transcendental philosophy. The latter is a thought model based on two planes, an 'ideal' and a 'real'. Representations are produced on the 'real' plane in the attempt to embrace ideals as closely as possible. The test involved in transcendental philosophy is not internal difference (what is genuinely new about this?) but similarity (how closely does this match the original?). Thus if it was attempted to characterize Caillois' remaining three play patterns in terms of underlying philosophy (*Man, Play and Games* (Chicago: University of Illinois Press, 2001)), mimicry might be described as transcendental, particularly when it replicates an ideal form or state of being as closely as possible (playing the role of the king). Agon is transcendental because it uses comparison to find the winner: the one closest to an ideal state – be it physical strength or mental concentration – wins the game. Alea (chance) finally has a dual character: it is transcendental when understood as the arrival of a pre-determined future, but generative when understood as a stochastic probability.

Perception of experience

Difference and Repetition contains everything necessary to map out this brief introduction to a generative ontology. However, to better understand its connection with play, some of the philosophical ideas that underpin Deleuze's philosophy of difference will need to be examined in greater detail. Therefore, what does Deleuze mean when he says that experience is based on sensation, but overshadowed by habit and memory? To begin with, it is necessary to recognize the way in which an experience is perceived is not solely dependent upon the 'object' of that experience, but also the 'subject'. Memories, for instance, are not really inscribed into objects, but are evoked by sensing objects or engaging with objects. While this activity is often considered to be voluntary, a large part of memory is involuntary and thus uncontrollable.[8] These two different processes of memory are also the key features of Marcel Proust's *A la Recherche du Temps Perdu.*[9] Here Proust shows how powerful involuntary memory is, because in the right circumstances our senses simply confront us with it. We are unable to intervene, and details that seemed forgotten come to overwhelm us. This 're-gained' past (which is not the original past) is so striking because here memory works in connection with present sensation and emotion. When, on the other hand, we actively seek to remember, this connection is often lacking. In *In the Shadow of Young Girls in Flower,* for example, the protagonist notices three trees that remind him of something. However, in spite of much searching, the memory remains inaccessible to him.[10] By contrast, involuntary memories flood back uncontrollably when he tastes a petit madeleine dipped in tea.[11] Proust thus shows that involuntary memory is superior to voluntary memory, but beyond conscious control.

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[8] Both Proust and Deleuze were influenced by Bergson's *Matter and Memory* (New York, Zone Books, 1994), where Bergson distinguishes between two different kinds of memory: on the one hand 'habit-memory', which consists in attaining automatised behaviours through continuous repetition (Bergson, *Matter and Memory,* p. 79 ff). Thanks to habit-memory we do not have to consciously remember how to open a door or how to drive a car. On the other hand, there is true or 'pure' memory, which Bergson also describes as contemplative (Bergson, *Matter and Memory,* p. 133 ff). Contemplation here needs to be understood as an involuntary process whereby images rooted in the deepest past move to the fore and are re-gained in the present.

[9] Marcel Proust, *In Search of Lost Time*, Vols 1 - 6 (London: Penguin, 2003)

[10] Proust, vol 2, p.296ff.

[11] Proust, vol 1, p.47ff.

Furthermore, he illustrates that engaging with the world through present sensation holds the key to unlocking the past (and later the future). This is because past events are linked with the present through repetition of the *original sense experience*: they are re-gained, for example, by tasting the madeleine *again, or* standing *again* in the hotel room in Balbec. However, while this causes memory to spill forth so vividly, it is not the *original past* that is repeated, but an interpreted or idealised one. This idealised past is so powerful that even present emotions are affected by it: *because he is remembering,* Proust's protagonist experiences a tormenting mix of pleasure and pain. These emotional reverberations between present and past highlight another key theme, which is the intermittence of emotion:[12] while it is well known that time is irreversible, the deep significance certain events hold often only becomes apparent when they are remembered. For the protagonist this is joyful when the object of his engagement has withstood the erosion of time, like the steeples of Martinville,[13] but painful when it is lost forever, like his deceased grandmother.[14] According to Proust, the essences of things only become comprehensible when things are in the past. Thus getting to know their meaning is always bought at the price of disconnecting from the present. The search for these essences, therefore, means to become stuck within a world of fictional pasts.

Another mechanism that corrupts present sense experience is habit. Habit not only adds to the loss of memory in general – Proust says it 'weakens all things' –[15] but also gradually erases the details of a loved one from our memory, leaving us with emotional indifference. This is played out in the protagonist's relationship with Gilberte, a former lover.[16] According to Proust's protagonist, greater intimacy initially provides greater happiness and yet, at the same time, habit starts to sow its seeds of indifference. To prevent this, Proust recommends travel,[17] periods of distance, or exposing oneself to new experiences.

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[12] According to translator John Sturrock (Proust, vol 4, p.xi), Proust even considered 'Intermittences of the heart' as an alternative title to 'In search of lost time' ['A la recherche du temps perdu'].

[13] Proust, vol 5, p.346 f.

[14] Proust, vol 4, p.158 ff.

[15] Proust, Vol 2, p.222.

[16] Proust, vol 2, p. 64 and Proust, vol 2, p. 222.

[17] Proust, vol 2, p.235.

However, in spite of these recommendations, there are no enduring interpersonal relationships in the search for lost time. Even parental love is inconsistent, as there is often not enough of it (Mama's kisses),[18] it is prone to erasure by habit (holidays with his grandmother in Balbec),[19] overshadowed by lesser fixations (the Duchesse de Guermantes),[20] and ultimately intercepted by death (grandmother).[21] Nevertheless, *A la Recherche du Temps Perdu* contains many lovers, from the naive to the obsessive, the exploitative to the possessive, the self-denigrating to the destructive, the selfish to the sadistic, the foolish to the ridiculous. These illustrate on one level that love, like memory, is involuntary and has to be played out; there are no second chances and no foresight to guide players along; all dramas unfold themselves painfully slowly. Even the experienced and wise cannot escape; they too are bound by the limits of their own perception. Therefore Proust's characters have no freedom of choice; they can only perform their roles in the face of continuous change.[22]

Thus over time, the various characters stumble through their lives, constantly shuffling to adjust themselves to their rise and fall in society. From momentary mood changes to large shifts in society's structure, there is nothing in Proust's work that provides a sense of stability or meaning, except for time passing. On a second level, it is the disappointments the protagonist suffers in life and love that also provide greater insights. Proust's protagonist increasingly discovers that social acquaintances, friendships and lovers hold no satisfactory answers to his searching. As he attempts to understand things for what they *really* are it becomes clear that he searches for truth beneath appearances. But can Proust's protagonist ever find this truth he seeks? For that matter, is it even possible to see things for what they are, love another person as they really are, or can the present only ever be understood through the past, when it is too late?

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[18] Proust, vol 1, p.16 f.

[19] Proust, throughout vol 2.

[20] Proust, vol 3, p. 64 f.

[21] Proust, vol 4, p.160.

[22] Poetry and banality, kindness and meanness, chauvinism and selflessness are often entangled within the same character. This is particularly clearly personified in Charlus.

The cinematic work *In the Mood for Love* and its second part, *2046*,[23] transforms Proust's thoughts successfully into film. Here Chow, a writer, falls in love with Su Lizhen, who never commits herself to him. When they eventually separate, Chow is heart-broken. Stuck between his illusions of love and a yearning for the past, the complexity of his emotions are revealed: he is longing for eternal love, seeking a truthful response from his beloved and also searching for the truth about love (its essence). Chow does not pursue these three quests in a linear or logical progression, but in a constant to-ing and fro-ing. Like one of Proust's characters, he may reach an insight on one level yet still fall for illusions on others. Thus in the years following his encounter with Su Lizhen, Chow is always in female company, 'passing time'. When he encounters a serious contender and 'a good ending is within his grasp', chance or circumstance intervene and it escapes him. For example, falling in love with a female writer who is already attached makes him realise that 'love is a matter of timing. It is no good to meet the right person too soon or too late.' The issue of time even enters Chow's science fiction novel *2046*: zone 2046, which features in the novel as a place where people recapture their lost memories and relive the past, is a space outside time where nothing changes. For Chow, however, it is also a painful reminder: 2046 was the number of the hotel room where he and Su Lizhen used to meet.

In 2046, Proust's ideas about the erosive nature of time become particularly clear: illusions first prevent Chow from seeing that the love he feels is not situated in the object.[24] Even Su Lizhen is unaware of the love she signifies. When Chow can look beyond this first disappointment, he notices that love is also only partially in the subject: he himself does not really love another person, only the image of love, which is his *perception* of another person at a particular moment in time. Again he cannot conserve this image, as everything is subject to time and change. While love lets him experience 'moments outside of time' that are more profound than either the object or the subject interpreting it, he simply cannot hold onto them, since time must pass. This last realisation is his ultimate disappointment, which changes his outlook on life. Thus when Chow realises that in spite of waiting, analysing and reliving the past, he will never find what he is searching for, his novel finds

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[23] *In the Mood for Love.* Dir. by Wong Kar-wai (Hong Kong: Tartan. 2001 TVD3349 VFC 22837), *2046.* Dir. by Wong Kar-wai (Hong Kong: Tartan. 2005. TVD3530 VFC 74366).

[24] In this passage, Chow and Su Lizhen are referred to as subject and object in reference to Winnicott's research on the transitional object phase in children (*Playing and Reality* (London: Routledge, 2005)), where the subject pulls an object into the space to explore it, or throws it outside the space to reject it.

a bitter ending. Asked whether he can rewrite it, Chow declines. He thinks he cannot find happiness since time has passed and he missed his opportunity. Although Chow has realised that avowal is not essential to love ('if you love a person you don't need to be with her'), which shows that he has overcome the erotic effect of memory. Nevertheless, he continues to switch between hope and despair, and in the end remains stuck in the past.

Proust's protagonist, on the other hand, realises that the truth he was looking for can be found in art. The creative act of writing gives Proust's protagonist a chance to reveal the essences in past events, and to experience a poetic space outside of time. Whilst still mindful of the past, time passing propels him to writing. Deleuze interprets this final development in Proust's novel as a sign of an underlying positive nihilism, which directs the focus of the search for lost time into the future, rather than the past: "Only art gives us what we vainly sought from a friend, what we would have vainly expected from a beloved".[25] Thus Proust's work, according to Deleuze, does not represent a longing for the past but is an uncompromising and affirmative search for a truth that can withstand the erosions of time.[26]

Escape from habitual perception

However, perception is always clouded by habit and memory, to the point that it seems impossible even to *think* about the present or the future without already interpreting it through the past. Deleuze observes that to find that truth outside of time, the effects of habit and memory must be overcome. The rational way of thinking must be suspended and time must become more than a linear succession of events. Proust's protagonist thus declares:

> One minute freed from the order of time has recreated in us, in order to feel it, the man freed from the order of time. And because of that we can understand [...] how the word 'death' has no meaning for him; situated outside time, what should he fear from the future?[27]

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[25] Gilles Deleuze, *Proust and Signs* (Minneapolis: University of Minnesota, 2000), p. 42.

[26] Deleuze, *Proust and Signs*, p. 4.

[27] Proust, vol 6, p.181.

Deleuze therefore reads the search for lost time as an 'apprenticeship of signs',[28] which culminates in the understanding that the truth is not contained in the external appearance of a thing, but in its essence.[29] Therefore, if experience could be thought of as a collection of impressions, it might be possible to extract the essences out of these impressions by exploring the memories connected with it.[30] Deleuze says these essences – strongest in signs of art – are nothing but pure difference: "What is an essence revealed in a work of art? It is a difference, the absolute and ultimate Difference. Difference is what constitutes being, what makes us conceive being".[31] As always with Deleuze, difference is not external (between things) but internal (what makes them unique). Difference, however, is not something that involves an active subject. On the contrary, difference constitutes subjectivity: "essence is the final quality at the heart of a subject; but this quality is deeper than the subject, of a different order".[32] Therefore, any thought or worldview has not been actively constructed, but simply comes to be expressed. Deleuze identifies this as a key process in the search for lost time, for example by saying that "even Vinteuil [a composer whose sonata features in Proust's work] has *"revealed"* [a particularly moving musical]

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[28] Deleuze lists worldly signs: sign of social conventions, friendship, love, sensuous signs as well as signs of art. Of all these, the signs of art are the most profound, as they unite all others as well as contain at the core the essence of their being. Sensuous signs are inferior to signs of art, as they cannot be read independently from the external circumstances that accompany them. Therefore they "represent only the effort of life to prepare us for art and for the final revelation of art" (Deleuze, *Proust and Signs*, p.65).

[29] It is important to be careful as to how to understand Deleuze's notion of essences. Clearly, as he opposes transcendental thinking, he is not referring to idealised forms of worldly things. Additionally, "the essences Deleuze finds in Proust [...] are distinguished from those of Leibniz and other traditional exponents of expression in one important way: essences for Proust are not principles of unity, but embodiments of difference" (Ronald Bogue, *Deleuze and Guattari* (London: Routledge, 1989), p.40). Thus Deleuze's essences do not eventually unify all possible viewpoints into one; instead, each essence is an absolute internal difference. Thus understood in the Deleuzian sense, essences may cause different manifestations of the same underlying substance (life) in the world, yet "the world revealed by each essence is radically different from the worlds revealed by other essences" (Bogue, p.40). Again it is important to understand 'radically different' in the Deleuzian sense, which means that – rather than being different through comparison – each of these worlds is unique, as it has come to differentiate itself.

[30] Proust shows the difficulties involved in this: experiences are never simple processes; they are invaded by habits and the past. Habit, for example, prevents us from paying much attention to the present: to Proust's protagonist, the importance of a 'first time' was often not apparent when it occurred, its significance was only revealed in retrospect or by repetition. His present is also often flooded by involuntary memories, and thus he pays only some attention to the present. However, the past offered by memory was also inaccurate, as it was not a former present that slipped into the past, but one that – modified by time and thought – became a 'pure past'. And yet more paradoxical, this 'pure past', which never really existed, used present sense experience to become fully actualised. These are the deficiencies of habitual perception and memory that cloud awareness.

[31] Deleuze, *Proust and Signs*, p. 41.

[32] Deleuze, *Proust and Signs*, p. 43.

phrase more than he has *created* it".[33] Essence, the final quality at the heart of a subject (that is, however, deeper than the subject), becomes "*expressed* [when] the essence [...] of the region of Being [...] is revealed to the subject".[34] Pure difference, therefore, is an actualization that occurs the moment it 'is being made'. As indicated in the passive voice, this process is not conscious and only later, when it can be observed or felt as effect, does it become thinkable: for example when Proust's protagonist realizes he is in love with Albertine and wonders where and when this came about. Although it is affirmative of life, pure difference can only be experienced as an *effect*: when time passes, when encounters come about or when changes happen that affect the future.

While already present in Deleuze's *Proust and Signs*, postulations of difference, existence and time become much clearer in *Difference and Repetition.* Here Deleuze identifies Nietzsche's concept of the eternal return as a model that allows one to overcome habit and memory.[35] The eternal return itself has its roots in ancient Egypt, but since then has been repeatedly contemplated by philosophers and scientists alike,[36] with Friedrich Nietzsche being one of the predominant figures. The concept holds that matter in the universe is limited and thus has been recurring and will continue to do so for an infinite number of times. In *Thus Spoke Zarathustra*, for example, Nietzsche explains the eternal return as follows:

> This long line behind us: it goes on for an eternity. And that long lane ahead of us – that is another eternity. [...] 'Behold this moment!' [...] 'From this gateway Moment a long, eternal lane runs *back*: an eternity lies behind us. [...] Must not all things that *can* happen *have* already happened, been done, run past? 'And if all things have been here before: what do you think of this moment [...]? Must not this

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[33] Deleuze, *Proust and Signs*, p. 42, emphasis by the author.

[34] Deleuze, *Proust and Signs*, p. 43. With this quote, Deleuze seems to refer indirectly to Spinoza's understanding of being as a unique substance with attributes and modes: in *Difference and Repetition* he says: "with Spinoza, univocal being ceases to be neutralised and becomes expressive, it becomes a truly expressive and affirmative proposition" (Deleuze, *Difference and Repetition*, p.40). Deleuze here alludes to the use of 'expression' in Spinoza's *Ethics* (1677), and how this revolutionised Western philosophy: when Spinoza said that nature expresses god, this meant that god could no longer be seen as superior to the world, but as identical with it. This collapsed what was hitherto perceived as two planes of existence into one. Unfortunately, it is not possible to expound on Spinoza further as this would exceed the frame of this research.

[35] Friedrich Nietzsche, *Thus Spoke Zarathustra* (London: Penguin, 2003)

[36] Physicists like Stephen Hawking, J. Richard Gott or Peter Lynds have been associated with the concept of the eternal return. Hawking's notion of the 'arrow of time', for example, considers the possibility of time reversal in cosmology (*A Brief History of Time* (London: Bantam Books, 1988), p.159 - 170)

> gateway, too, have been here – before? [...] 'For all things that *can* run *must* also run once again forward along this long lane. [...] '– and must we not return and run down that other lane out before us, down that long, terrible lane – must we not return eternally?[37]

Nietzsche often describes the eternal return as a heavy burden on the mind that only a positive nihilism can transcend. How can this be understood? Nietzsche lets Zarathustra see a shepherd lying on the ground, choking on a snake that has bitten itself fast into his throat. No pulling on the snake's tail can get it out. This striking image has its roots in Nietzsche's childhood, where once he found his father unconscious on the ground after a fall. After this incident, Nietzsche's father became insane and died.[38] Insanity choking a man to death may be used here as a metaphor for dormant weaknesses – wrong ways of thinking, maybe – that devalue life. In any case, the significance of this image certainly exceeds the historical and personal and, like Proust's images, points to an essence. Nietzsche evokes it to pose the central question: what is the right response in the face of weakness and death? Should the shepherd submit to his fate, hope for help, or find his own means of rescue? Zarathustra answers with affirmation: " 'Bite! Bite! 'Its head off! Bite!' – thus a voice cried from within me, my horror, my hate, my disgust, my pity, all my good and evil cried out of me with a single cry".[39] This strong, life-affirming cry is, according to Nietzsche, the hallmark of a courageous life, a life well lived. The ultimate affirmation of life would then be to wish for its eternal return, as only this attitude can truly transcend the despair that death imposes: "Courage, however, is the best destroyer [of discouragement], courage that attacks: it destroys even death, for it says: 'Was *that* life? Well then! Once more!' But there

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[37] Nietzsche, *Thus Spoke Zarathustra,* p. 178 f.

[38] This scene may echo a childhood experience that got the young Nietzsche thinking, and similarly the Nietzsche at the point of writing may have begun to observe the onset of insanity within himself. In more ways than one, this metaphor links past events to future ones. The translator R. J. Hollingdale suggests that since Nietzsche believed in the eternal return within *historical* times, Nietzsche interpreted his father's fate as something that would also befall him in due time, particularly so when Nietzsche's interprets it as his own death: "...it was a vision and a premonition: *what* did I see in allegory? And *who* is it that must come one day? [...] *Who* is the man into whose throat all that is heaviest, blackest will thus crawl?" (Nietzsche, *Thus Spoke Zarathustra*, p.180). However, understanding the eternal return as a physical reality seems strangely literal and limiting for Nietzsche's philosophy.

[39] Nietzsche, *Thus Spoke Zarathustra*, p. 180. Nietzsche's expression here is reminiscent of Deleuze's reference to the univocality of being: 'a single voice raises the clamour of being' (Deleuze, *Difference and Repetition*, p. 35), a key moment in *Difference and Repetition*, where Deleuze fully affirms Duns Scotus' notion that life is indivisible.

is a great triumphant shout in such a saying".[40] Thus once the shepherd adopts such an outlook, the snake (weakness) is overcome and the shepherd "a transformed being, surrounded with light, *laughing*! Never yet on earth had any man laughed as he laughed!"[41]

In *Thus Spoke Zarathustra*, Nietzsche defines the eternal return as linear ('a long, terrible lane'), but also circular ('all things that *can* run *must* also run once again'). While Deleuze very much champions Nietzsche's life-affirming positive nihilism, he recognizes the possible misrepresentation passages like this might create, and thus, in *Difference and Repetition*, sets out to deliver a more rigorous model of the eternal return. This is introduced in three syntheses of time. The first synthesis, which Deleuze calls the living present, maintains that time is circular. By repeating itself, time causes the emergence of habits. Habit, for instance, is responsible for the expectation to see the sun rise every morning, or the seasons change over the year. Habit thus encourages the thought that the future is already determined. This, however, limits how the world can be perceived. The second synthesis concerns the pure past. Time is often compared to a string of pearls that stretches from past to present.[42] Each pearl represents a moment in time. In order to move from one moment on to the next, an active synthesis, memory, is needed that compares the present moment to the past ones. This comparison, however, *colours* the present in the light of the past and alters its meaning. This means the present becomes a past that never existed. This is illustrated by Proust's characters, which, caught up in a fictitious pure past, come to identify themselves with something that never was. The linear model of time, therefore, also traps the thinking within identity and sabotages a true understanding of time. To transcend this vicious circle of identity, a *third* synthesis of time is needed. Identity can only be broken by the genuinely new, which Deleuze calls *difference in itself,*

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[40] Nietzsche, *Thus Spoke Zarathustra,* p. 178. A similar passage can be found here: "What, if some day or night a demon were to steal after you into your loneliest loneliness and say to you: 'This life as you now live it and have lived it, you will have to live once more and innumerable times more [...] Would you not throw yourself down and gnash your teeth and curse the demon who spoke thus? Or have you once experienced a tremendous moment when you would have answered him: 'You are a god and never have I heard anything more divine'" (§341 'The greatest weight', in Friedrich Nietzsche, *The Gay Science* (New York: Vintage, 1974)).

[41] Nietzsche, *Thus Spoke Zarathustra,* p.180.

[42] In the *Critique of Pure Reason* (1787), Kant proposed that time is imposed upon sensory experience (see Immanuel Kant, *Critique of Pure Reason*, trans. by Norman Kemp Smith (New York: St Martin's Press, 1965)). Deleuze points out that this places events into time, rather than creating time by living through events. The result of Kant's understanding of time is that time becomes linear.

or pure difference. Pure difference, Deleuze says, disrupts past and future in such a way that nothing will be the same again (or: nothing that is the same will repeat), and thus stops the past from casting its habitual projections into the future. It is the one core principle that divides, purges and re-orders the past, while at the same time it opens up the future. In Deleuze's third synthesis of time, the empty form, pure difference comes into being. It is called an empty form, as it cannot be actively experienced.[43] Time is no longer linear or circular but 'out of joint'.[44] This can be understood as

> demented time or time outside the curve which gave it a god, liberated from its overly simple circular figure, freed from the events which made up its content, its relation to movement overturned; in short, time presenting itself as an empty and pure form.[45]

At the core of the third synthesis of time, however, is the eternal return (of pure difference). While *eternal* has the meaning of *essential*, which has been already encountered in Deleuze's reading of Proust, it also has the meaning of *perpetual*, which can now be attributed to Nietzsche. Deleuze interprets Nietzsche's eternal return as a continuous, life-affirming process, a continuous motion of renewal and becoming,[46] where the essences of things reveal themselves. However, this process is selective. Deleuze states that "only the extreme forms return", those that can transform themselves or extend themselves "to the limit of their power".[47] These forms will continue to affect the future while the lesser ones, which establish identity, will not.

Deleuze's extreme forms seem to directly relate to core processes taking place in creative practice, where transgressing one's limits often helps to radicalize the practice. However, it is important not to misconstrue the process of selecting: this is not choosing between

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[43] ...and maybe because Deleuze wanted to indicate that the future here is truly opened up.

[44] Deleuze, *Difference and Repetition*, p.88. Deleuze here refers the reader to Hamlet, who expresses the great responsibility he carries: "The time is out of joint: O cursed spite | That ever I was born to set it right!" (Hamlet, Act I, Scene V, 189 - 190).

[45] Deleuze, *Difference and Repetition*, p.88.

[46] It is important to remember that Deleuze reads Nietzsche as if Nietzsche was already part of a philosophy of difference. Having outlined the failings of habitual perception in the first two syntheses of time, the third synthesis elevates Nietzsche's eternal return to the one concept strong enough to break habitual perception.

[47] Deleuze, *Difference and Repetition*, p.41.

extreme and lesser forms, or an activity of representation (all the things that are *like x* will stay...), and it does not conclude with a unification based on the negative (everything dies in the end anyway). Whenever differences are resolved in such a way, the concept of pure difference is misunderstood, and its radical power retained by what is identical. According to Deleuze, selection in the eternal return is a process where things come to individuate *themselves*, and because of this, the eternal return is where being finds its most affirmative answer. This passive but creative process of internal self-differentiation applies to everything that is, in other words it is ontological (the very nature of being). This is different to a transcendental philosophy, where the conditions for life and its transformation are thought to be external. Given this, a transcendental approach to the subject matter is problematic, as it does not provide sound philosophical underpinnings. But while self-differentiation is creative, it is also destructive, particularly of any constructs that are not essential. In 'making the difference', the eternal return breaks the grip of habit and memory and – like a revolution that eats its own children – attacks the very conditions (the past) and agents (the present) that made the return possible.[48] Therefore the eternal return is not a simple circle (as one may think from reading Nietzsche's passage), but as Deleuze says an 'eternally excentric circle'.[49]

Mental vertigo

It generally starts to become clear how fundamental Deleuze's concepts are to generative practices.[50] So far, it has been shown that, although passive, involuntary memory affects perception far more than voluntary memory. Concealed within signs, involuntary memories become activated through present sensation. The essence they contain can be unlocked through 'passing time', a kind of disinterested searching. The essences themselves, which Deleuze calls pure differences, come into being through self-differentiation, a generative

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[48] Deleuze, *Difference and Repetition*, p.90.

[49] Deleuze, *Difference and Repetition*, p.91. Excentric (or eccentric) here could be interpreted as deviating from expectation by having the normally assumed centre (identity) not in the centre, but having a different centre (difference).

[50] Such a profound connection is missing when generative art practice is contextualised through play theory, psychology, or complexity theory alone, as play theory is affected by social interpretation, psychology merely concerned with the effects, and complexity theory analyses the workings of the generative but lacks the link to experience.

process that happens in an excentric time. However, Deleuze's concepts also have particular value for the characterization of the existential thrill that lies in explorative play.[51] This thrill does not only result from experiencing destabilizing sensations, but is also the effect of disjointed time. To fully understand the connection between disjointed time and explorative play, it is necessary to re-examine some of Proust's description of sense experience. Why is tasting the madeleine or tripping over cobblestones so *very* disturbing?[52] It is not *only* because these sensations are unusual or destabilising. What stirs the protagonist at the core of his being is a sort of mental vertigo that is introduced by a paradoxical perception of time:[53] according to the memories that come flooding in, past and present exist simultaneously, while according to common sense, this cannot be.[54] Proust's protagonist even becomes aware of this own mental vertigo:

> Yet a single sound, a single scent, already heard or breathed long ago, may once again, both in the present and the past, be real without being present, ideal without being abstract, as soon as the permanent and habitually hidden essence of things is liberated and our true self, which may sometimes have seemed to be long dead, but never was entirely, is re-awoken and re-animated when it receives the heavenly food that is brought to it.[55]

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[51] The definition of explorative play expounded in chapter 1 holds that explorative play is a basic human characteristic that cannot be prevented or controlled. It seeks out its player in the encounter of something new or unusual. It is an existential thrill that targets the player through physical sensation. It fascinates, because it oscillates between what might be considered safe and unsafe. The fear involves exposure to something new, but more so experiencing loss of control. This concerns physical balance as well as mental stability. The risk involves a change to the player's habitual perspective.

[52] Proust, vol 6, p.174.

[53] Vertigo is defined as 'a balance disorder that can cause strange sensations like spinning while the body remains stationary' (The Shorter Oxford English Dictionary, 3rd ed. (Oxford: Oxford University Press, 1973)). Therefore, contrary to popular use, vertigo is not directly connected to fear of heights, but causes incongruities between sense experience (we are spinning) and knowledge of the world (we are stationary).

[54] There are discrepancies between past and present sensation. Why? This is the pure past coming into play. The pure past is not *relative* to either the present that it once was or to a present in relation to which it is now held to be past, but an ideal past which Deleuze calls an 'internalized difference'. While on one level the pure past is formed *at the same time* as the present (an idea introduced by Bergson) and floods back as involuntary memory, perception and voluntary memory establish a real *succession* on another level (the passing of time). In Deleuzian philosophy, sense experience is crucial as it affects human beings on a number of levels: as physical sense experience it is concerned with the present, as perception with the passing of time, and finally as memory it reveals a 'shred' that points towards the essences of things. These shreds that Deleuze calls virtual objects (Deleuze, *Difference and Repetition,* p. 98 - 103) are also those that Proust described as "real without being actual, ideal without being abstract" (Proust, vol 6, p.181). Disguised within real objects – for instance as parts of a subject's body, another person or object – the virtual objects make a connection with the pure past. Whenever the memory of a person or object is actualised through sense experience, this causes the feeling that one is close to an important insight. This is why Deleuze says they point towards time 'out of joint'.

[55] Proust, vol 6, p.181.

According to Deleuze, this mental vertigo works particularly well through sensation, because sensations are firmly anchored within the present, and thus forcefully bring memories to life. The implication of this is that during explorative play there are always two processes in operation: on the one hand physical vertigo that affects the basic emotions through intense sense experience; and on the other hand mental vertigo that is caused by the pure past. Both types of vertigo interrupt the habitual impression of time passing, and introduce the effects of disjointed time. However, while these two types of vertigo can be treated separately in theory, this is impossible in practice.

This is because play is instinctive and plays its player,[56] and the essential parts of memory are passive and overcome its player. Therefore both types of vertigo are involuntary and, as such, beyond the realms of analysis or logic; these thought activities merely find individuation through the player. For the same reason they cannot be controlled or stopped. This holds three major revelations: firstly, explorative play can be an existential thrill on the scale of rollercoaster rides or extreme physical exposure, but also a process with continuous effect. Particularly when players think they are simply passing time in explorative play, like the protagonist in Proust's novel, they really exercise a detached engagement with the world (which might ultimately be even more successful in revealing some of the essential truths about life than a purposeful and active search). This leads to the second revelation, which stems from this brief immersion in Deleuzian ontology: if the generative is understood as an active force, the thinking surrounding it is already fundamentally flawed. By restricting difference to active choice, an infinite process is made finite and the 'generative' divorced from its roots. Adopting choice as the underlying principle for a creative practice can only lead to works where interactivity is based on cause and effect. Therefore, only when it is recognized that the generative is passive does it become possible to create generative artworks that are based on sound philosophical foundations. Then difference can unfold through explorative play and improvisation, and participants in these works can respond in a more creative and individuating way. This points to the third revelation: immersed in the vertigo of explorative play, active choice does *not* intensify the experience, as the thrill lies in observing choices and actions that simply emerge from the subconscious. This process even reveals itself to an outside

[56] See chapter 1.

observer. Therefore insights gained from practice observations can help to critically review existing practice conventions – how generative artefacts are 'staged', for example – and further the development of new practices that are built around more open modes of engagement. This in turn allows to foster an intuitive rather than an intellectual reading of the work.

Intuitive understanding through explorative play

What is meant by that? Philosophically, the notion of an intuitive understanding is nonsense, as intuition is direct knowledge and as such does not involve the cognitive faculty. Linguistically, intuitive understanding is a paradox: it cannot be, but it can be experienced. This indicates that the two opposing elements – rational thought and intuition – are connected in a particular way: rather than an either/or state or a simple overlay of two processes, they *resonate*. An intuition, therefore, is not a single event followed by thinking, but rather a disturbance in the mind. This disturbance keeps driving us to a search, where we may analyse the sense experience, inspect our memory store, or try to make associations. We may even daydream or imagine its resolution. However, we will definitely keep testing whether any of the possible answers we found matches the intuition in essence.[57] To deepen this understanding of intuition, it is useful to scrutinize Bergson's work.

Bergson maintains that intuition is the method that reveals the essences of things, while rational thought fails to do so.[58] Bergson's elevation of intuition is intentional; he reacts to Kant, who maintained that human beings can never know the world as it is, but only obtain an imperfect perception of it. Although Bergson agrees with Kant in saying that sense experience leads to misconceptions, he also says that since there is only one plane of

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[57] This is why Bergson says the truth indicated by intuition is initially 'obscure' (Henri Bergson, *The Creative Mind: an Introduction to Metaphysics* (New York: Citadel Press, 1992), p.36).

[58] Other philosophers prior to Bergson – Schelling or Schopenhauer for instance – also set intuition up as a counter movement to cognitive thinking. However, they placed it above the intellect and outside of time. Thus intuition became understood as a god-like inspiration, or an a priori thing that reveals itself to us (Bergson, *The Creative Mind*, p.30f). In Western culture this notion then contributed to the notion of intuition as an aura surrounding art and artist and separating them from everyday objects and audiences. One of Bergson's main contributions to philosophy was, therefore, to place intuition within *time* (or duration).

existence, sense experience must also contain the key to overcoming those misconceptions and to unlock the essences within an object or encounter. Interestingly, Proust's characters already act out many of Bergson's ideas: their marked emotional insecurities, for example, cause their fixations and inconsistencies. They also continuously entrust important decisions to chance, whims and feelings. This all enforces the impression that for them, rational thinking plays but a small part. In order to fully appreciate Bergson's work however, it is important to distinguish more precisely between intuition, sensation and sense experience. Sensations are at the base. These cannot be thought, as they happen before consciousness. When language applies itself, we come to recognise them as sense experiences. However, in our habitual way of living, we only pay some attention to sense experiences, except for when these are new or unusual. Therefore an unusual experience (such as stepping on ground where there is none) causes surprise and a physical reaction that shakes us out of our habitual thought patterns. This reaction is an intensification of the present, but not an intuition. When thought reveals why the ground was unsafe to step on and at the same time safe (walking over the glass bridge in London's Science Museum, for instance), this satisfies our intellect. However, the explanation can neither stop the basic emotions from flooding in while standing on the bridge, nor does it expound the intuition that deep within this experience something else is contained that exceeds both emotion and explanation. When Proust's protagonist trips over the cobblestones, for example,[59] he instantly knows the significance of this event and searches his mind to try to reveal its essence. Searching requires mental effort and time, which is why Bergson maintained that intuition is not an event, but a *method*. In the effort to grasp the essence contained within the experience, Proust's protagonist attempts to re-construct it from already known truths (which, as Bergson says, only extends an established truth). However, if this truth is genuinely new, there are no pre-existing elements and thus the attempt to grasp must fail. This indicates, according to Bergson, that the truth is very significant: "No important truth will be achieved by the prolongation of an already established truth".[60] But since a new truth resists interpretation, how can it ever be understood? Bergson says its effects come to be recognised, for example when seemingly unsolvable problems resolve themselves. Whenever this happens, the new truth enables some more understanding and thus gradually reveals itself. Therefore truths that readily yield to analysis only illuminate a single

[59] Proust, vol 6, p.174.

[60] Bergson, *The Creative Mind*, p.32.

thought, while those that reveal themselves slowly have the power to "illuminate a whole region of thought".[61] This illustrates why for Bergson, truths obtained through intuition are more important than those achieved by analysis. How this plays out in practice can be observed in Proust's protagonist, who searches for essences by repeating the same sense experience that caused the intuition. This physical engagement with sensation is precisely what this research aims to achieve through explorative play. Explorative play might thus be a *method* that makes the resonances between sense experience, intuition and analysis perceptible.

Spatial vertigo

So far it has been discussed that for Deleuze and Proust, the creation of art is a paramount human activity, as only here pure difference makes itself felt. This may lead to intuition, which, as Bergson says, goes deeper than analysis. Thus experiencing art and poetry can bring us closer to a true understanding of the world than abstract thought. Gaston Bachelard then extends this philosophy by connecting it to space.[62] According to Bachelard, sense experience always connects two spaces: a poetic space which Bachelard calls 'the space of intimacy' as it is contained inside objects, subjects and encounters, and the 'world space' exterior to that. Both spaces blend, and through time and contemplation expand into immense spaces. In fact, the realisation of their immensity can cause dizziness, a vertigo of too much and too little space. What Bachelard means with this dizziness becomes clear in a passage he quotes from Jules Supervielle:

> Precisely because of too much riding and too much freedom, and of the unchanging horizon, in spite of our desperate gallopings, the pampa assumed the aspect of a prison for me, a prison that was bigger than the others.[63]

Here, interior and exterior space cause vertigo because they have exchanged their properties. But two more things are striking. Firstly – as with Proust – vertigo is brought on

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[61] Bergson, *The Creative Mind*, p. 36.

[62] Gaston Bachelard, *The Poetics of Space* (Boston: Beacon Press, 1969)

[63] Supervielle in Bachelard, p.221.

by sense experience (riding). This makes it clear that Bachelard also upholds sensation as the basis for experience. Indeed he maintains that only when art and poetry are explored through the *senses* is it possible to connect deeply with their essences: "when we really live a poetic image, we learn to know, in one of its tiny fibres, a becoming of being that is an awareness of the *being's inner disturbance*".[64] The phrase 'becoming of being' is a clear reference to the generative forces that are at work in the eternal return. Bachelard uses it here to indicate that an experience of space and time can only be made through the senses. This connects Bachelard's philosophy to Deleuze's generative ontology. The second realisation concerns the use of language in Supervielle's text: the 'imprisoning pampa' is an arresting paradox that preserves the significance of the initial experience. This shows that the actual moment when new experiences come to overturn habitual perception does still resonate in poetic or performative language. Supervielle's choice of words even implies *how* this took place: a rupture between habitual perception and actual experience made itself felt in form of excess (*too much* freedom, *too much* riding, *bigger than the others*). The excess indicates just how intensely the senses were stretched beyond their habitual range.[65] What follows then is a resonating vertigo that makes itself felt as a mental puzzle (the *imprisoning pampa*) and emotional distress (the *unchanging* horizon, our *desperate* gallopings). Supervielle's passage thus illustrates why Bachelard connected the experience of space with vertigo. This, however, has implications for the notion of vertigo in explorative play.

So far, explorative play has been connected with physical vertigo: a player's voluntary engagement in the temporary disruption of perception and proprioception, which makes itself felt as pleasureful dizziness, altered proprioception or temporary loss of orientation. Then through Proust's work, vertigo was set in relation to time, where it was found that involuntary memory can cause vertigo whenever there is an incongruity between sense experience and knowledge of the world (past and present coincide but time passes). Bachelard finally holds that the *temporal* aspects of vertigo really are inseparable from *spatial* ones. This makes it now possible to connect the notion of a spatial vertigo with

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[64] Deleuze, *Difference and Repetition*, p.220.

[65] Bergson says that – because we shun the genuinely new – we tend to use established ways of thinking as long as possible, stringing them along (Bergson, *The Creative Mind*, p.32 ff), hence the reference to stretching.

Deleuze's concept of space, and in doing so bring this investigation of vertigo in explorative play to a satisfactory conclusion.[66]

Deleuze says that space has two orders – extension and depth – which are fundamentally different. Extended space yields to measuring, which allows to establish relations between elements within extended space through analysis and comparison. Depth (or intensity), on the other hand, allows individuals to sense how significant elements are to them. The two orders of extension and depth determine each other in a reciprocal relationship, which Deleuze calls 'the asymmetrical synthesis of the sensible'.[67] Through this he explains why certain things matter under certain circumstances, and why the search for the essences within things is so vertiginous. Thus Deleuze says in the order of depth, difference in itself is at work: "Difference is intensive, indistinguishable from depth in the form of an non-extensive and non-qualified *spatium*, the matrix of the unequal and the different".[68] The intensities that are part of the order of depth are not perceptible, and thus cannot be identified or compared: "Intensity is not the sensible, but the being of the sensible, where different relates to different".[69] However, they cause qualitative differences to the elements within the extended space. An individual can, therefore, only ever perceive the effects of the intensities as qualities (*this* rendition of a musical phrase) or significances (the musical phrase *moves me*). Whenever we attempt to access intensities from the order of expansion (in other words try to explain what caused the sensation) we get nowhere. Deleuze says this is because qualities point to their intensities but at the same time resist being thought of: "... the quality as a sign [...] refers to an implicated order of constitutive differences, and tends to cancel out those differences in the extended order in which they are explicated".[70] What becomes sensible is a collision of sensation and cognition, and this collision changes constantly. For example, in Proust's work the significance of Vinteuil's little phrase varies according to the context where it is encountered, who it is articulated by, to what purpose

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[66] If this were a philosophy thesis, Deleuze's concept of space would now be unpacked in full. However, the frame of this research does not allow for more than a brief touch on this. Still, this brief touch is necessary, in order to complete the account of vertigo in explorative play.

[67] Deleuze, *Difference and Repetition*, p.222.

[68] Deleuze, *Difference and Repetition*, p.266.

[69] Deleuze, *Difference and Repetition*, p.266.

[70] Deleuze, *Difference and Repetition*, p.228.

and as part of what social event. Thus the perception of qualities in the extended space and the sensation of significances in the intense space influence each other and cause a constant movement. This produces a type of vertigo that may be called a spatial vertigo.

Thus to summarize, this research found that vertigo can be induced by physical play, that it is connected with different perceptions of time as well as the constant movement between extension and depth. What unites these three aspects of vertigo, however, is how they are experienced. Sensation and knowledge collide and cause a paradox, or irresolvable problem. This, according to Deleuze,

> breaks up the common exercise of the faculties and places before its own limit, before its incomparable: thought before the unthinkable which alone is nevertheless capable of thinking; memory before the forgotten which is also its immemorial; sensibility before the imperceptible which is indistinguishable from its intensive.[71]

The irresolvable problem thus escapes both good and common sense as it paralyses logical and analytical thinking, and can never be *solved* by the cognitive faculty. Deleuze in fact points out that solutions never expel problems for good; they just lead to further problems.[72] Therefore, the point of irresolvable problems is, on the one hand, to state them afresh, which triggers the thinking of new thoughts (in itself a creative response), and on the other hand, to understand them as complex challenges that need to be internalized and constructively built into a life. Only in this way problems can become affirmative of being.[73] Such an understanding also becomes manifest in Bachelard's remark that "poems are human realities; it is not enough to resort to "impressions" in order to *explain* them. They must be *lived* in their poetic immensity."[74] Thus real paradoxes – or irresolvable problems – are not simple contradictions which resolve themselves by clever thinking but key moments in human experience where established ways of thinking collapse.[75] Like

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[71] Deleuze, *Difference and Repetition*, p.227.

[72] Deleuze, *Difference and Repetition*, p.195 f.

[73] Deleuze, *Difference and Repetition*, p.267.

[74] Deleuze, *Difference and Repetition*, p.210, emphasis by the author.

[75] It would be beneficial at this point to investigate the different kinds of paradoxes, particularly the infinite regression or continuous circularity that some introduce, and relate this to Deleuze's work. However, this exceeds the frame of this research.

intuition they can point to fundamental truths that never yield to conscious grasp. These truths cannot be explained or even thought, but only expressed in creative acts: works of art, ideas, movement, sound, poetic language. Thus Bachelard says "we are never real historians but always near poets".[76]

[76] Bachelard, p.6.

5 - Reflective analysis and documentation: a purposeful translation

This chapter argues that Baxandall's notion of serial conceptualization may hold great value for the analysis and documentation of performative practices: It allows to deepen the research because it problematizes the relationship between observer and participant. The critical distance this creates is helpful for the second analysis of the action research workshops, which deals with participants' difficulties of verbalising play experiences. The inevitable interpretative reading that takes place turns practice moments into translations. Yet only through these purposeful translations is it possible to convey insights and stimulate further practice.

Documenting performative practices

Performative practices do not culminate in finite objects that encapsulate the processes that took place; what remains are only traces of practice in its various stages. It is for this reason that the body of materials that remains after the performative event is of such importance.[1] These materials may succeed in communicating some facets and viewpoints of practice, but necessarily fail to capture its core. Eventually they become 'documentation', a body of materials that translates the experience of the practice into a form that is repeatable or communicable. This translation often relies on measurable qualities like audience numbers, practice descriptions or musical scores, qualities that can easily evidence the existence of a practice, but not easily communicate its intensity. Intensity belongs to the order of depth, which documentation can only access by maintaining some of the qualitative, performative or poetic language used by those who witnessed practice or took part. One might therefore want to conduct an extended qualitative investigation into audience members' experiences. However, evaluating these investigations initiates yet another process of paraphrasing and interpreting. Documentation, it seems, can only ever be an incomplete but purposeful translation. This is also true on another level: the documentary material often has gaps, where essential moments have escaped notepad, camera and sound recorder. This might be because insights and intuitions work with a delay, only coming to the fore when not intentionally

[1] Martin Hargreaves and Joanna Bresl's *Displacement* (Chisenhale Dance Space, London, February 2006) was an interesting engagement with the question of how to deal with the absence of practice through the documentation of performative movement. Traces of practice – photos, video recordings, and objects were re-installed or left in the practice space.

sought. These may take effect just when the recording tools have been put aside. But even if notepads, cameras and sound recorders were continuously at the ready, gaps may still appear within the documented material. Cameras, for instance, cannot re-focus instantly like the human eye, which means that sometimes the recording tools are slow in finding the point of action the mind has already identified.[2] Moreover, sound recorders cannot distinguish significant sounds from background sounds like human hearing, nor can they create a spatial map. Technology requires someone directing it in a considered manner. This, however, is even more problematic as it opens a discussion about who controls the documentation and distribution of cultural production, and which manner is appropriate.[3] Even just selecting materials and compiling them onto a DVD creates a construct that undermines the value of direct experience performative practice emphasizes. All of this raises the question whether and how participants' experiences can ever be adequately represented.[4]

Representing performative practices

This thrust of this question can easily be misinterpreted. For example, in traditional audiovisual documentation it is a tacit agreement that a single viewpoint represents the many viewpoints of audience members present. In order to underline the diversity of viewpoints it may appear useful to record with more than one camera and to leave the choice of viewpoint to the viewer. But even then, this may not be successful, as the active choice required prevents viewers' immersion into the material, while the unavailable viewpoints become even more pronounced. Works like *Double Happiness* or *Timecode* thus show that simultaneous camera views provide a different, but not necessarily more

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[2] It may help to think of a live talk show where an audience member suddenly makes an important remark. Usually we would turn our head to face the speaker immediately. However, it often takes several seconds before the camera operator in the studio can pick out and focus on the speaker. Thus technology, the very means said to enable deeper engagement, can actually obstruct it.

[3] Entering this discussion here would exceed the frame of this research, and also divert the direction of the argument unnecessarily.

[4] One area within this research where this was more successfully implemented was the compilation of materials for the contextual review. Publishing these materials online as a database (http://www.mindatplay.co.uk) moved somewhat away from the usually applied art historical classification systems. However, this approach still remained limited, since the nature of this research did not allow for an open database (in an open database readers can also take editorial decisions).

direct, kind of engagement.[5] Other solutions may be to instigate a collection of audience members' recordings on a site like Youtube, or to provide a publicly accessible database of all thinkable camera angles through which users can navigate, or even to recreate the work as a virtual reality environment where a user controls a camera at all times. While such solutions show at least an awareness of the problem, it has to be realised that they do not embody different representations of practice, only different ways of thinking about encountering practice. In Michael Baxandall's view, such thinking touches only on the outermost layer of the problem:

> We do not explain pictures: we explain remarks about pictures – or rather, we explain pictures only in so far as we have considered them under some verbal description or specification. [...] The nature of language or serial conceptualization means that the description [of a picture] is less a representation of a picture, or even a representation of seeing the picture, than a representation of thinking about having seen the picture. [6]

If Baxandall's notion of serial conceptualization could be transferred onto this research, then play experience would be at the core. Next came a layer of observation ('having seen'), which is already hampered by the limitations of perception. We therefore never explain play experiences, only what we think we have observed about play. The next layer, 'thinking about', would then contain processes of analysis, synthesis, intuition and interpretation. This layer informs our thinking about play in general, which is crucial as it influences how play will eventually be represented (the final layer). This rough mapping exercise shows that the layers Baxandall identified may work as a distancing device that allows this research to be conducted in a more self-reflexive manner. The first three layers – experience, observation and analysis – shall therefore be scrutinized again, this time in greater detail and in the context of the action research workshops, while the last layer will be considered again at the end of the thesis.

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[5] *Double Happiness* is a 'simultaneous multi-viewpoint document' by Bodies in Flight & spell#7. The work is a collaboration of choreographer and co-director Sara Giddens, writer and co-director Simon Jones, and director Paul Rae. It was performed at the Arnolfini, Bristol, November 2000. The DVD was produced by the University of Bristol in 2002. *Timecode*. Dir. Mike Figgis. USA. Screen Gems. 2000. VFC 52863.

[6] Michael Baxandall, *Patterns of Intention: On the Historical Explanation of Pictures* (New Haven: Yale University Press, 1985), p.1 and 11.

Problems with experience and observation

Beginning with experience, the first question that needs to be asked is why the knowledge that the essence of play experiences cannot be described is not enough. If participants necessarily had to fail in trying to verbalise experiences, why did they not simply stop doing so altogether. According to Baxandall, it is a human instinct to attempt to explain, and thus the urge to communicate is unavoidable. What is interesting, however, is how human beings are explaining. Baxandall observes that explanations tend to be causal, because these suffice us in many situations of our lives. This is why we begin to seek them out. Causal explanations become so deeply engrained in language that they can hardly be avoided, which accounts for why we expect all events to have a cause. However, particularly during the vertiginous moments in explorative play, where time is disjointed, causalities do not apply.[7] This is why habitual linguistic patterns here falter, but the instinct to try to explain remains.

This, however, leads to another question: what knowledge might be gained from observing participants in explorative play, where vertigo induces communication but also causes linguistic patterns to break down? A document written in preparation for the action research workshops claims that knowledge would be constituted by 'verbal accounts of participants, their actions and non-verbal gestures, the time spent in the play space while engaged in movement or contemplation'. However, this really is a just list of observable activities that might contribute to knowledge. Knowledge itself must be an understanding of the research question in its entirety. If observations are expected to lead to greater knowledge, they need to be based on a decisive difference between the observer's and the participant's point of view. It might be helpful to imagine this as an engagement between two members of different cultures, whereby

> The participant understands and knows his culture with an immediacy and spontaneity the observer does not share. He can act within the culture's standards and norms without self-consciousness [...] He moves with ease and delicacy and creative flexibility within the rules of his culture [...] The observer does not have this kind of knowledge of the culture. He has to spell out standards and rules,

[7] This was established in chapter 4.

> making them explicit and so making them also coarse, rigid and clumsy. He lacks the participant's pure tact and fluid sense of the complexities.[8]

Understanding the difference between observers' and participants' expertise is crucial, particularly because the observation is nearly always driven by special points of interest pre-selected by the observer. Observers are observers because they work from an elevated perspective: they are the ones who identify the research question, see all players play, and connect this with the wider field of practice.[9] Even the scrutinizing of the observer's insights and intuitions is performed within the realm of the observer, and points of interest only exist because the observer identifies them in the analysis.[10] Since all of these processes take place in the observers' realm, the observation of play will therefore necessarily reward observers – but not participants – with a better understanding of how they think about play.

However, observers' understanding is incomplete, as it is based on comparisons and causal relationships found in the data. For example, observers usually attempt to reconstruct players' intentions because they tacitly assume purposefulness on the players' part, and because they expect play to be meaningful to the participant.[11] Yet a closer look reveals that there is no such thing as participants' intention. Because their point of view is necessarily one of being immersed, players may well experience intention as "a numberless sequence of developing moments of intention".[12] Every small response they might make can alter their play experience and change their intention, which makes the outcome of play unpredictable, precarious and exciting. The experience of this process cannot be re-

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[8] Baxandall here refers to intercultural differences: the participant is Piero della Francesca, a mid-fifteen century painter, the observer an art critic (p. 109). However, the core of this passage also easily applies to the differences between explorative players and their observer.

[9] Observers have an elevated perspective, but not a bird's eye view, because just like the participants, they are still immersed in their own cultural context. This makes observers not much different from participants and raises the question whether they have sufficient critical distance. Jonathan Crary says an observer is someone who sees within a prescribed set of possibilities, and who is embedded in a system of conventions and limitations (*Techniques of the Observer* (Cambridge, Massachusetts: MIT Press, 1992), p.6).

[10] Baxandall is more direct: the task of interpreting is unavoidable but precarious. Therefore observers need to think carefully about the criteria used to assess the relative validity of explanations and inferential criticism (p.vi). Points of interest, on the other hand, stand out because they are relevant to the question, not because they might be the important issues for the participants.

[11] Baxandall, p. vii.

[12] Baxandall, p. 63.

narrated, and thus it can only be acknowledged that observers' statements are approximations. Therefore, observations cannot reveal what happened, or what participants perceived to have experienced, but only how, within the cultural realm of the observer, one might think about explorative play.[13] This exacerbates the difference between the understanding of the observer and the understanding of the participants.[14] Participants, by contributing their play and verbalisations of those parts of play that are not observable, must face a linguistic impasse. Their descriptions of play are never factual accounts, only helpful translations. Even when observers record every word participants use, these might only be insufficient expressions of what participants really mean to communicate. What is not said or cannot be said might thus be very important. But how can observers know what is not said? One option is to re-examine together with participants what was said and felt, and view this from different angles until at least the wider context of thought can be located or the range of aspects that are at large begins to become discernible. This kind of active searching is tiring and, since it takes time for insights and intuitions to reveal themselves, not immediately rewarding.

The second option is that of intuition (direct knowledge). Practice very occasionally offers unmediated access to knowledge, and by being present when participants play, the observer may gain an intuitive understanding. This may be directly communicated to the observer through participants' movement improvisation or intensive play periods. An intuitive understanding, however, draws the observer deeper into the world of the players and reduces the difference in understanding between the participant and the observer. This has two implications: firstly the kind of knowledge gained from observations may need to be accompanied by knowledge resulting from another research method in order to enhance the validity of the findings.[15] Secondly, the shifting of viewpoints between participant and

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[13] It might seem as if participants' knowledge is of lesser value than the observer's, as it is never fully represented. This is not the case. Rather, because participants' knowledge is complex it can generate innumerable new insights. Most of these will not further this research question and are therefore not represented.

[14] Baxandall says the observer "works from comparisons not made by participants to generalizations participants would find offensively crude and crisp" (p. 110).

[15] This implication is picked up again at the end of this chapter where the observer changes into a 'participant observer' and introduces the performative practice as research.

observer makes them relative, which means that an analysis of what has been observed is not a straightforward matter, but may have to be performed in several layers.

Second analysis of action research workshops

In this research, the first qualitative analysis of the workshops merely employed a literal reading of data that identified a series of play stages involved. However, particularly in the later stages of play, participants were often self-absorbed, oblivious to their surroundings, and in creative flow. The activities taking place in these stages were too complex to be dissected and could not be compared with each other. To the observer, any attempt at analysing this data initially seemed like a lost cause: "A representation taken from a certain point of view, a translation made with certain symbols still remain imperfect in comparison with the object whose picture has been taken or which the symbols seek to express."[16] However, now that the theoretical foundations of explorative play have been discussed, and the problems of experiencing and observing discussed, an analysis of the communication that took place in the later play stages becomes easier.

Therefore the second analysis focuses on the verbal expressions used by participants during or after play. Since the actions most relevant to explorative play only began when participants started to challenge rule-based play, this second analysis uses a smaller collection of data than the first (figure 9 shows how first and second analysis correlate).

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[16] Henri Bergson, *The Creative Mind: an Introduction to Metaphysics* (New York: Citadel Press, 1992), p.161.

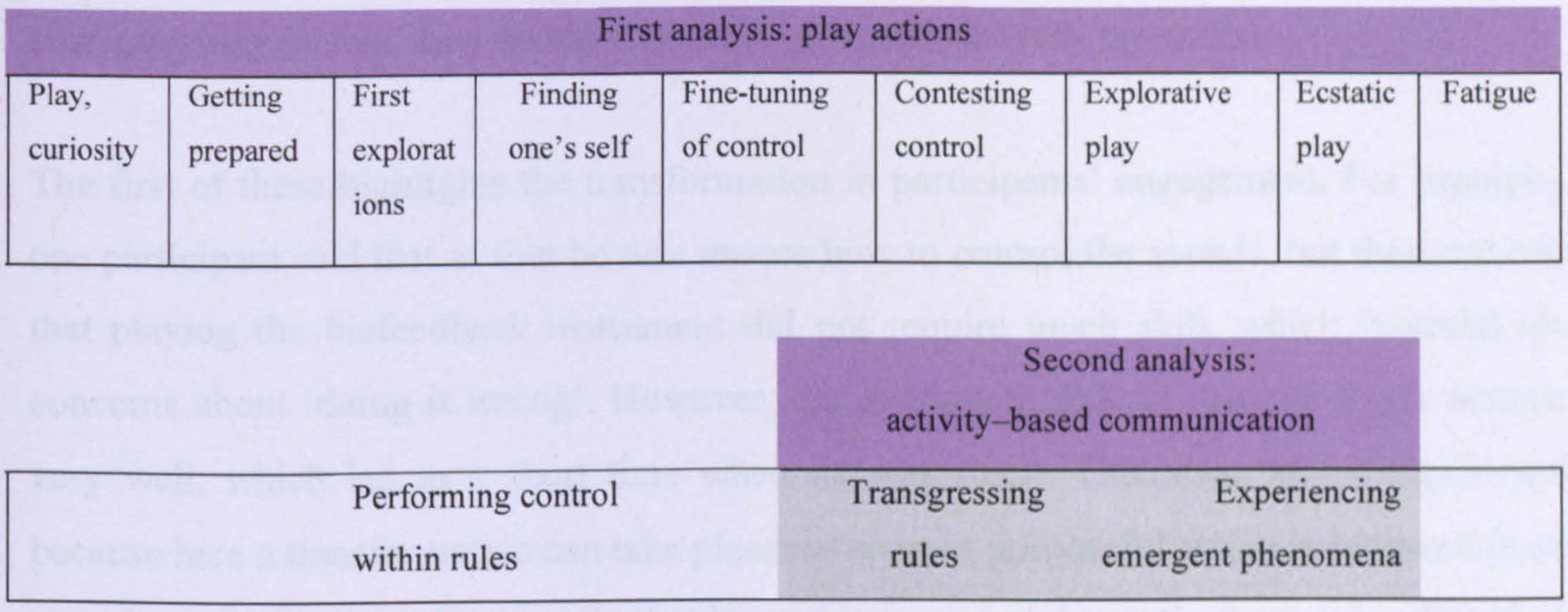

Figure 9: The correlation of first and second analysis of the action research workshops. Illustration by the author.

For the second analysis, the framework for activity-based communication analysis (ACA) developed by Jens Allwood, professor of linguistics at the university of Göteborg, provided a useful reference. Allwood maintains that the communicative aspects of an activity are determined by a number of collective and individual factors. These factors influence not only patterns of interaction, but also the types of linguistic expression used, as well as how expressions are used and interpreted in connection with the activity:[17]

> The best way to study linguistic interaction (and, thus, language) is to study it in different social activities. […] Linguistic differences between different social activities can be found in vocabulary, grammar, pronunciation and interactive style. […] The goals of linguistics will not only be to investigate social interaction as such, but to investigate linguistic interaction *in context*, as it is conditioned by the different social activities of which it is a part, and for which it serves as an instrument.[18]

This research is not a linguistic study. However, just like in activity-based communication analysis, it is imperative to maintain the link between verbalisation and play activity. Therefore a thematic index (see Appendix E) was compiled that would help to keep

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[17] (http://www.ling.gu.se/projekt/old_tal/?1148940214 [accessed 12.07.09]).

[18] Jens Allwood, 'Activity Based Studies of Linguistic Interaction', *Gothenburg Papers in Theoretical Linguistics,* 93, ISSN 9349-1021 (Göteborg University: Department of Linguistics, 2007), p.2 (emphasis by the author).

participants' accounts of play connected with their play activities.[19] Analysing the emerging play themes then revealed number of significant play moments.

The first of these highlights the transformation in participants' engagement. For example, one participant said that at first he was unsure how to control the sounds, but then realised that playing the biofeedback instrument did not require much skill, which lessened his concerns about 'doing it wrong'. However, the instrument did not respond to his actions very well, which led to a short time when he was stuck. This stage seems significant because here a transformation can take place: as soon as purposeful action is removed from play, it opens out to such an extent that it can become vertiginous (in the words of another participant 'daunting for people'). The participant then *explored* how the device linked body with sound by beginning to move more slowly and with more attention to the sounds. In this way he said he eventually realised that 'one can't go wrong here'. This was the turning point when he stopped trying to control the device. The participant then began to improvise and became gradually further absorbed in play, which showed itself by longer and deeper play periods. In this example, explorative play was used like a strategy, which was applied because reasoning and logical thinking would not influence the outcome.[20] Realising that 'one can't go wrong here' captures the shift of engagement from rule-based to explorative play. Participants were usually aware of this shift, at least to some extent. For example, another participant (absorbed in play) commented 'when there is light on an object it changes the human response'. Conceivably, the participant, a visual arts practitioner, here attempted to transfer some of the play and some of the language used in the workshops ('human response') into her area of expertise ('lights on objects'). However, this statement may contain more. Her comment could easily characterize her understanding of how she played: as she explored, she began to notice that things were different from her expectations. Thus when the light shone differently on objects (or when her thinking changed) it changed her response. What is striking here is that the change taking place is not described as a personal or active one ('I changed my response'), but as one that is

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[19] The selection of themes picks up from research in chapter 4, where the vertiginous processes of play were introduced.

[20] Here the explorative player finds a creative solution to the problem: he applies another way of thinking (or one might say another aspect of his personality) to engage successfully in play with the object. This reiterates that play is essentially creative and involves the whole personality of the player (Donald Winnicott, *Playing and Reality* (London: Routledge, 2005) p.71).

passive and general ('it changes the response'), which may communicate an understanding of having been played.

Another important observation concerns the intuitive understanding of the intensity of play. The sonified biofeedback was in itself a layer of communication, which made changes to players' mental states audible, sometimes even without players noticing it.[21] These changes tended to happen at the end of play periods, especially when participants (often spontaneously) expressed their reactions and thoughts. On one of these occasions, a participant said that wearing the sensors reminded her of being in hospital and subjected to scientific tests where a negative outcome may be possible. The equipment seemingly evoked some negative associations. However, these associations would not go away. Thinking about it prevented this participant from immersing herself more deeply into play. She eventually said that a few days earlier she had undergone a mammography. After that a sudden burst of sounds was heard, which meant that the galvanic skin response had picked up a significant change in her stress levels (curiously enough, the participant did not show any signs of noticing). The change in the sound made the word seem highly significant. One may therefore think that whenever the sound communicated an intensity, the participant could contribute the meaning to it. However, other observations problematised such a simple connection. Engaged in play, another participant said she felt like daydreaming and drifting. The sounds were 'like dolphin noises... they are not, but the sound evokes this picture'. Listening to the sounds felt 'like floating...like swimming...like flying', and observing the London skyline from the window she said 'when you focus on the horizon... you can almost see the sea'. Upon this, a sound was triggered by the stress level sensors. This passage, which accompanied a period of increasingly immersive play, also represents a process of gradual internal change. As indicated by the progression from 'dolphins' to 'horizon' and 'sea', the imaginary space here divorces itself from the physical one and expands. The switching between imaginative statements (they are like dolphin noises, one can see the sea) and their corrections (they are not really like dolphin noises, you cannot really see the sea),[22] further the impression that

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[21] Especially emotions that are accompanied by hair raising or spine-tingling sensations, increased sweating or shivering, can be easily picked up by the biofeedback sensors and translated into sound.

[22] On the one hand this shows an interplay between rational knowledge and perceptual knowledge, on the other hand a connection to a long standing discourse on optical theory in painting, which this participant, a painter and video artist, here makes.

the participant is in the process of opening up her thinking, while 'drifting', 'floating', 'swimming' and 'flying' show that the participant's awareness is differing from her habitual one.[23] The strong emotional reaction after the word sea therefore could – as in the previous example – indicate that an event or person to do with the sea caused a deep emotional reaction. However, in the context of continuous expansion, this may not be the end of it, and thus the details of the sea memory might be less relevant compared to the essence it cloaks. As the intensity of this essence is inexpressible, only its effects can be referred to. Thus the references made ('dolphins', 'horizon', 'sea') only touch the core of the matter, but do not reveal it. This exemplifies the notion of players 'being played': the essence revealed through immersion can only be individualised through the players but not identified by them.[24]

Further observations then deepened the understanding of the different types of vertigo that may be triggered by explorative play. For example, after an intense play period, a participant said that she felt she had been 'playing the space', and that it was her who was 'exaggerating effects on the environment, just by being there'. While this initially seemed to reflect an expanding and deepening awareness of space, this participant also said that her 'internal processes became external'. This might have indicated a spatial vertigo, where sounds that originate from inside the body and are externalised in space cause a vertiginous shift in scales. This experience may then self-reinforce its intensity through continuous listening. The impression of a spatial vertigo was also strengthened by another statement, in which she said that her play 'opened the space out... but more as an inner exploration'. The use of words here is significant, as paradoxes are often employed to describe situations where causal relationships do not apply. This could therefore be read as a further reference to a vertiginous experience. Her verbalisations of immersion, merging awareness and playing the space were therefore significant (as well as poetic).

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[23] A circular sound spatialisation was audible at the time. With other participants, this change of spatial awareness also took place, even without sound spatialisation. Spatialisation therefore might have simply exaggerated what would have taken place anyway.

[24] This process was also picked up on by other participants who said that it could occasionally feel 'like talking through sound'. This is interesting as it could potentially make the intensity of someone else's play intuitively perceptible or make differences between players' mental states audible. At a later multi-player workshop, the stress level sensors were passed on from participant to participant to reveal how different participants' states of being were.

So far, practice moments reflected processes of mental vertigo, expansion, depth and shifts of scale, but they have not yet illuminated the effect of explorative group play. This was revealed during a workshop where one participant improvised with sounds created from her stress level response and another with his sonified heartbeat. After attempts to control the instrument were overcome and participants were relaxed about working with each other, their play became noticeably smoother. A different form of engagement took hold, as the two individuals who had so far improvised next to each other or in turns now improvised together. For a period of time they moved slowly and in unison, while seemingly immersed into listening to the sounds and their surroundings. When this had come to an end, the first participant said she felt so connected to the other participant that she thought 'his heartbeat was her own'.[25] This articulates effacement, an important process within explorative play: by saying another heart beat inhabited her body she expresses a form of being played, thus ultimately transgressing the borders of her individual practice.

However, there was yet another aspect to this particular play spell. The play of the two participants exuded great intensity, which seemed to occupy the space in such a way that in affected everything within it ('I was the magnet that pulled the space together', said another participant after a similar play spell). Even the observer, who represented an audience, became immersed in the play. Gadamer says that players and audience members can be both *absorbed* by play, in such a way that there is no gap between the two.[26] But when there is no gap, then an intuitive understanding might be possible. This may be felt like a "sympathy by which one is transported into the interior of an object in order to coincide with what there is unique and consequently inexpressible".[27] If such a thing is

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[25] This is reminiscent of the reciprocity observed by Merleau–Ponty in *The Primacy of Perception*: "The communication and comprehension of gestures comes about through the reciprocity of my intentions and the gestures of others, of my gestures and intentions discernible in the conduct of other people. *It is as if the other person's intention inhabited my body and mine his.*" (Merleau-Ponty, Maurice, 'Eye and Mind' in *The Primacy of Perception* ed. by James M. Eddie (Evanston: North Western University Press, 1964), p. 215)

[26] According to Hans Georg Gadamer, games and plays become more significant when an audience is present. However, they are not directly aimed at an audience, even when they are played out before spectators. If they were, they would become shows and lose their real play character. (*Truth and Method* (New York: Crossroad, 1982), p. 109 – 115).

[27] With this quote Bergson defines intuition (*The Creative Mind*, p.161). He continues to say that analysis, on the other hand, is imperfect as it works from the outside. It can only dissect the object and describe each element by comparing it with what is already known.

possible, then during some play periods the observer – although not actively joining the shared improvisation – was also participating. This has implications on performative practices: rather than considering audience members as spectators, catalysts or witnesses, they could really be considered as co-players. Shared play might therefore set a common ground and collapse the perceived distance between performers and non-performers.

While it was significant when participants immersed themselves into play, it was also significant when explorative play did not happen. This may have been caused by a range of factors, not all of which were equally important; for example, some of the most obvious concerns that were voiced by the participants often only masked deeper-seated ones that were more difficult to identify.[28] This became particularly obvious in one workshop with a seemingly uncooperative participant, where as soon as one concern was dealt with, the issue re-emerged in another form; and play was put off time and time again. It seemed all too much for her. Another participant in a different workshop pointed out that the play space was too ordinary and 'did not have the magic' the participant was expecting, which held her back from engaging with the tasks at hand. Again, the disappointing space might not have been the real issue. For some participants, playing with the seemingly 'unworkable' biofeedback device was simply uncomfortably different. The observation situation did not help, but made participants even more self-conscious. Facilitation also emerged as a critical factor. This had a negative effect when participants felt overwhelmed by 'too much newness'. While for some this meant having to take in too much information, for others the kind of participation required turned the whole workshop into a daunting situation. Undoubtedly it is a challenge to engage with something different from the habitual, and therefore it was understandable when participants were mindful about immersing themselves into it. Moreover, from a participants' perspective it must have been difficult to gauge how much more new material would need to be dealt with. Therefore, as soon as 'newness' emerged as an issue, it had to be addressed. This was achieved by rewarding explorative play with engaging sound material, which self-motivated further play, or by letting participants move through the workshop schedule at their own pace.

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[28] One of these factors was the fragility of the prototype. Especially during early stages, participants indicated concerns about breaking the sensors, which in some cases hindered play and immersion. Although it could cause an obstacle when sensors actually had to be repaired, some equipment downtime had been anticipated for the workshops and time set aside to deal with this. Moreover, once used to the sensors, these worries usually disappeared.

Thus some participants engaged in ecstatic play early on in the workshop, while others had just reached its threshold at the end. This does not mean that some participants could not play as well as others, but because they had to deal with a new situation it simply took them longer.

However, crossing the threshold to ecstatic play requires a change of thinking, which some participants would not allow for. Especially at the beginning of the workshops, participants usually 'acquired': they extended their habitual forms of engagement to playing with the biofeedback sensors, and in this way tried to ground the workshop task in their own area of expertise. However, if this expertise involved *controlled* implementation of movement or repetition of tasks, such attempts necessarily failed. While most participants then searched for new ways of engagement, some would not change their approach until the end of the workshop. Although this was easy to see from the observer's viewpoint, for participants it was not always obvious to know what the blockage to play was and how to disentangle it. This can be made worse in a group situation where participants influence each other to keep 'acquiring', and to make the biofeedback device fit into their range of expertise. Clearly, facilitation needs to encourage participants to explore new methods of engaging with the device, without making this seem too intimidating.

However, there is a reason why participants might be fearful. Explorative play is serious play, not pretend play. In the words of one participant, it is 'like stripping someone down to the bare bones'. It may cause feelings of being exposed, of not being in control or not being within one's depth. This makes it risky play. The willingness to take risks therefore emerged as another important factor, as only then could players get to the point of understanding that play with the biofeedback 'is unpredictable and yet still linked to the body. I can have control over it or not'. Some participants never quite made it to this point. Therefore, while most found that the fluctuation of control holds a fascinating play experience where players were playing 'it' and 'it' was playing them, and which is deeply rewarding as 'you can explore things about yourself', others did not let go of acquiring and therefore did not allow themselves to be affected by explorative play.

A purposeful translation

The analysis of the action research workshops and group play sessions reveals how much participants helped to advance this research, particularly when they highlighted the features of explorative play by playing. However, in spite of notions of participation introduced earlier on,[29] the observer here still speaks on behalf of the participants. While this helps to keep the difference between observer and participant perspective distinct for future readers, it also reveals that it is merely a translation of participants' experiences. Nevertheless, this purposeful translation is important, as it places the research into the wider context of creative practice and gives it external validity. At the same time it reveals the internal coherence of the practice in question, which may ultimately lead to further insights and creative outputs; thus the purposeful translation of one practice might deepen another practice. Yet the importance of participants' experiences needs to find a more direct expression. This has two implications for this research.

Firstly it is necessary to follow up on the notion of a qualitative relationship. What that means is to recognise that explorative play can be a common ground that encourages communication and social interaction between all involved. It also initiates experiences of transformation, which are enjoyable but also unsettling in some ways (the accounts of participants, for example, reflect this as a mixture of delight and consternation). The qualities that emerged are therefore not by-products of practice but really intrinsic parts of the work, especially since they reveal the relational and generative nature of explorative play. Therefore, furthering communication and social interaction could become a practice goal in itself. It will need to be considered what consequences the qualitative relationship may have for already established forms of performative practice, and whether it could initiate new practice forms.

Secondly it is necessary to deepen the understanding of explorative play by becoming a player (see Appendix D). This change of perspective allows one to scrutinize the qualities that emerged from the action research workshops from a participant's point of view. Participants already identified two key characteristics of biofeedback practice: sonification and embodiment. The insight revealed by sonification is that the 'heart beat gives it

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[29] Notions of participation were discussed in chapter 2.

ground'. Play with sonified biofeedback can therefore restore a fundamental relationship between being and sound (a 'grounding'), which will be considered later on. The second feature, embodiment, arose from participants realising that biofeedback sensors work independently from movement ('there is no need to move...I can just be here'). Being in stillness with sonified biofeedback therefore holds a fundamental insight, which will be revealed in the following chapter.

6 - Biofeedback in the context of performance practice

This chapter connects the research to the field of contemporary performance. It introduces two core characteristics of current biofeedback performance (mediasation and altered proprioception) and argues that introspection and stillness enhance practice. The connections to Eastern practices this suggests are followed up, which reveals a third core characteristic (quality of the response). It is then investigated how introspection and stillness influence other performance practices with affinities to explorative play such as Butoh. Principles of practice found in Butoh are then fed back into biofeedback performance, where they bring about an iterative radicalization of practice.

Note: 🔊 This symbol, followed by a track number, refers to a relevant listening example on the accompanying Audio CD.

Core characteristics of performing with biofeedback

Biofeedback performance nearly always requires an element of mediasation,[1] which translates the biofeedback data and makes the physiological changes in the performer perceptible. Thus the use of translating media might be identified as *the first core characteristic* of performing with biofeedback. However, the problem that arises whenever live performance elements and translating media are combined is how the presence of these two elements may affect the apperception of the work as a whole. Since both elements compete for viewers' attention, there is a concern that the live element might be overpowered by its representation. In connection with this, Philip Auslander (*Liveness: Performance in a Mediatized Culture*) states that in contemporary Western culture, representations have come to be preferred over live performance elements.[2] Thus in popular music, for instance, music videos have replaced live performances in popularity, which shows that the quality of a live performance is now often judged by how closely it matches its representation.[3] While this concern needs to be acknowledged, the extent of which it may influence future practice seems unfathomable. A better perspective on the problem of combining live performances and translating media may therefore be obtained by observing that viewers – and even more so participants – often need to divide their

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[1] The term mediasation is used in this chapter to distinguish the use of media as an essential part of a practice from mediatization (the production of media-friendly representations of practices).

[2] Philip Auslander, *Liveness: Performance in a Mediatized Culture* (London: Routledge, 1999)

[3] Auslander, chapter 3.

attention between the performing body and its representation.[4] For instance in case of a performance and its simultaneous visualization, the further removed the projection is from its originating body, and the less both elements interact with each other, the more disjointed the experience. To avoid that, mediasation needs to maintain the connection between performing body and feedback, and make this connection as intuitive as possible. For example in the dance and media performance *Apparition*,[5] where videos of performing bodies recorded earlier were projected back onto them, this was achieved. This use of mediating technology not only helped to deepen the encounter with a body, but because image and body were at the same depth of field and spatial location, the projection acted like in a fold in time, allowing viewers to simultaneously observe the present and the past. This interrupted habitual perception and intensified a vertigo, which in this case was rooted in the inability to tell performers apart from their projections.[6] Crucially, however, *Apparition* drew attention away from the mediasation *method*: technology was not a focus point itself, but merely helped to intensify the encounter of the body.

In biofeedback performance, technology should be equally transparent. In fact, its core purpose should be to make the subconscious processes (that drive our bodies) perceptible to the senses.[7] How translating media may be applied successfully can be illustrated with Alvin Lucier's *Music for Solo Performer* (see figure 10, 🔊 1):[8]

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[4] For example, in the virtual reality dance environment *Cyberprint* http://www.mindatplay.co.uk/cyberprint.html [accessed 23.07.09]), colourful 3D renderings of the performers' physiological data were displayed on the wall behind the performers. In *Cardiomorphologies* (http://www.mindatplay.co.uk/cardiomorphologies.html [accessed 23.07.09]), the participant, seated in a reclining chair, faced a projection of concentric circles that represented his data. In *Whisper* (http://www.mindatplay.co.uk/whisper.html [accessed 23.07.09]), geometrical shapes that represented performers' data were projected onto the floor in between participants.

[5] *Apparition*, a dance and media performance developed by Klaus Obermaier, was shown at the *Ars Electronica* festival 2004. Although it is not a biofeedback performance, it is relevant because of its use of mediasation. See also http://www.mindatplay.co.uk/apparition.html [accessed 22.07.09].

[6] This was discussed at length in chapter 4.

[7] In contrast to other technologies such as motion sensing, biofeedback does not depend on physical activities being performed. Measuring performers' motion or location is therefore less important. This can free performers from executing tasks for technology's sake and enable them to engage more fully in improvisation and explorative play.

[8] The audio example here is not Lucier's original performance from 1965 (as documentation of this was unavailable), but a re-interpretation by Andrew Brouse, Automates Ki: Maxime Rioux, and César Saez distributed on http://www.youtube.com/watch?v=3uuYNKVQNMU [accessed 08.07.09]

Figure 10: Alvin Lucier performing with electroencephalography (EEG) headband. Photo by Phil Makanna. Courtesy Alvin Lucier (Lucier online)

Lucier, well dressed and surrounded by a set that amplifies his presence, simply sits centre stage, facing the audience. Wearing a biofeedback headband, he evokes the image of an inactive and yet powerful human being.[9] While this ambiguity unsettles some viewing expectations,[10] Lucier's stillness attracts the audience' awareness. Whereas in traditional Western performance stillness often represents an absence or end,[11] in *Music for Solo*

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[9] Referring to his performances in 1965, Lucier wrote: "I realized the value of the EEG situation as a theater element ... I was […] touched by the image of the immobile if not paralyzed human being who, by merely changing states of visual attention, can activate [...] a large battery of percussion instruments including cymbals, gongs, bass drums, timpani, and other..." (Lucier (online) http://emfinstitute.emf.org/exhibits/luciersolo.html [accessed 05.12.08]). This research disagrees with Lucier in one particular point: paralysis happens when a body remains stuck in the vertigo of the pure past. Lucier's stillness, however, challenges its audience.

[10] Perception is mostly concerned with the visual. Many in the field confirm this; Truax for instance says, "when a sound source is visible and auditory cues conflict with visual cues, vision always predominates over audition" (Barry Truax, ed., *Handbook for Acoustic Ecology*, CD-ROM edition version 1.1 (Vancouver: Cambridge Street Publishing, 1999)). Lucier works with that knowledge: by sitting still, the focus on the sound increases.

[11] Stillness in Western artefacts often signifies absence, disappearance or death. For example, the text accompanying Camille Utterbeck's installation *Luminous Flux* declares: "Alternatively, if a participant stands still, her image will disappear, dissolving in a ghostly fashion. *Motion becomes presence, and stillness absence.*" (Camille Utterbeck, (online) http://www.camilleutterback.com/luminousflux.html [accessed 5.12.08], emphasis by the author). Stillness is also used to offset (inter)action: "… *Untitled (Dying Bull)* … by Kevin Yates contain[s] no movement or obvious interactivity apart from looking. … Despite their sharp contrast with the electronic installations, the small figurines also act as a complement with a sense of stillness and scale. The stillness *reminds us of the inactivity between interactivity*, and although diminutive, the work commands no less a reaction than the other installations. The equity of response reflects the difficulty in measuring interactivity." (Kevin Yates, (online) http://themanitoban.com/2003-2004/1029/ ar_01.html [accessed 1.10.07], emphasis by the author). Stillness here describes a passive body but an active and contemplative mind. This is particularly problematic as it begins to draw a distinction between the body and mind that leads back to transcendental thinking.

Performer it is affirmative: it intensifies the present and draws attention to Lucier's brainwave patterns. These become perceptible when they trigger percussion instruments positioned in between audience members. Through this spatialisation, Lucier's patterns extend his stage presence far into the auditorium and dissolve the distinction between representation and performing body.[12] This in turn helps to further intensify the performance for the audience.

However, performers also need to come to terms with another phenomena, which is the effect of mediasation on proprioception.[13] Participants in Paul Sermon's *Telematic Dance* workshops, for instance, describe their first encounters with mediatising technology as 'using a crutch': having to put aside an awareness based on sensation and use cognitive thinking to 'find themselves' again in the mediated space.[14] But whereas for Sermons' performers the disjointed body awareness only had a temporary effect (which may not even have been perceptible to outside observers), for biofeedback performers, a disjointed body awareness is a severe handicap as every departure from habitual proprioception is

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[12] Representation techniques are reductive when they fail to translate the complexity of the performing body. In the case of Lucier's performance, if the multitude of processes taking place in Lucier's body had been lost in the audio translation, the work would have become less interesting. Lucier, however, managed the translation and thus the audience gets to know all the simultaneous micro-processes that constitute his being: nervous twitches, sensations, emotions, muscular spasms, and spine-tingling chills.

[13] Performance artist Louise Steinman (*The Knowing Body* (Berkeley, California: North Atlantic Books, 1994)) lists three types of proprioception (=how human beings sense themselves in the world). Kinaesthesia: the feeling of movement derived from skeletal and muscular structures; also pain, passage of time, and sense of rhythm. Visceral feedback: impressions from internal organs. Labyrinthine/ vestibular feedback: the position of the body in space (using the cochlea – inner ear). Ultimately, it may be possible to add an 'increased awareness of mental states through biofeedback' to that list.

[14] in Soeke Dinkla and Martina Leeker, eds., *Tanz und Technologie: Dance and Technology* (Berlin: Alexander Verlag, 2002), p.272 ff. These workshops – that did not use biofeedback – took place in 2000 at the Choreographisches Zentrum NRW Zollverein, Essen, Germany. Paul Sermon describes the process of two dancers improvising within the telepresence spaces as follows: at first they try a pantomime as a humorous approach to the strange situation. Then they try to dance a shared waltz, but it proves too difficult to coordinate the movements remotely. Then they try a simple lead-and-follow improvisation, where one partner imitates the movement of the other. Once a basic connection was established, they engaged in more complex improvisations. Simplifying the tasks thus helped them to 'find themselves' and each other. 'Finding oneself' therefore means to connect one's body awareness with a representation outside the body. One participant describes this as follows: "I realised that I had to do the opposite of what my experience with my mirror image told me, that is, I had to go to the left in real space in order to move to the right on the monitor. But I was still turning to the wrong side" (Dinkla, p.290). However, the disjointment exceeded getting to grips with a mirror image. Sermon himself said that dancers needed to "put aside their knowledge as dancers" (Dinkla, p.272) which is a body awareness based on sensation. Thus according to workshop participants, telematic dance required the use of cognitive skills for orientation instead of intuitive knowledge: "I lost my sense of space, my sense of time; I lost contact with my own body [...] I lost the embodied knowledge that I had as a dancer. I felt like a child, not knowing which leg was mine, which hand was mine" (Dinkla, p. 290).

immediately sensed. Thus to minimise the effects of mediatising technology, biofeedback practitioners need to cultivate a greater awareness of their proprioception in connection with the movements of their minds. Therefore, a *second core characteristic* of performing with biofeedback is altered proprioception, which needs to be balanced with increased introspection. Indeed, engaging in practices such as meditation, Yoga, neuro-linguistic programming, or (more suited to occasional performers) explorative play therefore holds significant value, as only with such introspective practice is it possible to perform successfully. However, in order to fully grasp the importance this statement, it is necessary to reflect on how introspection is currently perceived from within contemporary performance theory.

Connections with Eastern philosophy

Anthony Howell, for example, sees introspection as stillness and, in *Analysis of Performance Art*, differentiates between three main kinds: stillness as arrest, stillness as a state and breaking out of stillness.[15] Howell's categories are interesting as they reveal a difference between voluntary and involuntary stillness. But while this may be helpful for a narrative interpretation of performances, it does not disclose how stillness may affirm itself, or how performers may begin to cultivate it. On this point, Howell merely observes:

> There is a commonly observed "Zen" content to stillness. This is a stillness gone into itself... a composed state which deepens when one adopts a position which is easy to hold for a long time... Zen stillness is a continuous drawing-in to the interior.[16]

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[15] Anthony Howell, *Analysis of Performance Art* (Newark: Harwood, 1999), p.1.

[16] Howell, p.1f. Why this common association of stillness with Zen? Clearly, as well as sitting in meditative silence, Zen practitioners also lead an active and eloquent life: Kenneth Kraft (*Eloquent Zen: Daito and Early Japanese Zen* (Honolulu: University of Hawaii Press, 1992)) for instance demonstrates that it was the practice for Zen masters to migrate through parts of the world and to share their enlightenment with others in prose and in verse, thus contributing to a growing canon of poetry and literature. If such interchange is essential to Zen, where does the association with stillness and silence stem from? According to Kraft it has historic causes: Japanese monks travelling to China between the late twelfth to mid fourteenth century to study the latest Ch'an Buddhist literature had to overcome immense language problems (Kraft, p.3): the Chinese texts differed from the spoken Chinese, which in itself consisted of many different dialects. Moreover, many of the available translators were merchants, not Zen monks; and texts were copied by hand. All of this introduced translation errors and misunderstandings (Kraft, p.51 f). The Koans were particularly hard to study and translate, as they drew on paradoxes to transmit the teachings. Thus the monks, struggling to understand the essence of the koans, became very aware – but equally distrustful – of language. Maybe because of their increased linguistic awareness, the newly forming Zen strand of Buddhism became

This passage is important, but open to misreadings: firstly stillness in itself cannot be reached by merely 'adopting a position which is easy to hold' as this only mimics the form, and secondly if the 'continuous drawing-in to the interior' is to reflect Zen teachings, then it is not a gradual withdrawal from the world. Zen meditation is an exercise in mental emptiness or mushin ([無心] 'no mind')[17] where thoughts and feelings are not suppressed to the point of nothingness, but allowed to let go. Thus 'Zen stillness' can only fully manifest itself in performers once they realise that concerns about their appearance on stage are irrelevant. For performance this is a clear direction away from representation and mimicry.

A further potential misreading is imminent when Howell states, "stillness in performative terms is essentially physical".[18] If stillness is only thought of as non-motion or non-action, this only defines what stillness is *not*, but gets no closer to saying what it *is*.[19] The problem is once again created by the thought approach: asking what performers can do on stage to successfully communicate a particular type of stillness reveals a preconcern with form and representation, not with stillness in itself. On the other hand, asking what mental state a performer needs to attain so that stillness can take hold investigates into the essence of stillness, not its representation. What may be little known is that Zen meditation is independent from physical activity or posture: "walking is Zen and sitting is Zen. Whether one speaks, remains silent, moves, or rests, the body is at peace."[20] Now Howell's 'Zen content to stillness' makes sense: a mindset that can attain stillness independent from motion is helpful when performing with biofeedback.

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particularly insistent that "the deepest insights can not be verbalized or even conceptualized" (Kraft, p.7). Zen thus adopted the koans as its main teaching device and Zazen (seated meditation where practitioners confront this ineffable truth) as its main method. Although Zen nowadays is often associated with silent meditation, action and developing linguistic awareness are still core elements of this practice.

[17] Short for mu shin no shin [無心の心], literally: 'mind of no mind'.

[18] Howell, p.6.

[19] If stillness is understood as non-action, no progress has been made towards understanding its nature: a negative definition (an opposite, a negation or a subversion) simply cannot encapsulate that.

[20] Yung-chia in Kraft, p.118.

However, how can such stillness be attained? Zen, like all Buddhist practices, acknowledges the deficiencies of habitual perception and memory and provides guidance for those who want to break away from such a 'clouded' worldview. In this, Zen[21] relies mainly on the koans [公案 'kung-an', literally: 'public case'],[22] "spiritual puzzle[s] that cannot be solved by the intellect alone."[23] These contain paradoxical statements that disrupt habitual thinking and bring the usual train of thought to a halt. They can only be resolved with a non-dual mindset, in other words by realising that the differences between things that are conventionally adhered to are only artificial constructions.[24] However, once this realisation takes hold, the change of thinking has already happened; hence it is said that Zen koans can be perceived *intuitively*. If one tries to explain what it was that was actually perceived, one finds that there are no words for it, and so every attempt to re-embed this intuitive perception within conventional language is unsuccessful – as the Zen saying goes "as soon as you call it something, you have already missed the mark."[25] Conventional language here fails, because something that exceeds its limits cannot be placed within it. However, silence also misses the mark, as these new insights *need* to be communicated somehow. Declaring the truth to be ineffable is somewhat useful, but ultimately disappointing, as such declarations are formulaic. The solution to the impasse is indicated in one of the koans, where a monk asks: "Both speech and silence are involved in separation and discrimination. How can we proceed without erring?" His master replies: "I'll always remember Chiang-nan in spring – the partridges chirping, the flowers so fragrant."[26] The master's reply in verse form ruptures the conventional flow of communication itself, to let the monk feel the essence of the reply.[27] At the same time the

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[21] Although this concerns mainly the Rinzai branch of Zen, koans are also known in the Soto branch.

[22] The 'Blue Cliff Record' koan collection, for example, can be found online at http://perso.ens-lyon.fr/eric.boix/Koan/Hekiganroku/index.html [accessed 21.12.08].

[23] Kraft, p.58.

[24] Zen master Daito comments after one such enlightenment: "Once you suddenly smash through, and go on to make the leap beyond, you will find that everything around you and all that you do, whether active or at rest, is the scenery of the fundamental ground, the original Mind. There will be not a hairsbreadth of difference between you and other things – there will be no other things" (Kraft, p.114).

[25] quoted in Kraft, p.153.

[26] Kraft, p.165.

[27] A highly developed awareness of language is demonstrated by this reply. This is typical for early Zen practitioners (Kraft calls this 'eloquent Zen' (p.151 f)), which is not to say that today's Zen practitioners are not eloquent in their use of language. The difference drawn here is between a practice in formation and one

master demonstrates how poetic language can reach deeper than description or analysis, and express an essential truth.[28]

Having followed Howells' reference to Zen to some extent has made it clearer why connections between Eastern and Western philosophies can deepen a performance practice. However, such interconnections are also increasingly common in wider culture. *The Monk and the Philosopher,* for example, focuses on Matthieu Ricard, who, after completing his doctorate in molecular biology at the Institut Pasteur, studied Buddhist philosophies and now lives the life of a Tibetan monk.[29] Knowing his father is a Western philosopher prompts the question as to what initiated such a change. Ricard replies that in contrast to Western thinking, Buddhist philosophy unites thinking and doing, and insight and everyday life.[30] While this is a generalization, its element of truth resonates with other voices, for example that of art theorist and psychologist Rudolf Arnheim. Like Ricard, Arnheim criticises the Western preference of the intellect over other types of knowing, which can in its extreme forms introduce a split between mind and body and devalue experience based on sensation:

> [Western culture is] unsuited to the creation of art and encourages the wrong kind of thinking about it. We have neglected the gift of comprehending things through our senses. Our eyes have been reduced to instruments with which to identify and

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fully formalised. Zen Buddhism still develops in many different schools and traditions today and it is in the early stages of formation, that practitioners – grappling particularly hard with translating, understanding and re-interpreting teachings and rules of practice – develop a fresh awareness of language.

[28] Interestingly, unless considering some of the core elements of Deleuzian philosophy (chapter 4) that tackle the ineffability of qualitative experience, one might be in a similar position to the monk who realises the finity of conventional language. Although comparisons between schools of thought are difficult, one may still be drawn towards finding parallels between non-dual thinking in Zen and Deleuze's concept of difference in itself, especially since both break with representational thinking; and further between Deleuze's asymmetric synthesis of the sensible (that holds that art and poetry can convey essential truths) and Zen literature and poetry that is said to transmit essential truths. Furthermore, the paradoxes in the koans induce a vertigo that interrupts habitual thinking – similar to the sense experiences in Proust's *A la Recherche du Temps Perdu* (*In Search of Lost Time*, Vols 1 - 6 (London: Penguin, 2003)). Zen's use of poetic and performative language is also similar to Bachelard's use of poetic language (*The Poetics of Space* (Boston: Beacon Press, 1969)).

[29] Jean-Francois Revel and Matthieu Ricard *The Monk and the Philosopher* (London: Harper Collins, 1998).

[30] Revel and Ricard, p.81. A core teaching in Zen is that truth is not independent from everyday life. Insights are to be verified through practitioners' lives, and thus they need to be maintained not only during meditation but also while engaging in everyday affairs (hence the understanding of Zen [禅] as 'the everyday mind').

> to measure. Concept is divorced from percept, and thoughts move among abstractions.[31]

What is interesting about statements like this is that Eastern practices are often called upon to resolve problems introduced by Western transcendental thinking, without attempting to 'correct' this thinking from within Western philosophy. Yet the underlying issue is not the difference between Western and Eastern schools of thought (as in the end these are just labels), but the extent to which an individual is prepared to examine how and why they think in a particular way. Nevertheless, publications like Revel and Ricard's *The Monk and the Philosopher*, Howell's *Analysis of Performance Art* and Arnheim's *Art and Visual Perception* hint at a large number of contemporary theoreticians and practitioners whose work is informed by the Eastern philosophies they engage with.[32] Thus, references to Eastern schools of thought can no longer be dismissed as irrelevant to the field, and yet such references have to be thorough. Mistranslations and insufficient contextualisation of Zen teachings, for example, have mystified rather than advanced research in the past.[33] Worse still, superficial referencing has commodified philosophical concepts into 'pick and mix' sound bites.[34] Biofeedback practice, which has come to be popularly associated with alternative practices on the one hand and surveillance technology on the other, is particularly exposed to this malpractice. Researchers like Dr. Elmer Green therefore take refuge in objective journalism in order not to inflate popular mystifications further. In

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[31] Rudolf Arnheim, *Art and Visual Perception: a Psychology of the Creative Eye* (Berkeley and Los Angeles: University of California Press, 1974), p.1.

[32] This research alone encountered composer John Cage, performance theorists Baraitser and Bailey, Zarilli, and Anthony Howell as well as art psychologist Rudolf Arnheim.

[33] This concerns publications like Eugen Herrigel's *Zen in the Art of Archery* (London: Routledge & Kegan Paul, 1982). According to Shoji Yamada (*The Myth of Zen in the Art of Archery*, (1999) pdf downloadable from http://www.thezensite.com/ZenEsays/CriticalZen/The_Myth_of_Zen_in_the_Art_of_Archery.pdf [accessed 23.10.08]) Herrigel, a German philosophy professor who taught at Tokyo University during the 1930s arrived in Japan with a keen interested in mysticism and all things Zen. Practice is the passageway to Zen, and thus Herrigel was introduced to Kenzo Awa, an eccentric archery teacher. Unbeknownst to Herrigel, Awa did not embrace Zen and was criticized by other archery teachers, particularly since beginning to turn his version of archery into a new religion. Therefore while teaching Herrigel, Awa misappropriated many Zen phrases. This (mis)match of teacher and student, an over diplomatic translator as well as misunderstandings resulting from cultural differences lead Herrigel to propagate many myths about Zen archery in the Western world, the extent of which has only come to light since Herrigel's *Zen in the Art of Archery* was scrutinized by Japanese readers.

[34] One may want to think of the innumerable references made in Western culture to the koan *The sound of one hand clapping*. However, just quoting this puzzling koan neither shows nor generates an understanding of it.

Biofeedback: the Yoga of the West,[35] Green therefore sets out to give a succinct account of his biofeedback research, which consists of physiological studies of yogis in India and the United States. In order to establish credibility, he stresses the scientific approval of biofeedback treatments, and then emphasizes the benefits of biofeedback (health benefits, stress reduction, prevention of strokes, pain control, promoting a measured lifestyle). This strongly underlines the social and moral validity of biofeedback sensing. Finally, by promoting biofeedback's ease of use ('achieving in 30 days what takes a yogi 20 years of training'), he plays on its potential market value.

However, in spite of the objective narration, the visuals tell another story: yogis wearing biofeedback sensors sit surrounded by a Western research team.[36] This image is striking, as here the conflict between cognition and sensation in the Western mind, which was criticised by Arnheim, seems to have become personified. Thus when the documentary is looked at thirty years on, one comes to question whether Green's appreciation of the yogis' abilities to control their physiological processes does not feed into a Western preference for measuring and rational thinking, which may ultimately be motivated by a fear of losing control. What also becomes clear in Green's research is that internal stillness and introspection cannot be achieved by biofeedback equipment alone. While the presence of dials and feedback sounds may reassure some Western minds, it is only when the interest in measuring is put aside that the depth of experience can resonate. Therefore, contrary to Green's purpose-driven documentary, it is necessary to embrace the 'lack of purpose' that defines Eastern traditions and also explorative play.[37] Thus biofeedback technology can only ease, but not replace, introspection. This is also the core of Ricard's critique of the Western preoccupation with measuring:

> Buddhist and other contemplators have been applying themselves to the introspective approach for more than two thousand years. Using mechanical instruments is hardly likely to teach one anything about the nature of the mind, because what one will be studying and measuring will only be the nervous system's

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[35] Elmer Green, *Biofeedback: the Yoga of the West,* video documentary (1974, 40:00 mins. Producer Elda Hartley, Hartley Film Foundation, Cat Rock Road, Cos Cob, Connecticut, 06807)

[36] Unfortunately the yogis' view of the Western research team was not sought. This may have given this documentary a more balanced format.

[37] See chapter 1.

> input and output. Consciousness itself will be left out of the investigation. Only the mind can know and analyse the mind.[38]

This critique reiterates that in a performance context, a researcher need not be concerned with proving biofeedback's validity through experimentation – if anything, validity has already been established. Thus medical precision or literal transcriptions are not required here. The effort should rather be directed towards the sensory quality of the response produced, which means that the actual feedback (sounds, music, visuals, staging etc) must exceed literal transcriptions. This focus on the quality of the response is *the third core characteristic* of biofeedback practice. Indeed, the quality of the response is significant; it can introduce a feedback loop in the performer, which again opens up the range of performance outcomes and introduces unpredictability. Therefore, while biofeedback performers should be reasonably familiar with the technology, it is more important to cultivate introspection. However, this does not mean physical inactivity; otherwise biofeedback performers would simply sit in meditative silence. How stillness is understood must therefore be questioned further, and set in relation to the generative processes that allow performance to take on form.

Biofeedback and experimental performance practice

To illustrate this relation it is beneficial to examine existing experimental performance disciplines that already generate content from stillness. Butoh (舞踏, originally Ankoku Butoh, 'dance of utter darkness'), a contemporary dance/performance practice concerned with radical improvisation, provides a particularly suitable context for this, as here Eastern and Western influences have become so intertwined that it is now considered to be intercultural.[39] Moreover, in its radical philosophical underpinnings, Butoh is closely

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[38] Revel and Ricard, p.81.

[39] Butoh was founded by Kazuo Ohno and Tatsumi Hijikata in post-war Japan. According to Paul Roquet (*Towards the Bowels of the Earth* (Davis, California: Palupalu Publishing, 2004)) it initially expressed the loathing felt by many Japanese in the face of the American occupation and the spreading of Western cultural influences. However, while Hijikata generally resented the growing influence of the West, he was also greatly moved by literature that dealt with absurd or liminal experiences, in particular works by Artaud, de Sade and Genet. These he connected with Zen philosophy and his own experiences of the war in such a way that a range of grotesque and extreme performances emerged, which shocked their audiences and also shook the underlying framework of representational art itself. Although according to mainstream Japanese society Butoh is a peripheral cultural activity with limited influence, some Butoh productions have, nevertheless, remained censored for many years. The shocking content of these works derived from a Butoh philosophy that asks performers to remove their social conditioning and to dance the 'dead body', dancing without

related to explorative play and a generative ontology. This connection can be elucidated through Butoh's focus on the 'dead body'. Butoh dancers' bodies are called dead when they dance without intention, without thinking, without decision-making.[40] This, however, already shows some connections to the Zen doctrines of no-mind (mushin) and non-duality: applied to movement practice, mushin holds that any physical expression is faster, more accurate or deeper when the mental control of any actions is relinquished to the subconscious. In martial arts disciplines therefore, mushin is achieved when movement sequences – absorbed deeply into bodily memory – are executed before any analytical thinking or emotional trauma can slow combatants down. Butoh, on the other hand, achieves mushin when performers move in mental detachment (for example during spiritual or zero walking),[41] when movement transitions take place before performers can fully think about it, or when unplanned movement takes place. Thus even when Butoh performers are detached, there can still be a great amount of (physical) activity. This shows that the two processes do not exclude each other, on the contrary: stillness is only complete when performers *act* in the right way of *thinking* which is not to analyse, compare or interrogate, but to observe things from a position of disinterestedness.

Once it is recognized how thinking and acting are interrelated, it is possible to get a grip on non-duality in Butoh, which holds that differences between beings are only socially

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intention, without thinking, without decision making. This can, at least, shatter a person's social paradigm; at best it can become a life-affirming experience that embraces other forms of being. Dancing Butoh can change individuals' attitudes to society, and more importantly lead to the production of works that challenge the established social order. Particularly during the 1970s - 80s, Butoh came to fully embrace its radical essence: a growing number of performers problematized horrific, absurd or paradoxical areas of human experience through Butoh dance. Since the 1980s many different practices have emerged outside Japan, often influenced by local traditions and rituals. Current Butoh practitioners in Japan include Yoshito Ohno (son of Kazuo Ohno), Min Tanaka, Asubestos Kan led by Akiko Motofuji (Hijikata's widow), Katsura Kan, and Dairakudakan led by Akaji Maro. Many practitioners perform internationally, such as Marie Gabrielle Rotie (UK), Joan Laage (US), Atsushi Takenouchi (Japan/UK/France), Minako Seki (Germany), Yuko Kaseki (Germany), Sankai Juku (France), and Diego Piñón (Mexico).

[40] Roquet, p. 20.

[41] Zero or spiritual walking in Butoh shows many similarities to a Zen walking meditation: walking slowly, in a state of emotional detachment ('zero engagement with emotion'), with intense focus on sensation (placing the feet on the ground and controlling the continuous shift of weight). While there is general consensus in Zen about the benefits of Zazen (seated meditation), a Zen mind is not achieved only through this practice. Older Buddhist teachings identify four meditation postures: sitting, standing, lying down and walking. With today's practitioners the walking meditation is increasingly popular, as for most people it is easier to integrate meditative practice into their daily schedules. (http://www.insightmeditationcenter.org/articles/walkingmeditation.html [accessed 25.11.08]) This shows yet another parallel between Zen and experimental performance practice.

constructed. To reach the dead body, it is therefore necessary to work against society's prescribed roles and imposed bodily inhibitions, a process Hijikata calls the 'rejection of the social construction of the body'. This means to resist conventional thinking and conventional aesthetics. Instead, Butoh involves the basic emotions and embodied memories of individual performers to generate performance material. Kazuo Ohno, in particular, used his embodied memories (early childhood memories, first encounters of objects, relationships) as impulses for dance. However, this use was never representational:

> If you wish to dance a flower, you can mime it and it will be everyone's flower, banal and uninteresting; but if you place that beauty of that flower and the emotions which are evoked by it into your dead body, then the flower you create will be true and unique and the audience will be moved.[42]

The Butoh aesthetic embraces all aspects of life, from the attractive, nascent and vigorous to the fading, absurd and obscene. This means to embody them, performers must have lived such experiences. Some performers therefore undergo extreme ordeals; Hijikata, for example, communicated the trauma and crisis his body experienced to the audience by moving through agonizing positions until exhausted. He also danced without clothing, thus symbolically removing indications of his social status and role. To make the dead body even more intense, Hijikata and Ohno explored sensations of different-abled bodies, and developed a range of characterizations. Once these were absorbed into bodily memory, Hijikata and Ohno were able to shift fluently between them.[43] What particularly connects these Butoh characterizations with this research, however, is the linguistic impasse Hijikata encountered: trying to transmit the essence of his characterizations to his students he recognised the danger of 'missing the mark'. He solved this with a dance notation that consists of striking and paradoxical images.[44] These target the emotions and embodied memories of a performer and provoke physical reactions, from which performance material

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[42] Ohno in Jean Viala and Nourit Masson-Sekine, *Butoh: Shades of Darkness* (Tokyo: Shufunomoto, 1991), p.22.

[43] These shifts – often considered as the heart of a Butoh performance – could be instantaneous or gradual, but never representational.

[44] Hijikata's passage 'You live because insects eat you' introduces a small range of these identities: "*You live because insects eat you.* A person is buried in a wall. He becomes an insect that dances on a thin sheet of paper. It makes rustling noises, trying to hold falling particles. The insect then becomes a person, so fragile that he could crumble with the slightest touch, who is wandering around." (Hijikata on *Yukio Waguri: Butoh Kozensha*, CD Rom Collection, CD 1).

may then be generated. In this way the internal differences contained in Hijikata's images find diverse and unpredictable expressions in Butoh performances.

However, the impossibility of expressing internal differences in conventional language is only one of many parallels between Butoh practice and this research: both Butoh and explorative play oppose common sense and good sense as valid boundaries of practice, as well as mimicry and representation as relevant means of expression. Instead, they draw on the notion of a passive subject (one that is being individuated, or being played) and maintain the self-emergence of form and action. For this, however, a generative ontology is the necessary philosophical thought base. Also in Butoh, there is no separation between practice and philosophy, as movement is always performed in connection with particular modes of thinking. This intensifies and radicalizes Butoh performance. In explorative play, on the other hand, the immersion into play generates a self-reinforcing vertigo that ruptures habitual perception and proprioception, and introduces other modes of thinking.[45] It could even be argued that explorative players experience mushin when they play without attachment and without analyzing their play, or when their bodies react before they become fully aware of it. However, while there are significant similarities, Butoh has a clearer methodology for practice than explorative play. Therefore it will be of great benefit to extract some of these and to transfer them to biofeedback practice.

Performance principles for biofeedback practice

The body in Butoh is called dead, not because it is inactive, but because it is no longer used as an instrument of representation. Butoh performers, however, not only steer away from representation, but also concentrate on practice methods that reveal generative processes taking place in the body. This radicalizes their practice, as it renders the body a site where essential crises are played out. Applied to biofeedback performance, such principles of practice also bring about a radicalization. Mushin in Butoh, for example, demonstrated that mental detachment is not opposed to movement, but connected in a more complex manner. Within the philosophical framework of this research, this connection can be thought

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[45] This is why the notion of 'intuitive understanding' in explorative play was introduced in chapter 4.

through Deleuze's 'asymmetric synthesis of the sensible', where mental detachment and movement may respond to two different orders: detachment would be connected to intensity and internal depth,[46] while movement would be an extensive (= perceptible) quality. The two orders would resonate in such a way that movement unforeseeably finds form when touched by intensities.[47] When informed by this thinking, biofeedback practice has no need for purpose or artistic intention: the processes that reveal the body as 'being played' are already fully affirmative of being.

The elimination of purpose and intention from practice was also advocated by John Cage, who said, "The highest purpose is to have no purpose at all. This puts one in accord with nature in her manner of operation."[48] Biofeedback practitioners already work with open systems ('nature in her manner of operation') and thus have little to gain by trying to fit the richness and unpredictability this system contains into a framework limited by purpose and intention. In fact it is the absence of purpose and intention that conveys the operation of those systems in the clearest possible way. However, if practice does not find form through intention and purpose, a different process takes over. This is explorative play. Here, like the protagonist in *A la Recherche du Temps Perdu*, players develop an awareness of the intensities that make themselves felt.[49] Experienced as vertigo, this reinforces itself the more they allow the depth of the past – contained within each present – to gain hold. Immersed in such a state, intention and purpose become irrelevant while play gains in intensity. Cage's *4'33"*, for instance, demonstrates the significance of this process.[50] As the obvious audience expectation (sound) is denied, the focus shifts onto the intensity that makes itself felt. This radiates from the performer who is on stage ready to play. However,

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[46] An interesting question is whether someone could ever *interpret* the significance of an experience another person had through biofeedback itself. There is considerable agreement on the mental states participants experience in biofeedback (in the measurement of brainwave patterns for instance these are described as alpha, beta, delta, theta). One can also 'reward' participants with enjoyable audiovisual feedback if they stay within particular states (which is the principle of biofeedback training). However, one can never *know* another person's mind, only recognize fluctuations between conventional perception ('play') and detachment ('being played').

[47] Moving is an actualisation that takes place when intensities (depth) bring qualities (extensions) into being.

[48] John Cage, *Silence, Lectures and Writings* (London: Marion Boyars, 1999), p.155.

[49] Explorative play that takes hold of its players is a form of 'being in stillness'.

[50] The full title for this work is: John Cage, *4'33" for Any Instrument or Combination of Instruments* (New York: August 1952, second version c. 1960). However, since the work is usually referred to as *4'33"*, this convention was also followed in this thesis.

Playing *4'33"* is difficult because it requires musicians not to deal with extension (sound) but with intensity (stillness), and this for a prolonged period of time. This exposes differences between players who mime or dramatize stillness,[51] and those who are still.[52] The latter option is harder, as players have to let go of intention and purpose. Biofeedback performers face a task similar to musicians playing *4'33"*, in the sense that they must be prepared to shift their awareness from extension (representation, conscious thoughts) to intensity (stillness, detachment). It is therefore crucial to question what is understood by stillness, particularly since only some forms of stillness are suitable for performing with biofeedback (see figure 11).

Concepts of stillness:	**Practice examples:**	***Excitations* practice:**
Relaxed (still) body, detached mind	Meditation (Zazen)	
Form being generated by a non-thinking (still) mind	Improvisation practices (Butoh, Jazz), live performance, explorative play	Action research workshops, early performances
Mind being performed with a relaxed (still) body	Traditional biofeedback practice (Lucier, Rosenboom), explorative play	Action research workshops, later performances, participative group sessions
Non-stillness: attached mind, self-conscious, practice concerned with imitation of form[53]	Reproductive music, theatre and dance practices, learning processes (Rote Learning), competitive play (Gymnastics, Ballroom Dance)	

Figure 11: Concepts of stillness.
Illustration by the author.

Biofeedback performance may concern itself entirely with observing the very small movements of the mind. Similar to Zazen meditation, such practice is then characterised by 'stillness' in body and mind.[54] In practice, however, this path is not often pursued, as a

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[51] See http://uk.youtube.com/watch?v=jxfOr0T5Vi8 [accessed 24.01.09] and
Armin Fuchs' interpretation: http://uk.youtube.com/watch?v=gN2zcLBr_VM [accessed 24.01.09].

[52] BBC symphony orchestra, John Cage at the Barbican, 16 January 2004,
http://uk.youtube.com/watch?v=hUJagb7hL0E [accessed 24.01.09], and
David Tudor http://uk.youtube.com/watch?v=HypmW4Yd7SY [accessed 24.01.09]

[53] Being active in mind and body may be driven by processes of reproduction (for example performers learning new sequences). These does not play to the strength of biofeedback, as performers who analyse themselves 'in action' prevent more relaxed states of mind from taking hold. Worried or agitated performers, on the other hand, produce feedback where thought patterns change too quickly to become recognisable. Neither of these is 'being in stillness', as 'being played' cannot take hold.

[54] External movement and internal movement referred to in this section are not opposed in the sense of a mind body split, but represent different expressions of the one underlying grounding force (being).

meditative state is difficult to attain, and even if attained only generates the very small movements. Audience members would only perceive *that* performers are calm, which would not further their perception of how the mind *moves* ('nature in her manner of operation'). Therefore alternatively, biofeedback performance may concern itself with stillness in the mind and activity in the body, in other words the principle for mushin. In Butoh performances, mushin can manifest itself when performers remain detached while performing unintentional or internalised movement.[55] Biofeedback sensing would add little to such performances, as movement already is an external response to an internal intensity. External movement could of course be coupled with the performer practising attachment and detachment of the mind, which was realised to some extent in the biofeedback performance *Flesh Protocol.*[56] However, such practice is problematic, as existing viewing conventions have by now generated particular expectations: motion sensing has become a widely used technology,[57] and thus while mushin holds that mental state and movement do not need to correlate, audiences have come to expect movement and audiovisual feedback events to coincide.[58] If there is no visible connection between the two, it becomes unclear how the feedback relates to performers' activities.

This point was raised, for instance, by audience members at the *Fresh! Festival* (May 2005, 2), where different biofeedback instruments were brought together for the first time (see Appendix D for a matrix of all performances). Here a Butoh inspired movement structure was conceived that consisted of a simple progression: from lying on the floor while the audience entered the space, to gradually standing up, and then returning back to lying on the floor. This took place over fifteen minutes. During this time, biofeedback sensors were placed on the skin to intensify the sound or removed to create a diminishing

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[55] One might argue that this occurs whenever performers execute materials that have been fully absorbed into bodily memory. However, referring to Butoh practice is relevant as here it is the centre of practice: performers generate these materials through introspection, internalise them, and later improvise with them while remaining detached.

[56] See http://www.mindatplay.co.uk/fleshprotocol.html [accessed 12.07.09].

[57] Motion sensing is not only used in contemporary dance performances (such as *cell66b* at http://www.mindatplay.co.uk/testpatches.html), but also in wider popular culture. Game consoles like the Nintendo Wii, for instance, have brought motion sensing applications into many households.

[58] Mushin, nevertheless, holds great value for biofeedback practice, albeit for another reason: it challenges the conventional understanding of stillness as non-motion and initiates a search for a deeper understanding of the connection between extension (external qualities, movement) and internal state (depth).

effect.[59] However, the question and answer session afterwards revealed that some audience members were unsure whether the sensors were reacting to the movement or not. They were only able to relate biofeedback to sound with the help of further demonstrations. Biofeedback, therefore, seems to communicate more successfully when the audience is focused entirely on the changes that become perceptible. This can be done when performers do not distract the audience with external movement, but instead focus on mental processes. As biofeedback practitioner and composer David Rosenboom said:

> It is an essential characteristic [...] that the performer constantly rides a borderline between being, on the one hand, an initiator of action and, on the other, submerging him/herself in processes larger than him/herself. This requires that the performer become adept at manipulating his/her state of consciousness, application of wilful actions, and the energizing or programmed personal response modes.[60]

However, while the activities Rosenboom outlines are not different from 'ordinary' ones, a great difficulty lies in producing them in a performance context. This not only requires familiarity with techniques of attachment and detachment, but also much confidence to retain such 'normal' patterns. One might think that a meditator who also has performance expertise would make a good biofeedback performer. However, it is often the involuntary fluctuations between control and letting go that communicate the workings of a mind in the most intuitive way, and thus someone with incomplete control over their mental movements often generates more interesting feedback. If this person were to perform a rhythmic alternation between attachment and detachment, for example, the 'regular' feedback pattern would soon be broken up by uncontrollable impulses. Allowing this to happen is, however, an essential element of biofeedback performance, as only then does it communicate the mental movements as they 'normally' take place.[61] For example, Alvin Lucier's piece *Clocker* (🔊 3) feeds the stress levels of a performer into a device that

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[59] Standing up, lying down and taking sensors on and off intended to give the performer mental focus points, but also reveals that performance at this point was directed towards intentional change.

[60] David Rosenboom, 'On Being Invisible' (online) http://music.calarts.edu/~david/mediaworks/on_being_invis_ii.html [accessed 12/03/07], p.4.

[61] This state in explorative play, where the player becomes more aware of how events take on shape, has similarities to being in creative flow (see chapter 1).

speeds up or slows down a mechanical clock.[62] Changes in the clock's rhythm then communicate the mental movements taking place in the performer's mind. This simple sonification system is enhanced by the composition. *Clocker* uses delay loops and reverberations, which turn the simple clock into a percussive instrument that is capable of a wide range of expressions, from a chorus of crickets to a set of low drums. As percussion instruments are not usually employed to carry melodic or harmonic progression in Western music, they seem particularly suitable to challenge the habitual listening patterns of an audience, and to develop new listening patterns.[63] Thus Lucier's clock seems like a suitable choice, especially since it keeps biofeedback changes *directly perceptible*. This, however, is crucial.

Participant feedback from action research workshops (April 2005) confirmed that when the link between body and sound could be perceived directly, the work was more appreciated.[64] However, since only a performer can directly perceive this link, audience members needed to become performers, or at least to become so deeply engaged with a performing body that they would feel it as theirs. For this reason, practice began to explore participative sessions where audience members could perform themselves, as well as performances that engaged intensely with small audience groups. These formats ultimately emerged as the most suitable to radicalize practice.[65] Qualitative feedback, which was gathered in question and answer sessions as well as direct observations of play sessions, provided a continuous insight into the perception of the body/sound link. The feedback deepened the ongoing reflection on practice and thus radicalized the analysis of the biofeedback performance field. However, while analysis made it possible to expound

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[62] This performance, with the full title *Clocker: for Amplified Clock, Performer with Galvanic Skin Response Sensor and Digital Delay System*, took place in 1973. The soundtrack is available on Alvin Lucier, Lovely Music, UPC Code: 745295101925, 1995, CD

[63] Lerdahl and Jackendoff (*A Generative Theory of Tonal Music* (Cambridge, Massachusetts: MIT Press, 1983)) maintain that the absence of a tonal centre and harmonic progression in a piece necessarily shifts the listener's attention towards the rhythmic events, and thus a listener will derive tension and relaxation in the piece not from pitch factors but from "rhythmic, dynamic and timbral considerations" (p.297).

[64] Although the nature of this link can easily be *explained or demonstrated*, this again relies upon audience members' cognitive rather than *intuitive* understanding. Thus while demonstrations of practice were useful to promote biofeedback performance they could not transmit the essence of the work.

[65] Performances were used more frequently as with an increasingly experienced performer, different methods could be tested out without having to work through the threshold stage of the new over and over again.

principles for biofeedback practice, its deepest intensities could only be encountered in practice.

Radicalization of practice

The radicalization of practice that took place progressed biofeedback performance from being concerned with extension (movement, sound) towards depth (stillness). In the course of this, a range of contributing factors emerged that made the practice stronger (see enclosed DVD: section 'Performance Archive'). These factors were: staging, performed activity, depth of play, play process and duration, audience size, facilitation and sound composition. When these worked together, biofeedback performances were more often referred to as mesmerising and illuminating. To clarify how wider practice may benefit from this practice exploration, it is necessary look at these contributing factors in greater detail.

The first of these concerned the *staging* of the performance. As one might assume, restricting the performance space can intensify a biofeedback performance. The performance at the *East End Collaborations* (September 2005, 🔊 4), for example, achieved this by reducing the number of audience members to five, and choosing a dark and confined space with hardly any room for movement. The lighting was such that only the face and upper body of the performer was illuminated, which triggered reactions like 'haunting ... we won't be able to forget your face for a very long time'. Sitting together in an almost dark space focused the attention on the smaller movements of the performer, such as attaching or detaching the sensors, and the resulting changes in the sound. Being close to and exchanging gazes with unfamiliar audience members also triggered emotional responses in the performer, which again was picked up by biofeedback sensing and translated into sound. As these responses could not be suppressed, the performance began to reveal non-intentional material. Audience feedback suggests that while the encounter with the performer was almost uncomfortably close, the sounds and the darkness created the illusion of a larger space that made this bearable. These contradictory sense experiences kept audience members in a state of raised awareness that intensified their listening to the sounds.

In addition to staging, the *nature of the performed activity* also had an influence on the reception of the work. The *E-performance* conference (December 2005, 🔊 5) was a significant event in that regard, as here the work was the least well received. This performance employed a vocabulary of best rehearsal moments.[66] These were distinct performative gestures, each of which would generate a different sound pattern.[67] The vocabulary provided a range of performative elements for the performer to fall back on once an improvisation sequence had come to an end, or provided starting points from which to improvise. While its scope was finite, its pre-determined rules (the grammar) that outlined how individual gestures were to be strung together allowed for variety.[68] However, while innovative performance outcomes could be achieved in this way, structurally the work became very complex. Audience members found the work ambiguous and the rules obscure. Only some parts of the performance were referred to as intense or having compelling sounds. One audience member said, 'It seemed like the Theremin all over again.[69] Which is cool but how does it work and why bother? [...] It does the same thing pretty much'. Clearly, at this point the link between performing body and feedback sound had become obscured by the (redundant) grammatical system. However, the

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[66] The notion of a performance *vocabulary* links back to the generative-transformative grammars of language proclaimed by Noam Chomsky in 1956, a theory that explains the creative power latent in generative systems. The generative linguistic theory later derived from it attempts to "characterize what a human being knows when he knows how to speak a language, enabling him to understand and create an indefinitely large number of sentences, most of which he has never heard before. This knowledge is not on the whole available to conscious introspection and hence cannot have been acquired by direct instruction. Linguistic theory models this unconscious knowledge by a formal system of principles or rules called a *grammar*, which describes (or "generates") the possible sentences of the language" (Lerdahl and Jackendoff, p.5). This definition of the generative has often been applied to art and music, particularly in those practice areas where rule-based systems are used. Performance artist Silke Mansholt, for example, works with a vocabulary of poetic moments. These are self-contained and symbolical, similarly to the scenes in Tarkovsky's film *Mirror*. During *In Memoriam Nature*, a performance in progress show at the Chelsea Theatre, London, September 2006, Mansholt had a range of objects and props spread out on stage. Each object would be used in a symbolic action, and generate part of the performance. In music, Lerdahl and Jackendoff developed a 'generative theory of tonal music'. Using their system of rules it becomes possible to identify how listeners prefer to understand the surface and structure of a piece of tonal music. This helps to shed light on human musical cognition on the one hand but also to articulate artistic aspects of a piece of music without resorting to either mathematical description or (ineffable) intuition.

[67] A very small selection of these is included in the section 'Performance Archive' on the accompanying DVD.

[68] For example, one rule described how sensors were to be combined in order to create particular sound patterns, another rule concerned the order in which the biofeedback instruments needed to play to achieve a gradual sound layering.

[69] Electronic music instrument, first built by Leon Theremin in 1919. The notion of a Theremin is interesting, as this instrument is famous for its eerie sounds. It also has a tinge of mystery about it as usually it is played without touch. This suggests that sound and performance delivered some of the intended effects.

acknowledgement that practice failed to communicate the link between body and sound prompted greater scrutiny of its core elements. Thus the key function of stillness in biofeedback performance was discovered. From then on, the performed activity was simplified, in order to further an intuitive understanding of the biological system in operation.

A further important factor was revealed when the *depth of play* was explored. Baraitser and Bayly (*Now and Then: Psychotherapy and the Rehearsal Process*) observe that many contemporary performance stages are made to look like rehearsal spaces in order to evoke the raw, challenging and dangerous elements that reveal themselves during rehearsals. They say that audiences can often still sense that

> The performance bears witness to something prior, an event that happened somewhere else, 'in rehearsal', or in everyday life, and that has passed away into representation, into performance? All practitioners can recall the experience of the perfect rehearsal moment that got away, the one that could never be re-achieved either by technical mastery or by 'playing'. These are the moments rehearsal tries to record, replay, frame and represent in a Winnicottian process of 'pre-play', the process of discovering what is and is not under our control. However in the abrupt shift from rehearsal to performance it seems that these moments are punctured and their significance begins to drain from them.[70]

The notion that 'pre-play' takes place in rehearsals but not in performances is significant, as it reveals a weakness of representational performance practice. However, when – as it is the case with *Excitations* – biofeedback performance is entirely concerned with 'pre-play' (discovering 'what is and is not under our control'), then no 're-play' possible, and performers must each time lose themselves whole-heartedly in play to reveal the nature of their biological process.[71] Therefore, rather than thinking of practice as consisting of rehearsals and performances, it made sense to focus each time on playing as deeply as possible.

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[70] Lisa Baraitser, and Simon Bayly, 'Now and Then: Psychotherapy and the rehearsal process' in *Psychoanalysis and Performance*, ed. by Adrian Kear, and Patrick Campbell (London: Routledge, 2001), p.68.

[71] Early practice involved performing to a camera, which simulated an audience. Reviewing these recordings later on increased the performer's awareness of the audience's viewpoint. For example, it highlighted that only when the performer stopped worrying about the camera and became fully immersed in play, a deeper play intensity could become perceptible that engaged the observer more in the action.

To radicalize the performance further it also helped to look more closely at the *play process and duration* involved. This established that most *Excitations* performers needed to try to gain control over the biofeedback instrument before they could engage in explorative play with it.[72] The time required for this seemed to depend on the individual player. However, once control was attained, the focus of play could change.[73] This was not only because exploring control was physically demanding, but also because wilful action cannot be sustained indefinitely. Thus gradually, focused and formalised play *had* to give way to purposeless and explorative play, where the underlying biological processes could reveal themselves more clearly. This explorative play stage would then vary between several minutes to several hours. As Huizinga observed, play "begins, and then at a certain moment it is "over". It plays itself to an end."[74] This observation was confirmed by the workshop participants, who preferred explorative play to set its own duration rather than it being determined by a facilitator. Thus ideally, explorative play in a performance needs to self-form and self-conclude.

Another factor that influenced the intensity of the performance was the *size of the participating audience group.* In earlier practice stages (*East End Collaborations* September 2005) it seemed that the smaller the audience group, the more 'responsive' the performer could be, as more attention could be paid to each individual audience member. With larger audience groups this practice was no longer successful and had to be substituted. Therefore at the *E-performance* conference (December 2005), the performer, wearing the sensors, walked between audience members as a way of increasing intensity. This was only partially successful, as it re-introduced in the minds of audience members a false connection between movement and sound. Moreover, the continuous shift of the visual centre of the performance (the performer walking in the space) prevented stillness from taking hold. Therefore the task of interconnecting with individual audience members

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[72] See chapter 3.

[73] At first, there were periods of exploration followed by thoughtful pauses or attempted repetitions. Later on, performers listened to the sounds in stillness, or moved only when a need for movement arose. Sensors were used together to make the sound layering more or less dense, or used in 'playful touch': the galvanic skin response is a feedback mechanism that measures electronic conductivity of the skin. 'Fleshy' parts like fingertips react differently to 'bony' areas like the skin above a joint. Different sound patterns can therefore be created depending on where the sensors are placed on the body. A later performance at the East End Collaborations (reference) used this kind of touch to direct the audience attention further onto the performing body.

[74] Huizinga, Johann, *Homo Ludens* (London: Routledge & Kegan Paul, 1980), p.9.

was later (*Florida Electro-Acoustic Music Festival* April 2008) taken up by spatialised biofeedback instruments, while the performer returned to sustaining the stillness.

The final significant factor revealed by practice was the role of the *sound composition*. The *Time Flesh & Nerve* performance (June 2006, 6) was significant, as here the composition had become more structured. The performer – freed from carrying out compositional tasks – could engage more deeply in explorative play. This also directed the audience awareness to that end and intensified the performance. It was further enhanced by representing the different biological measurements as distinct sound textures. These had been given greater musical depth than before (and thus provided a more intrinsic listening focus), and were spatialised using surround sound. The improved sound composition took full effect at the *Florida Electro-Acoustic Music Festival* performance (April 2008, 7), where the performer simply faced the audience while listening to the unfolding sounds. Audience feedback later referred to the sounds they heard as the 'heart' sounds or the 'nerve' sounds, which suggest that the intended individuation was becoming more successful. One audience member commented that it was 'good to hear the whole body coming in', which indicates that a link between body and sound could be perceived without much effort.

However, reflecting more deeply on progress achieved revealed that not even at the *Florida Electro-Acoustic Music Festival* was the concept of stillness as perceptible as it could have been. For the *concluding performance* of this practice (see DVD: section 'Final Performance', 8)[75] it was therefore decided to add another device to the biofeedback sensors. Like a balance board, it sonified the smallest shifts of weight of the performer. Just standing still on the board in an 'ordinary' manner therefore produced variations in the sounds, which revealed that, even while seemingly 'doing nothing', subtle and uncontrollable processes of the body are always at work. This helped to question the notion that 'not moving the body' equates to stillness. However, the device could also be used in another way. When the biofeedback sensors sonified a change in the performer's emotional

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[75] 8 is a studio mix that was recorded prior to the live event. Here a 5.1 surround version was flattened into a stereo version (which explains why the circular spatialisation is heard as a stereo panning, and sound echoes occasionally travel in a more erratic fashion). However, here the fluctuating heart rate and the bass frequencies are well pronounced. One can also hear some very small sound events that stem from sensor crosstalk. On the other hand, in the live version (on the DVD) one can hear the 5.1 surround sound spatialisation, but the heartbeat is less interesting, and the lower frequencies sound 'flatter'.

states, the performer could choose to engage with this more deeply, possibly letting it develop into physical movement if there was an impulse for it. The resulting changes in posture gave these emotional states visible form, while the coinciding balance shifts created yet greater sound variations. Again these were fed back to the performer, and so forth. Used in this way, the balance board could help to make the workings of a feedback loop more perceptible to the audience. Moreover, since any physical movements usually developed gradually and only after a change of emotional states had been announced via the biofeedback sensors, the work emphasized that movements were merely responses to internal impulses, and not pre-planned actions.

7 - Biofeedback sound composition

This chapter extends principles of practice identified for biofeedback performance to biofeedback composition. As the effects of listening to biofeedback are central to this research, it was explored what emotional response heartbeat, stress levels or spatialised sound may instil in a listener, and how stillness may increase immersed listening. Supported by research in contemporary music theory, it argues that electroacoustic compositions such as 'Excitations' can disrupt habitual musical expectations of Western audiences while generating compelling listening experiences. To achieve the former, 'Excitations' employs an ambiguous tonal centre, no harmonic progression, an irregular meter, and complex repetitions that correlated different biofeedback instruments. To achieve the latter it uses a mapping system that makes the characteristics of biofeedback (indeterminacy, open-endedness, and internal correlation) intuitively perceptible.

Note: 🔊 This symbol, followed by a track number, refers to a listening example on the accompanying Audio CD, which is discussed in the text. The chapter is also supported by a more technical discussion of relevant sensing and compositional techniques (Appendix F).

Disrupting habitual listening expectations

The two effects of explorative play, the disruption of habitual perception and the possibility of intuitive perception, are not only achieved in physical play with the biofeedback sensors, but also by listening to the sonified biofeedback. The disruption of habitual perception, for instance, can be achieved when the composition denies some of the general listening expectations an audience holds. While it may initially appear counterproductive to make claims about general audience expectations (especially when the practice methodology of this research has hitherto revolved around the quality of individual experiences), recent studies in music theory claim that some listening expectations can be generalised for a contemporary Western audience. For example, Fred Lerdahl and Ray Jackendoff (*A Generative Theory of Tonal Music*)[1] argue that within Western tonal music,[2] there is considerable agreement about the most 'natural' ways a piece of music is heard. This

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[1] F. Lerdahl and R. Jackendoff, *A Generative Theory of Tonal Music* (Cambridge, Massachusetts: MIT Press, 1983)

[2] Lerdahl and Jackendoff define Western tonal music as whatever falls into a pitch system that uses "the major-minor scale system, the traditional classifications of consonance and dissonance, the triadic harmonic system with its roots and inversions, the circle-of-fifths system, and the principles of good voice leading" (p.117).

would indicate that at least parts of musical cognition are innate and take effect before the listener becomes aware of it. Employing a methodology commonly used in generative linguistic theory, Lerdahl and Jackendoff define these innate parts in a system of 'well-formedness rules' that lets Western listeners recognize musical groupings (such as motives or phrases), metric structures (strong and weak beats), time-span reductions (pitch in relation to meter and grouping) as well as prolongational reductions (tension and relaxation in harmony or melody).[3]

Although Lerdahl and Jackendoff mainly consider innate listening expectations in connection with tonal music, they maintain that these apply to atonal compositions as well, because they take effect before listeners can become aware of it. Thus in atonal compositions, non-hierarchical aspects such as timbre,[4] dynamics, microtonal changes, intonation or density of the piece "play a greater, *compensatory* role in musical organisation".[5] And when musical organisation becomes less predictable, music is perceived more locally with attention to "sequence[s] of gestures and associations".[6] This would indicate that it might be possible, particularly with non-hierarchical pieces, to draw listeners' attention away from following a 'narrative' and towards each moment as it unfolds, with greater attention to details. Even if this strategy may only succeed with some listeners, for the composition of a biofeedback piece it may still appear as a useful first direction.

However, in response to Lerdahl and Jackendoff's argumentation, it also needs to be pointed out that atonal compositions are not *only* listened to with innate listening expectations. Otherwise every composition that is not tonal could only ever be perceived as an opposition, negation or inversion of tonal music, and not as a musical entity in its own right. Yet some compositions by Karlheinz Stockhausen or John Cage are no longer

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[3] A more comprehensive account of musical cognition is provided by Daniel Levitin (*This is Your Brain on Music* (London: Atlantic Books, 2007).

[4] Timbre: tonal quality or sound colour that makes a musical instrument unique and distinguishable. The timbre of a sound can be described by attributes such as harmonics, vibrato and the attack-decay envelope.

[5] Lerdahl and Jackendoff, p. 297 f, emphasis by the author. Density can be understood as musical events per unit of time.

[6] Lerdahl and Jackendoff, p. 297 f.

concerned with rules and structures of tonal music,[7] and some contemporary listeners no longer *like* to listen to traditional structures of Western tonal music. This highlights the important difference between first time and repeat listening, and indeed, Lerdahl and Jackendoff talk about preference rules, which describe how experienced listeners prefer to hear a musical passage.[8] This would suggest that the influence of innate listening expectations is moderate, and at its most influential in first time listening situations. Cognitive and cultural aspects of sound and music listening, on the other hand, have more impact on repeat listening. These might be even responsible for the development of listening behaviours.

According to Francois Delalande, there are certain *behaviours* that occur when listening to music: taxonomic listening (the morphology of structures is distinguished), empathic listening (which focuses on immediate reaction to what is heard), figurativization (a search for a narrative discourse in the work), search for a law of organisation (search for structures and models), immersed listening (where the listener feels part of the context while listening) and non-listening (where the listener lost interest or concentration).[9] These behaviours are practiced and reinforced by the listener, and therefore cannot be controlled by a composer. Still, one might think that a composer should be able to help nurture some of these listening behaviours. For instance, by using musical structures that mutate over time, listeners might be encouraged to listen out for the laws for this transformation. The use of sound spatialisation techniques might encourage immersed listening.[10] A live

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[7] Compositions like *4'33"* by John Cage (*4'33" for Any Instrument or Combination of Instruments* (New York: August 1952, second version c. 1960) may well have lost their element of surprise when listened to again. But *4'33"* not only *surprises* its listeners, it also has a cognitive aspect that challenges listening expectations in other ways.

[8] Transformational rules finally describe listeners' relationship to minor musical distortions. These really are less important in music, but more so in the generative linguistic theory from which they are derived (Lerdahl and Jackendoff, p.8ff).

[9] in Leigh Landy, *Understanding the Art of Sound Organization* (Cambridge, Massachusetts: MIT Press, 2007, p.94). In 'Music Analysis and Reception Behaviours: Sommeil by Pierre Henry' (*Journal of New Music Research*, Vol. 27, No.1 - 2, pp.13 - 66), Delalande concentrates mainly on three listening behaviours: taxonomic listening, empathic listening, and figurativization.

[10] Delalande's immersed listening behaviour is not only described as 'feeling part of the context' but also as 'partaking in the flow of a sequence' (Landy, p.94). This second, more active, description suggests that listeners may experience emotional and/or physiological reactions to the sound, for instance they may feel their bodies responding to musical events in some way, and may follow this impulse voluntarily. Spatialised sound might increase an immersed listening behaviour, as then listeners can experience these musical events more as a space surrounding them, which can encourage deeper physical reactions. In other words, they may feel more like being a conductor than being an audience member.

performance, certain timbres, or chords might evoke an empathetic reaction. A sonification system or the use of rhythmic structures might inspire the search for the laws of organisation of the piece. Thus while no prediction about the reception of a piece is possible, such nurturing, or, as David Huron calls it, 'manipulating' of listening behaviours, can have a considerable impact on musical perception.

Similar to Delalande, Huron also thinks beyond the notions of innate listening expectations. In *Sweet Anticipation, Music and the Psychology of Expectation*, he applies concepts held in evolutionary psychology and cognitive science to demonstrate how composers like Richard Wagner, Arnold Schoenberg or Igor Stravinsky have manipulated listener's expectations and behaviours in the past. Huron thus points out that compositions of the Classical period resolve the tensions created by dissonant chords regularly, which creates a sense of relief in the listener. In Wagner's compositions, on the other hand, this expected resolution is delayed and misdirected so persistently that any sense of certainty about the progression of a piece is denied. In the aria *Einsam Wachend in der Nacht* (🔊 9), for example,[11] cadences do not ever resolve themselves as expected or find their traditional closure. The tension is thus continuously carried forwards, in this case through an entire musical piece, with only minimal resolution. To strengthen this impression even more, Wagner also inverted the traditional positioning of notes within individual chords: traditionally, the tonic is used in its root position to create a sense of stability and resolution. Yet in Wagner's work the tonic is rarely found in that position. This further emphasizes the instability and permanent anticipation of change, which is introduced by Wagner's unresolved cadences. Thus according to Huron, Wagner's work was "the first sustained effort to systematically thwart expectations – to consistently not give listeners what they expect".[12]

Schoenberg, on the other hand, achieved this effect by inverting tonal and harmonic clichés. He began, for instance, to break musical lines or melodies into fragments and pass these between several instruments, thus colouring each musical fragment by the timbre of the instrument that currently played it. This technique, known as 'Klangfarbenmelodie',

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[11] Richard Wagner: Tristan und Isolde, Act 2 Scene 2: Aria *Einsam Wachend in der Nacht.*

[12] David Huron, *Sweet Anticipation: Music and the Psychology of Expectation* (Cambridge, Massachusetts: MIT Press, 2007), p.333.

already inverted some listening expectations.[13] Then with his twelve-tone method, Schoenberg began to organise pitches in such a way that a tonal centre could no longer be located by listening. As musical themes or melodies could not establish themselves through repetition,[14] and it therefore remained impossible to predict what the key of the piece was, or how it would progress (🔊 10),[15] the twelve-tone method often caused a sense of discomfort in listeners with traditional listening expectations. Then in *Five Orchestral Pieces: III. Farben* (🔊 11), Schoenberg freed chords from their structural function. For the first time, chords were only used for the atmosphere they created, and not for their function within harmonic progression. Stravinsky finally denied listeners the consistent meter. *The Rite of Spring,* for example, is permeated with unexpected accentuations (🔊 12).[16] Huron proves that these accents are "forty times more difficult to predict than a purely random sequence of accented moments".[17] Thus first-time listeners have no idea when the next accent will come, which takes their attention away from expected progression and focuses them on the present.

According to Huron, the compositional techniques used by Wagner, Schoenberg and Stravinsky trigger psychological mechanisms in the listener, which can be described in an

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[13] In Schoenberg's *Harmonielehre*, written in 1911, the idea of a Klangfarbenmelodie is merely introduced. The relevant passage can be translated as: 'it must be possible to put together progressions of tone-colour whose relations with one another work with a kind of logic that is entirely equivalent to the logic which satisfies us in the melody of pitches' (Vienna: Universal Edition, 3rd ed., 1922, p.506 f). A good example of a Klangfarbenmelodie being realized is Anton Webern's *Orchestration of the Fugue No. 2 (Ricercata) from the 'Musical Offering' of J. S. Bach* (1935), a work by one of Schoenberg's pupils. Especially at the beginning, the changes in tone-colour within the melody are very pronounced. Schoenberg believed that working with Klangfarbenmelodien can heighten the pleasure of listening to music as it can make musical structures come more alive (p.507).

[14] The twelve-tone method is a musical system developed by Arnold Schoenberg in the beginning of the twentieth century. Here "the concept of melody and harmony is replaced by what is called a tone row. A tone row contains all twelve tones of the chromatic scale, arranged in a particular order that is unique to the composition. The tone row should not contain any sequence of notes that might suggest a tonal center, such as three notes in a row that outline a major triad. The entire composition is then based on the tone row" (http://www.outsideshore.com/school/music/almanac/html/Music_Theory/Harmony/Non-Tonal_Music.htm [accessed 21.07.09]).

[15] The twelve-tone method can be easily perceived in Schoenberg's *Sechs Kleine Klavierstucke* (Opus 19), in particular in the piece *Rasch, Aber Leicht.*

[16] These accentuations are particularly clear in Part I *Adoration of the Earth: II. The Augurs of Spring.*

[17] Huron, p. 346.

emotional response system.[18] The first emotional response already occurs when a listener merely imagines the outcome. A second one takes place when the expected events are imminent and the body reacts with a tension response. After the musical event, there is an immediate reaction, which is the third response. This is entirely physiological and not mediated by conscious thought. Together with this response, a fourth prediction response occurs that assesses the accuracy of the expectation. Later, once the whole situation has been sufficiently considered, a fifth and final appraisal response occurs.[19] Since for evolutionary reasons human beings do not like surprises, compositions where at least some listening expectations are subverted cause an unfavourable emotional response: "transgressing expectations causes an organism to sit up and take notice. The experiences are memorable, even if they aren't initially all that pleasant".[20] Thus according to Huron, atonal, non-progressing or a-rhythmic compositions are memorable because they cause the five emotional responses to be dissimilar, which results in complex or contradictory emotions. Research into innate listening expectations, listening behaviours and the emotional response system therefore suggests that there are quite a number of compositional techniques that, when combined, may significantly influence the way a composition is received.

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[18] Huron argues that denying, suspending or fulfilling musical expectations evokes a variety of basic emotions: tension, awe, laughter, surprise or fright. This claim is supported by statistical evidence (p.7 ff).

[19] In this research, the performer often felt these responses, but – more importantly – they were picked up by the biofeedback sensors. For example, the tension response at the start of a performance usually sent the Galvanic skin response reading off the scale, and thus could only be used once this initial reaction had passed. Then, imagining a pleasant outcome while playing (Huron's first response) often relaxed the skin response and heart rate, while imagining an unsuccessful performance affected it in the opposite way. Also sometimes, after a larger biofeedback change had been sonified, a reaction to the sound occurred that was also picked up (Huron's third response). This all highlights one implication of composing with biofeedback, which is the necessity to bind the emotional response system into the compositional structure.

[20] Huron, p. 353. Such unfavourable responses are also remembered by John Cage: "At the New School once I was substituting for Henry Cowell, teaching a class in Oriental music. I had told him I didn't know anything on the subject. He said, "That's all right. Just go where the records are. Take one out. Play it and then discuss it with the class." Well, I took out the first record. It was an LP of a Buddhist service. It began with a short microtonal chant with sliding tones, then soon settled into a single loud reiterated percussive beat. This noise continued relentlessly for about fifteen minutes with no perceptible variation. A lady got up and screamed, and then yelled "Take it off. I can't bear it any longer." I took it off. A man in the class then said angrily, "Why'd you take it off? I was just getting interested"" (John Cage, *Silence, Lectures and Writings* (London: Marion Boyars, 1999), p.93).

Core characteristics of sonified biofeedback

Thus a suitable strategy for the composition of a memorable biofeedback composition might consist of unsettling *some* audience expectations whilst rewarding others.[21] In this way the experience will be disconcerting enough to disrupt habitual listening patterns but pleasant enough to sustain an interest in listening.[22] But what is the listening interest of sonified biofeedback? In *Haunted Weather*, Toop recollects Felix Hess' attempts to record the spatial qualities of Australian frog chants. Hess never quite managed to capture it on tape. In addition to the spatial aspects, something more profound was amiss. Hess wrote:

> A recording has a definite beginning and end whereas a real chorus [of frogs] continues indefinitely, with a diurnal and even an annual rhythm. And there is a lack of something utterly fundamental. The essence of the moment of listening, *this* moment in time, is absent in my recordings: the "past" and the "future" have been arranged already along the tape.[23]

The same problems identified here crop up when trying to record biofeedback sounds. For one, a sound recording only ever picks up what is measurable. The playback is necessarily disappointing as only the extent of sound events can be captured, but not the intensity of the experience. This always seems to slip away. It is neither situated in the sound event listened to, nor can the listener control it. It seems to become activated merely in the moment of listening to the event. Once listeners lose their focus on this moment, the core characteristic of it being 'alive' also slips away. Therefore, the recording not only fixes something continuously changing into form, but also terminates the sense of infinity that was received while listening to the original sound event. This impression is even stronger when the playback happens disassociated from the sensations that make the original

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[21] This strategy was later adopted for the sound composition of *Excitations* and explored in iterative stages. Verbal feedback and direct observation of audience members hereby helped to intensify the composition and to direct the listening awareness onto the subtle variations characteristic of biofeedback. Especially by denying expectations of melodic and harmonic progression, listeners' attention could be directed onto a more intense perception of timbre, dynamics, density and pitch deviation.

[22] Indeed a balance has to be struck: On the one hand history reveals that listening expectations violated on a grand scale can become unbearable for an audience. Stravinsky's *Rite of Spring* at its premiere in 1913, for example, unsettled listeners' expectations to such an extent that the performance eventually degenerated into a riot. Fulfilled musical expectations, on the other hand, provide increased listening pleasure, but can also lead to reproductive compositional practice and excessively bland music (*'elevator music'*).

[23] Felix Hess in David Toop, *Haunted Weather: Resonant Spaces, Silence and Memory* (London: Serpent's Tail, 2004), p. 191.

encounter so intense. The *live performance* of the sonified biofeedback is therefore crucial, not only because here sensation and performing body coincide, but also because they affect each other directly and intensely, and thus a sense of an indefinite continuum can become perceptible.

However, to make this a truly compelling experience, the sonification process needs to exceed literal sonification. The research workshops showed early on that, if the sonified biofeedback could be interpreted too easily, this could lead participants to provoke physiological changes in order to make the piece sound compelling (for instance by spinning around to induce dizziness, holding the breath, etc). Moreover, when a rising pitch indicated rising stress levels, this subliminally directed some of the participants to interpret that change and, rather than listening to the biofeedback in itself, they began to spin a narrative. While in general, listeners' interpretations of a biofeedback piece are out of a composer's control, practice revealed that there are compositional tools that encourage the weaving of narratives and others (for example simply 'announcing' a change in stress levels) that do this less. Thus, particularly in the case of sonifying stress levels, it proved beneficial not to relate biofeedback changes and sounds too directly, but to surprise participants by using compositional strategies that exceeded literal sonification. Therefore later on in the development of *Excitations*, changes in stress levels were sonified differently: they merely altered the sound of some bell-like electroacoustic percussion 'instruments'.[24] These were tuned to a single extended chord (see figure 12, 🔊 13),[25]

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[24] *Excitations* is an electroacoustic sound composition that uses digital signal processing to produce and manipulate every sound element within the piece. Although strictly speaking it is not correct to call the individual timbres or textures that were used 'instruments', this was done because most listeners who took part in the research called them so. From their perspective, it was less important whether the sounds they heard stemmed from real instruments or were computer generated; they called them 'instruments' because they had been given some equipment that allowed them to produce a range of different sounds.

[25] Extended chords in themselves, i.e. when not used to convey strong emotions or to serve a musical 'narrative', can sound calming and relaxing to contemporary listeners. In the last 150 years or so, Western listeners have become more and more accepting of dissonances in music, which suggests that increased exposure to dissonances makes them increasingly tolerable. Thus while Baroque composers rarely used chords that extended the triad by the seventh, composers of the Classical era used them more frequently. Many composers of the Romantic era such as Wagner, Mendelssohn, Schubert, Schumann or Beethoven then used further extended harmonies. Yet they still remained within a major and minor scale system. This convention was only inverted by Impressionists such as Debussy or Ravel. In *Prelude à l' Après-midi d'un Faune,* for example, Debussy employed dissonances, unusual scales and extended chords to sketch the atmosphere of a particular moment in time. Using extended chords for their ability to create 'colour', is a technique still often found in contemporary music today. In Jazz, in particular, most chords are at least extended by the seventh. These chords often do not relate harmonically to each other but are chosen because of their sound colour: the dissonances within extended chords add character to the sound that harmonic major or minor chords lack.

which could be interpreted as either an inverted A minor chord with 7^{th} 9^{th} and 11^{th}, or as a G major chord with aggregate notes, or a C major chord with aggregate notes, or even a B minor chord that misses the fifth:

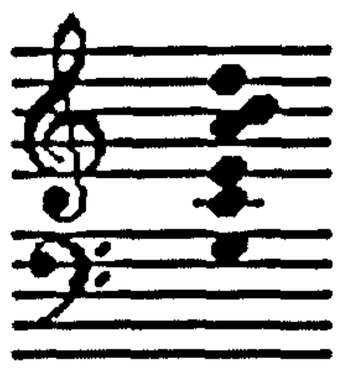

Figure 12: The chord used in *Excitations*.
Illustration by the author.

Since there is only one chord in the piece, it is difficult to even speak of tonality. In a traditional composition, a chord like this could have a range of possible harmonic functions, for example as a tonic it could assert a clear dominance over all other chords used, and thus for the listener function as the core that provides rest and resolution. But if a composition never progresses beyond one chord, it is impossible to establish any of this. Moreover, there is a sense of non-progression, because this chord can never be determined with certainty. This is disruptive, especially since this chord is common to tonal music, which may lead listeners to expect habitual musical progression.

Using only one chord throughout the piece introduces an open-ended stillness, which can be sustained indefinitely, as without harmonic progression, neither identification of this chord nor resolution of its internal tensions are possible.[26] In this regard, the chord behaves like an explorative play space: as long as it is not subjected to purpose, it escapes the hierarchy of identity. But the stillness evoked by the single tonal centre is not experienced as stagnation, as progression is never even suggested. Neither does it feel empty: the tensions caused by the chord's internal dissonances pull it in many different directions at the same time. Additionally, changes in the performer's stress levels lead to chord inversions that make it expand and contract. While a close-knit note grouping evokes a stronger sense of stability, other inversions that disperse the notes intensify particular dissonances and make it sound less stable (🔊 14).[27] Thus while the chord generally evokes

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[26] Compositions that use harmonic progression usually follow the rules of classical composition. One of these rules is that extended chords (especially in their 2^{nd} inversion when the fifth is in the base) create tension that must be resolved. Here, however, there is no harmonic progression, and thus no expectation of resolution.

[27] For example, the seventh on the bass creates the interval of a second to the fundamental. This causes strong friction and sounds less stable than other inversions.

feelings of calmness and stability, its subtle internal tensions and ambiguities keep listeners alert.[28] It seems to hover like a cloud of particles: apparently stable, but less and less so the closer one listens. Some sounds in Rosy Parlane's *Iris* behave in a similar way.[29] The work, composed in three parts, remains fairly unchanging in terms of harmonics and tempo. This focuses listeners' attention onto the densely layered clouds of sounds, which, like a swarm of insects, seem externally still but internally full of frantic movement (🔊 15).

However, *Excitations* also inverts expectations of a consistent *meter*. Counting in heart beats rather than metronome beats not only emphasized the natural variations found in the biofeedback data but also revealed the complex iteration of the heart beat: *roughly similar* muscle contractions occur at *roughly similar* time intervals and continue in this manner until a larger change occurs.[30] Although listeners used to exact rhythmical repetition may experience this slightly irregular 'biological meter' as unsettling, it communicates the fluctuations of live biological structures in an intuitive way, and allows listeners to attain the sense of it being a fragile continuum rather than a fixed reproduction.[31]

Another important characteristic of biofeedback is that it is a *compound* rather than an addition of individual processes. When one is used to measuring breathing, heartbeat and stress level cycles in isolation, it is easy to forget that all these processes really are correlated. Indeed, the nature of this correlation is vital, as it is generated by the unpredictable interplay between extension (measurable differences) and intensity. This is complex, and can only ever be made perceptible to listeners when sonifications of breathing, heartbeat or stress levels are allowed to affect each other. How this translates

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[28] Moreover, the instruments that play the chord in *Excitations* are not perfectly tuned, as the frequencies used to generate their partials deviate slightly in pitch. These small frictions also add listening interest.

[29] Rosy Parlane. Iris (UK: Touch Records, 2004). TO:58.

[30] In *Excitations* the heartbeats are counted in the following way: a *past* object detects peaks in the incoming heart data. A timer object then translates these peaks into beats per minutes, before a clocker object counts beats into sets. The size of a set is controlled by the stress levels of the performer: the lower the stress levels the larger the set. Only on a complete set, are other instruments brought in or out and the spatialisation changes. This has the effect that the piece unfolds more slowly the more relaxed the performer is. While the exact timing and duration of the piece varies, overall it is constructed in such a way that it slowly relaxes the performer and listener, which means that the meter will gradually extend (🔊 7).

[31] Once used to hearing this 'biological meter', the total symmetry created by the common practice of sampling heart sounds may well stand out as superficial.

into the composition therefore needs careful consideration. For example, it may make sense to the composer to use the rising stress levels of the performer to increase the pitch of the heart sounds, but to listeners this may appear arbitrary. A better way to communicate the correlation between stress levels and heart rate is therefore by convolving the two biofeedback sounds (multiplying them in the frequency domain).[32] Convolved sounds still carry recognizable characteristics from each sound parent, but have their own character. In some cases, this makes them more interesting to listen to than two sounds being played simultaneously. Particularly in electroacoustic compositions like *Excitations* it is easy to amalgamate two sounds in this way. Convolution therefore emerged as an important cross-synthesis technique that allowed the composer to exceed literal sonification and to produce compelling sounds (🔊 16). But while convolution helped to make the interdependency of different biofeedback processes perceptible, it still failed to reveal more about the nature of this correlation.

Biofeedback consists of a range of complex cyclical activities, which range from very small activities in the nervous system, to heartbeat, pulse, breathing, blood supply to our limbs and daily metabolic rhythms. A graph of a biological micro-cycle such as capillary blood supply can look reasonably similar to the graph of a macro-cycle such as the heartbeat. This may infer a complex repetition at different scales, a process known in fractal geometry as *self-similarity*. Composer Eduardo Reck Miranda defines this as

> Fine patterns that repeat at different levels and sizes. Essentially, a fractal roughly resembles a Russian doll in the sense that fractals contain nested similar patterns

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[32] Convolution is a signal processing technique often used for the simulation of concert hall acoustics (by multiplying a sound with the impulse response of a concert hall in the frequency domain) or to filter out noise from signals (Gareth Loy, *Musimathics: Volume 2* (Cambridge, Massachusetts: MIT Press, 2007). But convolution can also be used as a compositional tool, when it works like a cross-synthesis that combines the properties of two distinct sound signals into one. Yet this is not a simple multiplication of two signals. When a signal *a* is multiplied with signal *b*, "each sample of *a* is multiplied by the corresponding sample in *b* [...] in contrast, with convolution *each* sample of *a* is multiplied by *every* sample of *b*, creating an array of samples of length *b* for every sample of *a*" (Curtis Roads, *Microsound* (Cambridge, Massachusetts: MIT Press, 2004), p.212 f.). A convolution of signals is thus a multiplication in the frequency domain. In Max/MSP, this can be done using a *fftin~* object that transforms the two source signals into spectra using a Fast Fourier Transform. The two spectra are then multiplied before an *fftout~* object performs an inverse Fast Fourier Transform that converts the spectrum of the product back into the time domain. As with convolution "any frequency that is strong in *both* [parental] signals will be very strong in the convolved signal, and conversely any frequency that is weak in either input signal will be weak in the output signal" (Barry Truax, *Convolution* (online) http://www.sfu.ca/~truax/conv.html [accessed 16.06.08]), convolving the high frequency little bells in *Excitations* with the high frequency flanged bells produces interesting results while – predictably – convolving them with the low frequency heart sounds does not.

> comparable to the way in which a large doll contains a smaller version of itself, which in turn contains an even smaller version, and so on.[33]

However, whether self-similarity really exists depends on how closely one examines it. Curtis Roads, for example, highlights that with the arrival of electroacoustic composition techniques, composers can now set about shaping sound events the size of a sample less than 1 millisecond.[34] He points out that self-similarity often disappears when a different time frame is used as reference. 'Zooming in' on an apparently simultaneous onset of two notes, for instance, shows that they were not at all simultaneous. This demonstrates the important difference between what is perceived and what really happens. Thus Roads maintains that models of self-similarity will always be perceived as imperfect, and illustrates this with a quote by composer Horacio Vaggione:

> The world is not self-similar.... Coincidences of scale are infrequent, and when one thinks that one has found one, it is generally a kind of reduction, a wilful construction. The ferns imitated by fractal geometry do not constitute real models of ferns. In a real fern there are infinitely more accidents, irregularities and formal caprices – in a word – singularities – than the ossification furnished by the fractal model.[35]

Nevertheless, playing with the idea of self-similarity has inspired many compositions in the past: Johann Sebastian Bach, for example, employed self-similar sound structures in chorale BWV 668 (🔊 17). Here the motif in the soprano voice is overlaid with its repetition at double speed in the lower voices and its inversion in the alto.[36] However, Bach does not take self-similarity to its limit here, he merely constrains it to some structures that can easily be perceived by a listener. Used in such a way, self-similarity can add coherence to the piece, while it challenges composers to achieve musically interesting results with a limited range of source material. Ryochi Ikeda's *C7:: Continuum* (🔊 18), for example,

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[33] Eduardo Reck Miranda, *Composing Music with Computers* (Oxford: Focal Press, 2001), p.90.

[34] This means that in addition to habitual time scales (years, days, hours, minutes, seconds) there are now scales of milliseconds and μ-seconds for composers to consider. However, Roads warns: "we must recognize that each time scale abides by its own rules. A perfect hierarchy is a weak model for composition" (Roads, p.332). Instead, he proposes a multi-scale approach to composition.

[35] Vaggione in Roads, p.332.

[36] BWV 668 is quoted in Miranda, p.95.

uses a minimal range of sound materials (a recorded beat) that is shifted in pitch.[37] This produces accelerated or decelerated beats in different pitches. The gradual introduction or withdrawal of different pitches then creates density and tension, while the compulsive repetition of the beats suggests that one is being retained inside an infinite system. A comparable effect was intended for *Excitations*, with the difference that *Excitations* would simply sonify an existing biological system. Thus rather than imposing self-similarity on the generated signals, the composition aimed to propose the idea of self-similarity to the listener. When the stress levels of the performer changed, for instance, a set of bells played an extended chord. One large bell was chosen at random, and its flange rate and duration also randomised.[38] Simultaneously, a group of 'little bells' picked up some notes from the chord several octaves higher.[39] These bells rang one at a time in random order, which produced a 'randomized arpeggio' of short melodic sequences reminiscent of some serial music (🔊 19). Finally, some notes of the chord were also carried by a singing bowl-like instrument, where each 'bowl' was assigned a note of the chord. While one 'bowl' sound diminished, a following one would slowly become audible. This added subtle accentuations to the chord, and extended its decay time. Little bells, bells and singing bowls thus repeated aspects of the chord, but at different pitch levels and time scales. Using three instruments instead of just one helped to deepen the impression of scaled repetition as well as intensifying the chord's internal tensions, fracturing in this way the impression of continuity and stability. This impression was furthered by randomising the order of the little bells, and inverting the chord played by the big bells. Moreover, the singing bowls deviate slightly from their assigned pitch. This deviation was achieved by duplicating the signal and introducing small, randomised time delays – a technique known

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[37] http://www.mindatplay.co.uk/continuum.html [accessed 12.07.09]. Repeated listening to *C7:: Continuum* suggests that the initial material was the recording of a heartbeat.

[38] In *Excitations*, randomness was employed in the form of various seedable random number generators: When the stress levels of the performer changed, one of three large bells was played at random. Its duration varied between 5000 and 15000 milliseconds. This was decided by *RanIJ*, a Max/MSP object that selects random integers from a given range. The bell's flange rate varied between two and three hertz, which was determined by *Ranf*, an object that selects a random float number between zero and one. These external objects, written by Gary Lee Nelson in the early 1990s (downloadable from http://timara.con.oberlin.edu/~gnelson/ maxdownloads/downloadmax.htm [accessed 13.06.08]), added small variations to note and pitch levels.

[39] All biofeedback instruments were tuned to each other.

as flanging.[40] These pitch deviations undermine stability and identical repetition on the tonal level, while providing interesting changes in the accentuation of the chord.

Deepening the relationship between body and sound

So far it has been established that *Excitations* has an ambiguous tonal centre, no harmonic progression, and an irregular meter. Complex repetitions interrelate the chord inversions, as well as notes and pitches of different biofeedback instruments. All of these compositional methods not only invert a range of listening expectations but also reveal the indeterminacy, open-endedness, and internal correlation engrained in the biofeedback. This is crucial, as *Excitations* is not a stand-alone electroacoustic composition, but a real-time sound composition that intensifies the biofeedback performance it ties in with. Because of this, the main compositional purpose was to sonify the biological structures in such a way that the relationship between performing body and sound could be *deepened*, as this would encourage listeners' intuitive understanding. Therefore it was not only important to use suitable compositional methods but also a sonification system that 'mapped' the biofeedback data appropriately. This meant the system had to be able to measure sufficient amounts of data that would reveal its characteristic structures, while still producing a compelling composition. This notion of 'data mapping' is also known in other areas of generative music practice, where composers use, for example, iterative algorithms to create sets of values (orbits)[41] and then map these onto musical parameters. However, it seems

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[40] Flanging is an audio effect that can be created when two identical signals are mixed together, but with one signal being time-delayed by a small amount (usually less than 20 milliseconds). According to Julius Orion Smith III, the term 'flanging' originates from a technique that emerged in the 1960s, whereby two tape machines play two identical tapes in unison. When the flange of one of the supply reels is touched, it plays a little slower and a delay develops between the two tape machines. When the flange is released, and the flange of the other supply reel touched, it causes the delay to disappear and then to emerge again in its opposite form. This produces an interesting 'whooshing' effect that passes through the sound. Within digital signal processing, flanging is acoustically modelled as a feedforward comb filter that modulates the frequencies of a set of uniformly spaced notches and/or peaks in the frequency response. These notches and/or peaks are related to each other in a linear harmonic series. Varying the time delay causes these to sweep up and down the frequency spectrum. If some of the output signal is fed back to the input, this produces a resonance effect that further enhances the intensity of the peaks and troughs. (Smith, J. O. *Flanging*, in 'Physical Audio Signal Processing', online book, https://ccrma.stanford.edu/~jos/pasp/Flanging.html [accessed 27.07.2010]).

[41] According to Miranda (p.83 f), an orbit, also called a set, is the outcome of an iterative process, a mathematical procedure that is repeatedly applied, whereby the output value generated by the first application of the process provides the new input value for the next application, and so on. The values that result from each application are called points of the orbit. Depending on the kind of mathematical procedure applied, iterative processes produce, over time, one of three classes of orbits: orbits that tend to become stable around a fixed value, orbits that tend to oscillate between specific elements, or orbits that fall into chaos.

that finding an effective mapping strategy is not easy, regardless of the generative strategy practiced. Thus Miranda writes:

> Devising mappings that are too simplistic may strip a potentially rich orbit of its details, producing music that is dull and uninteresting. Conversely, a method that is too complex may mask the behaviour of the orbit and jeopardise the composer's original intention to use the iterative process in the first place. Clearly, a balance must be struck.[42]

To judge this balance right for *Excitations*, it was necessary to repeatedly perform and enquire how listeners perceived the relationship between performing body and sound.[43] Although this slowed down the working process, one clear advantage of it was that it maintained the connection with first time listeners. Indeed it would have been detrimental had listeners' intuitive perceptions become obstructed by compositional decisions. Still, such differences between composers' perceptions and listeners' perceptions are not unheard of in contemporary practice. For example, Boulez's *Le Marteau sans Maitre* counts, amongst experts, as an acclaimed example of serialist music, yet David Birchfield, a composer working with genetic algorithms, questions whether audience members understand the work in the same way:

> A listener's ability to cognize the musical surface must be taken into consideration in the composition of music to avoid "a huge gap between compositional system and cognized result." Compositional systems that ignore this paradigm will fail to communicate with listeners.[44]

To obtain a better idea of how *Excitations* may actually foster intuitive understanding, a number of sessions were held, where interested audience members could perform with the biofeedback sounds themselves. Valuable insights emerged from observing these sessions, for example the realisation that the mapping system needs to be immediate if listeners are to read changes in the sound as changes in the performing body. To prevent any such time

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[42] Miranda, p.89. Miranda here specifically talks about the difficulty of mapping chaotic orbits.

[43] Biofeedback data is indeterminate, and thus biofeedback compositions will not repeat themselves in exactly the same way again. This means that the aesthetic qualities of the piece cannot be honed by repeatedly performing the *same* piece.

[44] Lerdahl quoted by David Birchfield ('Generative Model for the Creation of Musical Emotion, Meaning and Form' in *Proceedings of the 2003 ACM SIGMM Workshop on Experiential Telepresence ETP '03* (Berkeley, California: Nov 2003) pdf downloadable from http://portal.acm.org/citation.cfm?id=982484.982504 [accessed 24.05.09]) p.100.

delays it became therefore necessary to limit the technical complexity of the composition.[45] Yet this restriction also made conceptual sense: biofeedback already is a complex system in itself. The composition therefore does not need to further the complexity, but merely work with the complexity at hand.[46] Consequently the sonification strategy should concern itself with merely translating the retrieved data into sound.[47] *Weathersongs* by Richard Garrett,

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[45] Depending on computer processor speed, a 'next to real-time' data transfer will restrain the number of signal processing operations that can be performed simultaneously. For example, even just convolving a small number of live signals on personal computers consumes a high amount of processing power.

[46] It is also worthwhile pointing out that structural perfection is not achievable when working with live data streams. In addition to the natural oscillations, there are often interferences that occur as the data is transmitted. These are difficult to predict as they can result from mismatched hardware components or interfering wireless equipment nearby. In a 'traveling' live performance where equipment owned by the artist is interfaced with hardware supplied by the venue, such interferences can easily occur. When, on the other hand, incoming data was 'cleaned' and filtered too much, some of the biofeedback oscillations were also erased. Thus it proved sensible to only aim for the best possible result. The aesthetic that emerged from this could be described as imperfect, impermanent, and incomplete, which interestingly is also a definition of the Japanese wabi-sabi (Leonard Koren, *Wabi-sabi for Artists, Designers, Poets and Philosophers* (California: Stone Bridge Press, 1994), p.7). Wabi-sabi (侘寂) embraces asymmetry, asperity, simplicity, modesty, intimacy, and affiliates itself with 'natural' processes. It influenced pre-war Japanese culture in a similar way that the Greek ideals of beauty and perfection influenced the West (Koren, p.21). Although wabi-sabi manifests itself in objects and places, it is first and foremost an "aesthetic appreciation of the evanescence of life" (Koren, p.54). With a mindset that embraces impermanence, interferences resulting from the sonifying process or from audience activities add enriching context to the sound, while the variations in the biofeedback data add traces of the system they originated from.

[47] One way to sonify continuous biological data streams such as the heartbeat is to use wavetable oscillators, which convert data streams into sine waves. In Max/MSP, this is can be done by sending the data streams as frequency values into *cycle~* objects. The resulting Theremin-like sine wave sounds are the simplest form of sonification. *Line~* objects can then be added to generate amplitude envelopes that define attack and decay. When sine waves are multiplied by *line~* objects, the sine waves are separated into individual notes and the composition begins to act like a filter for the energy oscillations received from the body. In order to give these notes more distinctive voices – or timbres – the sine waves can be fed into additive synthesis or frequency modulation synthesis (FM synthesis). Both processes define the timbres of sounds but in slightly different ways: additive synthesis simulates the multiple harmonics (or partials) of a sound by blending together a number of waveforms that are pitched to different harmonics. 'Harmonic' partials are tuned to multiples of the base frequency, while 'inharmonic' partials result from non-integer multiples. Each partial has its own frequency and volume envelope, which gives a composer control over every aspect of the sound. In FM synthesis, on the other hand, the 'carrier' wave signal is multiplied by a modulating wave signal. The amplitude of the modulating signal causes the frequency of the carrier signal to 'deviate' above and below its frequency while the frequency of the modulating signal causes what are termed 'sideband' frequencies to appear on either side of the carrier frequency. The ratio of deviation (d) to modulation frequency (fm), called the modulation index I, controls the spectral richness of the sound (I = d/fm). As with additive synthesis, the harmonicity ratio (H) – which is the ratio of modulator frequency to carrier frequency (H = fm/fc) – decides whether the final FM tone will contain harmonic or inharmonic partials: when the harmonicity ratio is a fraction, the note contains an inharmonic spectrum. This combined with a percussive amplitude envelope (strong attack at the beginning and exponential decay) lets the note sound like a drum or bell. Additive synthesis was used to define the sound of the singing bowls and the big bells that correspond to the Galvanic Skin Response in *Excitations*. The big bell has a complex spectrum (some partials are harmonic, some inharmonic) and a long duration (between 5000 - 15000 ms). Because of its prominence in the piece, every partial of this sound needed to be controlled. FM synthesis was used for most of the heart and pulse sounds. These have a short duration of 40 - 500 ms each. Especially for the shorter sounds controlling every partial is unnecessary as a listener cannot perceive it and thus additive synthesis was not needed here. Thus overall, additive and FM synthesis were chosen for this composition because they not only emulate existing sounds but also to generate new and unusual timbres. This is particularly important if one does not want to merely

for instance, makes effective use of this method.[48] The complex system here is not biofeedback, but the weather. Data from barometers and hydrometers is translated into different electroacoustical instruments that sonify the changes in the local weather conditions. This allows listeners to perceive changes within the system in an intuitive way (🔊 20). Such data 'farming' from a complex system is also becoming more popular amongst Human Computer Interaction (HCI) researchers. According to Phoebe Sengers, HCI research is moving away from complex computational modelling that attempts to reproduce users' behaviour. Instead, researchers feed the user data itself into the (much simpler) computation of the interaction. Thus in the end, the simpler method allows for better comprehension of a complex system.[49] Identifying the sonification strategy employed in *Excitations* as data 'farming' completes this account of compositional tools, which is summarised in figure 13. Still, what it *is* that sonified biofeedback may intuitively convey has not even been touched upon. This, the essence of the composition, needs to be discussed. To do this at an appropriate depth, only two of the biofeedback processes (heart sounds and stress levels) will now be examined further.

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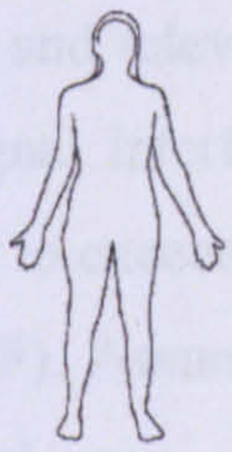
imitate existing biological or orchestral sounds, but acknowledge the sonifying process itself in the composition.

[48] Richard Garrett. Weathersongs (UK: Sunday Dance Music, 2006). SDRICO2. See also http://www.mindatplay.co.uk/weathersongs.html [accessed 12.07.09]

[49] Phoebe Sengers, 'The Engineering of Experience' in *Funology, from Usability to Enjoyment* ed. by Mark A. Blythe and others (Dordrecht, The Netherlands: Kluwer Academic Publishers, 2003, p. 19 - 29). This development is in contrast to digital media practice where data is often still fed into a modeled version of the system. This not only complicates the artistic approach but also obscures the workings of the system. Examples for such modeled systems are *Life spacies II* (http://www.mindatplay.co.uk/lifespacies.html), *Technosphere* (http://www.mindatplay.co.uk/technosphere.html) or *Spore* (http://www.mindatplay.co.uk/spore.html).



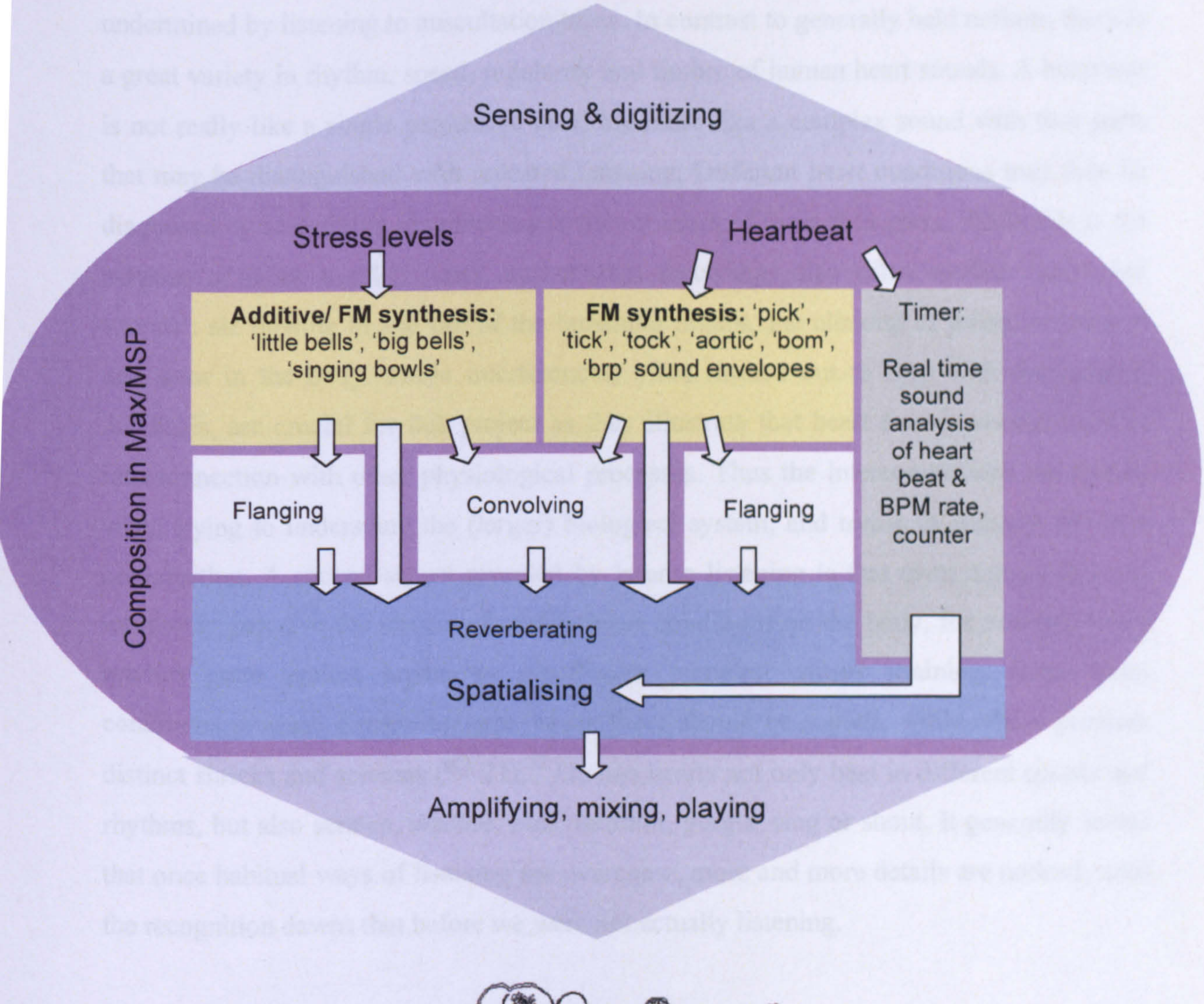


Figure 13: Compositional scheme for *Excitations*.
Illustration by the author.

Heartbeat

The typical heart sounds used in film and television productions were not applied in this composition. This was because of signal interferences in the data acquisition, but more importantly because *Excitations* aimed to exceed literal sonification techniques and clichéd use of sound (discussed in Appendix F). Assumptions about uniformity and regularity of the human heartbeat that stereotypical uses of heart sounds propagate can be quickly undermined by listening to auscultation tapes. In contrast to generally held notions, there is a great variety in rhythm, speed, regularity and timbre of human heart sounds. A heartbeat is not really like a single percussive beat, but more like a complex sound with four parts that may be distinguished with repeated listening. Different heart conditions may then be diagnosed by identifying disturbances to one or more of these four parts. While this is the purpose of these training tapes, auscultation recordings also often contain 'unwanted sounds': air flowing in and out of the breathing organs, the clicking of joints, or injuries and wear in the body. These interferences, often filtered out to help with the medical diagnosis, are crucial for this project as they illustrate that heart sounds always exist in interconnection with other physiological processes. Thus the interconnections are crucial when trying to understand the (larger) biological system, and trying to embody this in a composition. A second aspect revealed by intense listening is that even non-medics can intuitively perceive the trauma of certain heart conditions on the body, for example when arteries grate against organs or insufficient pumping causes straining. Some heart conditions produce distressing gaps where there should be sounds, while others generate distinct shrieks and screams (🔊 21).[50] Human hearts not only beat in different speeds and rhythms, but also scratch, wheeze, puff, murmur, gurgle, sing or shout. It generally seems that once habitual ways of listening are overcome, more and more details are noticed, until the recognition dawns that before we were not actually listening.

However, the practice of recording and repeating a heart sample (or even a string of heart samples) not only omits these differences that active listening reveals, but also creates the acoustic illusion of an ideal heartbeat whose wearer does not age. Yet heart sounds can

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[50] In conditions such as aortic insufficiency the heart can sound like a seagull scream (Jane M. Orient, *Sapira's Art & Science of Bedside Diagnosis* (London: Lippincott, Williams & Wilkins, 2000), p.356). Listening to this ominous cry can trigger strong emotional reactions, even in medically untrained listeners.

reveal the age of the wearer: young children's hearts, for example, beat almost twice as fast as adults'. The imprecision is therefore not found in the sounds, but in our listening and working preferences: from within our habitual frame of reference, where time is measurable and progressing continuously, heart sounds can be treated with detachment. Vertiginous aspects of time and space have little effect, as the mere act of identifying sounds as recordings already sends them into the past, while identifying them as recordings of someone else's heart sound makes them retreat from our bodies.[51] Thus it is possible to gain distance. *Representative* use of heart sounds is thus falsely reassuring because with a looped heart sample, there will always be a next beat. When a durational frame of reference is applied, on the other hand, and time is derailed, our pasts become active again and deepen the present. In this frame of mind, listening to someone's live heart sounds, for example, provides an intense encounter of their presence. Understanding the precariousness of existence makes each heartbeat special and re-affirming. The heart sounds used for *Excitations* therefore needed to communicate the delicateness of human existence by *being* delicate in themselves, rather than by representing it. This was achieved by creating a group of small percussive instruments that ranged from a machine-like beep to a voice-like cry and a low thump (🔊 22). The pulse activity was sonified as a subtle tickering and scratching (🔊 23). The most pronounced part of each heartbeat then set off individual instruments,[52] while its rate influenced their timbre.[53] This allowed the sound to convey the small fluctuations in the performer's heart sounds in real time.

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[51] Even trying to identify heart conditions while listening to heart sounds is a distancing mechanism.

[52] Measuring the heartbeat in order to play a note on each beat seems unsophisticated, but provides an interesting compositional scope: the lower the heart rate, the longer the note and thus the more opportunity for a listener to take in onset, increase of amplitude, overtones, tremolo, decrease of amplitude and end of note. As the human heartbeat rate varies from about 60 to 240 beats per minute, this can significantly alter the listening experience, for example if performers were to lower their heart rate during a performance.

[53] This real-time sonification allowed listeners to maintain a close connection to the performing body. Practice showed that too much artistic license could distance listeners from the physiological processes the composition aimed to communicate.

Stress levels

Changes in stress levels reveal the fluctuations between attachment and detachment that take place in the performer's mind.[54] But since, in contrast to the heart sounds, these fluctuations generate no perceptible sound signals by themselves, it is necessary to assign sounds to them. Thus it may make sense to connect the to-ing and fro-ing of the mind with types of sounds that have become associated with continuous change. However, such associations should not be made arbitrarily. Rather, they may already pre-exist in the form of sound archetypes. One of these archetypes is the sound of bells. Bells have been used in many meditative and religious practices to accentuate a transformation taking place.[55] Thus temple bells, for example, are central to Korean Buddhist practices because "through the sound of the bell Koreans tried to comprehend [...] that all objects and living things in the universe [...] continuously change form".[56] The deeper meaning of this statement can be revealed by looking at the sound characteristics of a typical Korean temple bell. The *Emille Bell*, also known as the sacred bell of King Seongdeok the Great, is one of the largest in the world. It was cast in 771 CE and weighs 25 tons. Made from solid bronze, it is housed in the Kyongju National Museum, Korea (see figure 14). Like a typical Eastern bell, its sound is solemn but delicate, with a long decay of about ten seconds (🔊 24).[57] This bell has a particularly rich sonic spectrum that can change depending on how the bell is struck.

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[54] This is discussed at length in chapter 6.

[55] However, the connection of bell sounds with transformation has also become engrained in wider Western culture. For instance, school bells are often used to signify the end of a period of time, and the beginning of another.

[56] Lee Ho-Jeong, *Bells Closely Linked to Buddhist Religion*, (online) http://www.koreanbuddhism.net/jokb/news/view.asp?article_seq=866 [accessed 06.06.08]

[57] The use of large temple bells coincided with the spread of Buddhism from Northern India around 600BC. Over the centuries the bells developed their culture-specific shapes and sounds, in response to the different peoples of Asia. In contrast to European bells Korean bells are low-pitched, and struck from the outside by a wooden log on a chain rather than a clapper. A predictable bell timbre, as in European bells, is not important since the bells are not to be used in a musical set: temple bells are solitary sound events, only embedded in their location. For this reason temple bells do not need to be tuned to the tempered scale, like their Western counterparts, and may contain many inharmonic partials. The result is often a complex sound phenomenon that reveals a range of different harmonics over time. European bells, on the other hand, are generally tuned to a major or minor harmony and are struck by a clapper from the inside. Large cast bronze bells have been known in churches since the early medieval times. Casting bronze bells was a monastic practice until the late renaissance when a growing musical interest prompted the development of bells as musical instruments, such as carillons in the mid 1500s. During the 1630s in Flanders, the musician Van Eyck and the Hemony Brothers bellfounders produce the first well-tuned musical bells for use in carillons, using a fundamental and overtones tuned to 2 and 2.4 times the fundamental. Since the 1890s the harmonics of bells made by English bellfounders Taylors at Loughborough consist of base hum (or fundamental), the prime one octave above, the

Figure 14: The *Emille Bell* (image downloaded from http://www.lifeinkorea.com/travel2/kyongju/122).

A recent paper compared the current sound spectrum of the bell with a recording from 1966. This revealed that to a stationary listener the bell can display a Doppler effect where the sound seems to "roll from side to side".[58] This effect can be exaggerated by striking at the right moment "when the bell returns after coming closely".[59] Moreover, repeated listening also reveals that there are different partials involved, which can either be heard together or one after the other, sounding then a little like 'Emm-iil-eeh'.[60] Thus while the pendulum effect (as well as a slight asymmetry of the bell) may cause this sound

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tierce (a minor 3rd above the prime), the quint (a perfect 5th above the prime), the nominal (an octave above the prime) and the deciem (a major 3rd above the nominal) (Benson, 2007, p. 138). The Federation Bell Installation in Birrarung Mar, Melbourne, finally demonstrates that modern bells can be tuned to any timbre (http://www.ausbell.com/Federation%20Bells/FEDBELLS.html, [accessed 06.03.09]).

[58] Kyung A. Jang, Hee Won Lee and Myung Jin Bae, 'On a Study of Vibration of the Divine Bell of King Songdok by Doppler Effect' in *Proceedings of the 43rd IEEE Midwest Symposium on Circuits and Systems,* Lansing MI, Aug 8 -11 2000, pp. 726 -729 (downloadable from http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=952859 [accessed 25.05.09]). This paper suffers from an inadequate translation into English. It mentions a 'Macnorlee effect'. With much allowance for errors, this may be a reference to Lord Rayleigh, who illustrated the time reversal effect of the Doppler effect by saying that by moving in a particular way it may be possible to hear a symphony being played backwards (John William Strutt Rayleigh, *The Theory of Sound: Vol II,* (London: Macmillan, 1926)).

[59] Jang, Lee and Bae, p.728.

[60] Emille is a phonetic spelling of how the Silla word for 'mother' is pronounced (Silla was one of three ancient kingdoms which, at its height in 576, occupied most of the Korean Peninsula). The name comes from a legend spun around the making of the bell which says a baby girl was sacrificed by being thrown into the liquid bronze and now cries for her mother each time the bell is rung.

phenomenon, this does not articulate the meaning the sound carries for listeners: rather than merely being a symbol for transformation, the sound is actually transforming itself during the time it rings.[61] Thus even without knowledge of physics, Buddhist disciples can perceive the teaching through active listening, as the connection between extension (what can be heard) and depth (its essence) becomes exceptionally clear in the *Emille Bell* sound.

Inspired by this unity of method and meaning, a set of electroacoustic instruments (reminiscent of bells, gongs and singing bowls) were created for *Excitations*, which would sonify changes to the stress levels of the performer. As discussed before, these use only one single chord. A set of polyphonic little bells ring some of the notes, big bells introduce inversions of the chord, and singing bowls accentuate and extend individual notes of the chord in time (🔊 25). Different ways of tuning the bells were explored, some of which produced musically interesting results.[62] However, due to their overuse in New Age and popular relaxation music, Eastern bell sounds have nowadays almost become a musical

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[61] Eastern singing bowls also share this acoustic quality, and antique Eastern singing bowls may even sound polyphonic. Contemporary singing bowls usually contain two or more clearly audible inharmonic partials (David J. Benson, *Music: a Mathematical Offering* (Cambridge: Cambridge University Press, 2007), p. 139). Ironically, the Emille bell is no longer allowed to transform physically. It has not been rung publicly since 1993, as each strike adds to its current state of deterioration. Most papers about the bell therefore refer to a recording made in 1966.

[62] An early experiment, for example, aimed to extend the array of bell sounds by combining two bells. These had inharmonic partials that were created using FM synthesis. It was planned that a change in stress levels would cause a stepped change in the carrier frequency of the bells, thus pitch shifting their sound but maintaining their timbres. While this worked well for one bell in isolation, in combination the sounds were unclear, neither fully harmonic nor overly disharmonic. Since more control was needed in the shaping of each partial of the bell sounds, additive synthesis was used from then on. At that point it also became quite apparent that this composition was about to produce Western bell sounds that were tuned to a chord in the equal tempered scale. Yet the equal tempered twelve-tone scale only emerged in the 18th century from a range of other compromises such as just intonation, meantone scale, or irregular temperaments. These all attempted to ease harmonic progression through all keys by spreading the mathematical error that occurred in the calculation of intervals between octaves. Eastern bell sounds, on the other hand, contain inharmonic partials and follow a different tuning system. Therefore the question arose whether the tempered scale would be at all useful for this composition. David Benson, professor of Pure Mathematics, quotes a synthesist saying "the dominant Western tuning system – equal temperament – is merely a 200 year old compromise that made it easier to build mechanical keyboards" (Rich in Benson, p.167). Particularly when sounds are digitally synthesized there is no need to make do with this compromise, as potentially any intonation system can be used (in fact none of the Western intonation systems is necessary to generate an Eastern bell sound). Moreover, when the Emille bell was cast, polyphony was not even known in Europe. Using the twelve-tone equal tempered scale to emulate a sound phenomenon that originated outside this system seems strange. However, as the compositional intention was to reward at least some conventional listening expectations, it made sense to continue to use Western intonation systems. But since *Excitations* does not move through harmonic progression, the tempered scale is not necessary. Instead, it might be useful to explore the just intonation system with its emphasis on perfect intervals, as this may give *Excitations* more sound colour and clarity. However, due to time constraints it was not possible to implement this within this research.

cliché.[63] The composition had to employ them in such a way that listeners would hear them afresh. This was achieved by sonically differentiating each bell type, and also by applying sound spatialisation techniques.[64]

Spatialisation and responsive feedback loops

The listening sensations evoked by spatialised sound could be described as a unity of body, sound and space. Such experiences are significant, as they connect listeners with much earlier ones. Hearing develops well before human beings are born and thus from very early on, they are familiar with hearing the sounds of their mother's body.[65] For some time, researchers like K. J. Gerhardt have investigated how babies may hear in the womb.[66] According to them, the tactile components of sound (vibrations, felt as bone conduction) are much higher than airborne components. This type of hearing may be imagined like being immersed in water where lower frequencies (100 - 1000 Hz) carry better than higher ones, and vowels are heard more clearly than consonants. Although under water sounds lack spatial direction, they still carry intonation, rhythm, harmony and iterations. Maybe because of this first form of hearing, lower sounds that surround listeners can evoke an experience of closeness. This sensation returns, for example when listeners feel another's voice resonating in their bodies. Thus opera singers can 'touch' listeners with their voices, and let their chests resonate as if they were singing. A feeling of unity may also occur when a voice triggers the resonant frequencies of a space. Moreover, the two can become so interlinked that the listener cannot tell if the voice is activating the space, or if the vibration of the space is activating the resonances of the body. In such a situation, sound

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[63] Fusing traditional meditation bell sounds with popular music song structures and harmonies can generate compositions that are structurally and musically inferior to any of the source materials they allude to. This had to be avoided here. While it was important to use sounds that would help the performer to relax and to attain deeper listening patterns (practice revealed that too much anxiety on stage resulted in permanently high stress levels and little variation), this was not to be done in clichéd ways.

[64] This meant to consider spatialisation options higher than stereo, including quadrophonic sound, surround sound (5.1, 7.1, ...) and a custom-made speaker configuration (4.2 plus ceiling at *FEMF* 2008).

[65] This was discussed in *Life Before Birth* (Channel 4 Broadcast 07.04.2005). Low sound frequencies with a rhythmic beat, like the ones used for the heart sounds in *Excitations* ('bom', 'brp') may repeat these early experiences to some extend.

[66] Kenneth J. Gerhardt and Robert M. Abrams, 'Fetal Hearing: Characterization of the Stimulus and Response' in *Seminars in Perinatology*, Vol. 20 (1996) No. 1, pp. 11 - 20, W.B. Saunders

mediates a *unity* between self and environment.[67] Alvin Lucier's piece *I am Sitting in a Room,* for example, clearly illustrates this.[68] Lucier uses the acoustic properties of the performance space itself to gradually erase a recording of his voice: by re-recording the playback over and over again, the reverberating frequencies of the room gradually come to the fore. This means that over time, the listening focus necessarily shifts from Lucier's words to his voice and finally to the reverberation of the room. And while the concluding repetitions of *I am Sitting in a Room* may not sound at all womb-like, they make it intuitively perceptible why sound cannot be considered separately from space (🔊 26).

While Lucier's work inspired the composition of *Excitations*, research workshops and open play sessions also revealed another beneficial effect of spatialised sounds. Unbeknownst to the participants, a range of different spatialisation options was played. These included a slow and continuous circular rotation of sound,[69] a slow continuous panning of sound, sounds trailing randomly through the space at random speed, and (as a control mechanism) no spatialisation. The sounds described as 'calming' were usually the ones where sounds was either rotating or panning, which suggests that the slow but steady to-ing and fro-ing helped performers to relax. Knowing this was useful, not least because relaxed performers generally produce clearer biofeedback data. Furthermore, observations also revealed that during those two spatialised sound options, most participants gradually moved towards external and/ or internal stillness, which in turn intensified the performance. It thus became apparent that the rich details of spatialised sound could encourage active listening, while their slow rotation or swinging can relax the performer. More importantly still, listening to spatialised sound is a method in itself, which has the potential to deepen the connection between extension and intensity in the listener. However, this connection is not only due to a re-occurrence of our first listening experiences. In a biofeedback composition, small movements from inside the body of the performer become externalised and enlarged to such an extent that listeners become fully immersed in it. Thus two different dimensions exchange their core characteristics. But whenever imperceptible differences become vast,

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[67] Barry Truax, *Acoustic Communication* (West Point, Connecticut, and London: Ablex publishing, 2001), p.38.

[68] http://www.mindatplay.co.uk/sittinginaroom.html [accessed 12.07.09]

[69] A fully completed rotation or panning motion took between 8 - 10 seconds.

or internal effects become externalised, vertigo sets in that causes habitual perception to rupture.[70] How sounds are spatialised is therefore crucial.

Practice thus became concerned with exploring more intrinsic spatialisation options that would intensify these effects.[71] A first step that would extend listeners' perception of space beyond the speaker circle was to apply reverberation.[72] This not only intensified the composition but also created sharper contrasts between distance (far sounds) and intimacy (near sounds). Then delay lines separated out simultaneous sound events, generating in this way greater clarity as well as sonically interesting echoes.[73] Next, sounds were sent to travel in space according to their main frequencies: low heart sounds (< 100 Hz), for example, that were meant to connect listeners with their very first listening experiences should be felt rather than heard.[74] Therefore these were sent directly to the subwoofer(s). High frequency sounds (> 2000 Hz), on the other hand, were to originate from above the listeners (where possible) where they would expand listeners' perception of space vertically. Mid-range frequencies (100 - 2000 Hz) finally are the ones most easily perceived as travelling; these frequencies were therefore predominantly spatialised horizontally. To make their movement even more perceptible, their decay times were extended. Later performances, such as the one at the *Florida Electro-Acoustic Music Festival* (2008), had an even more developed sound spatialisation (see figure 15). Here the sounds spiralled slowly outwards and inwards. This was achieved by combining

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[70] Spatial vertigo is discussed in chapter 4.

[71] In the early practice stages, a small quadrophonic setup was used that allowed for spatialisation but could also be transported easily between performance venues. However, a problem that can occur with such a setup is the comparatively low spatial sound quality that can be achieved. For example, a Max/MSP spatialiser patch written in 2003 used the Pythagorean theorem to measure the distance of sound event from the four speakers. While this worked, the sound increased exponentially when the location coincided with a speaker, which forced listeners' attention to that location. When trailing in between speakers, on the other hand, the sound level dropped noticeably, and it was much harder to pinpoint a location. Later on, a Max/MSP spatialiser patch written by Randy Jones (http://www.2uptech.com [accessed 21.07.09]) was used, which produced more even results.

[72] *Excitations* uses *Monoverb~*, a Max/MSP reverberation object written by Olaf Matthes (downloadable from http://www.akustische-kunst.org/maxmsp/ [accessed 13.06.08].

[73] For example, the sounds that originated from convolving little bells and flanged bells were delayed by up to a second. This created enough of a gap for listeners to hear the differentiation but to have the original sounds still in memory.

[74] In an earlier stage of *Excitations* (*E-performance*, 2005), there was even a visual repetition of this unity. By touching her own chest and face, the performer would set off lower (vibrating) frequencies in the piece and thus touch the listener's body with sound.

contraction and expansion of sound (through near and far reverberation) with circular rotation.[75] The spiralling speed was determined by the performers heart rate and stress levels: the stress levels decided how many heart beats would make a set; the more relaxed the performer, the more beats per set and the spiralling slowed down. When a set was full the sound began to spiral outwards, then during the next set the sound returned back inwards. As it was known that a performer usually relaxes more and more during a performance, the piece would naturally decelerate over time. The spatialisation thus only reinforced what was likely to occur.

[75] Earlier stages experimented with concentric circling. Here performer and audience were seated in the centre of a space while the sound rippled out and in, in tune with the contracting and expanding heart muscle of the performer. But this effect overpowered the composition and needed to be modified, which is why an irregular rotation was tried. This produced a sonic impression of 'eiern', which may be best translated as 'being out of round', where sound deviated slightly from pitch and rotated asymmetrically. This was achieved by combining reverberation with flanging and circular rotation. The resulting experience could be described like sitting inside a huge singing bowl with the mallet traveling around the outside. While by and large this was successful, it still did not allow sounds to travel individually.

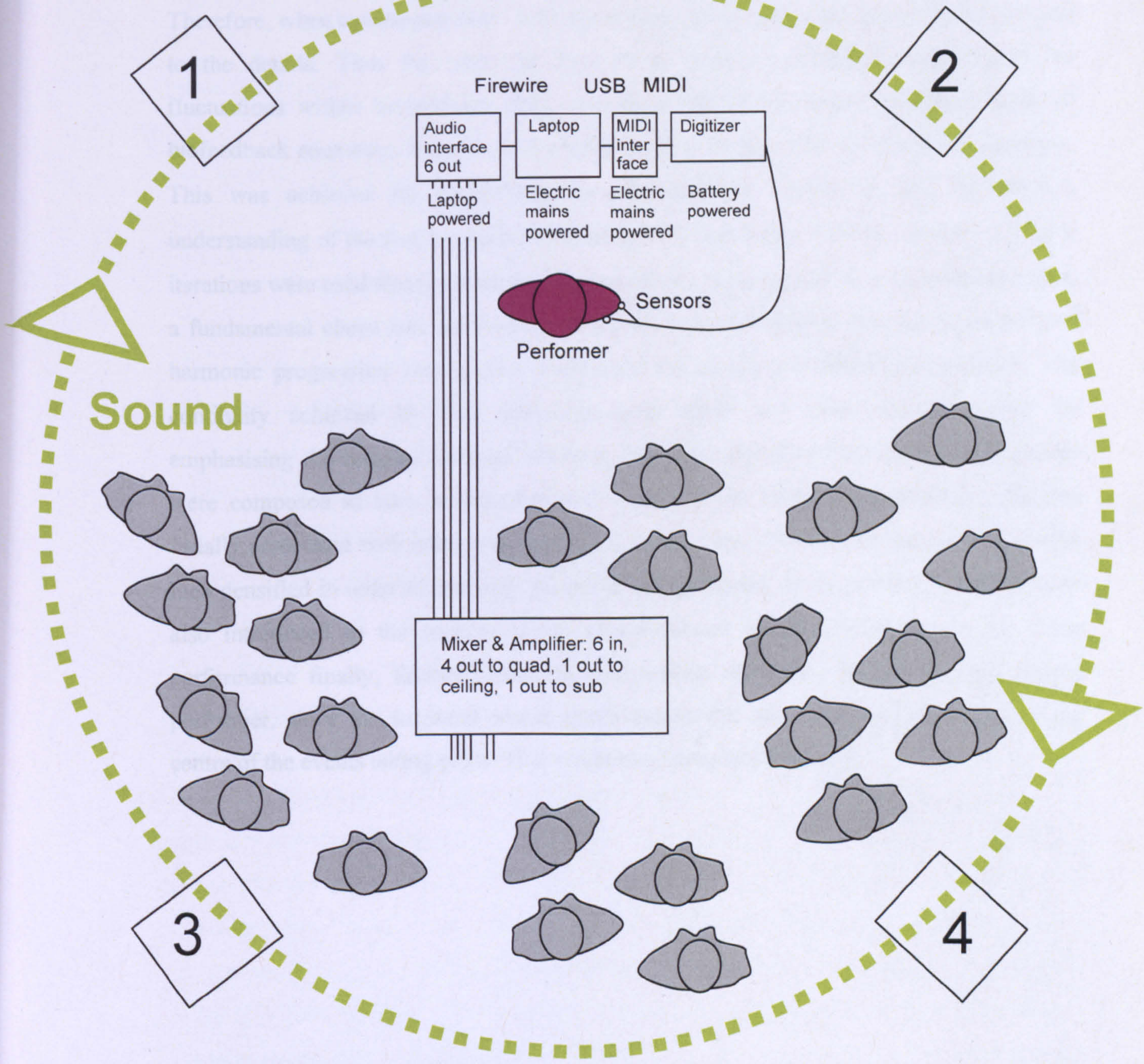

Figure 15: Floor plan of the *Florida Electro-Acoustic Music Festival* version of *Excitations*. Illustration by the author.

Summary of compositional methods

How sounds are heard is influenced by innate and acquired listening expectations. Therefore, when a composer plays with these expectations, much attention needs to be paid to the details. Thus the aims for *Excitations* were to intuitively communicate the fluctuations within biofeedback data, and show the interrelation of different kinds of biofeedback responses, but also to immerse listeners closely into the events taking place. This was achieved by simplifying the compositional system so that an intuitive understanding of the link between performing body and sound could be attained. Cyclical iterations were used that responded to changes in the physiological data. In addition to that, a fundamental chord was selected that suggested open-endedness, but the expectation of harmonic progression was denied. This made for an unusual listening experience. The continuity achieved by this non-progressing chord was then counterbalanced by emphasising the internal tensions within it. Next, the timbres of the biofeedback sounds were composed in such a way that each sound would enhance the aesthetic qualities usually associated with heart beat and stress levels. These individual sound textures were then densified in order to intensify the listening experience. Some gradual mutations were also introduced to the sounds, which would reward attentive listeners. In the video performance finally, listeners hear the composition from the physical position of the performer, since the surround sound spatialisation that was used positions them in the centre of the events taking place. This reinforces immersed listening.

8 - Conclusion

This chapter concludes the research by observing that explorative play can indeed convey an 'intuitive understanding' of the generative. This makes explorative play a crucial human activity. What is interesting to explore, therefore, is how explorative play is perceived within contemporary culture: if it is only associated with thrill seeking and not with self-observation, the danger of a continued production of limited play experiences persists. However, if its transformative potential is recognised, the possibility to rethink how we play is opened up.

The issue of explorative play revisited

In the beginning of this research, the question was posed as to what the fascination of observing (or listening to) generative processes in action might be. Searching for an answer led to a re-examination of theories concerning the generative, and introduced a practice that investigated explorative play with sonified biofeedback. From these investigations, a range of responses emerged, one of which was that the observation of generative processes can be intellectually challenging, especially when, as in this practice, players need to deal with the complexities of their own physiological processes. However, explorative play with these processes can also become terrifying when it reveals how little control players have: for example when transformations in the mind or body occur before players are aware of having initiated these transformations. Another finding was that explorative playing with generative systems can render the distinction between *pre*-play (rehearsal) and *re*-play (performance) irrelevant: there is only play. This suggests that explorative playing and reality are not opposites, but take place simultaneously – in which case it is just the intensity of play that varies. Experiencing this becomes all the more intriguing when players are aware that the intensity of their own play cannot be controlled, and that it may potentially take hold of them at any moment. One could imagine such a process as a constant responsive feedback loop involving the player, which makes explorative playing existentially thrilling as well as transformative.

But why was explorative play explored in connection with biofeedback? The self-reinforcing feedback loop enabled by listening to one's sonified biofeedback can act like a catalyst to explorative play, and move participants from conscious control towards affect and intuition. Such a shift of engagement may act in a similar way as Winnicott perceived

the transitional object to operate; in the sense that by resisting its player's control, the object transforms its player. Explorative play with biofeedback could thus be seen as an adult version of a transitional play phase, where experiences of "magic and omnipotence intersperse with moments of loss of control".[1] But, unlike Winnicott, who described these disjointed experiences as clashes between subjective and objective observations of the world, this research interpreted them from another angle. Deleuze's philosophy of difference allowed a deeper understanding of the role of perception in such disjointed experiences, which made it possible to grasp why some experiences touch human beings at a deeper emotional level than others. This phenomenon, which Deleuze describes as the work of essences at the core of human existence, has also been articulated by other philosophers and poets. Vyacheslav Ivanov, for instance, observed how these ineffable essences could become perceptible within artistic images (or 'symbols'):[2]

> A symbol is only a true symbol when it is inexhaustible and unlimited in its meaning, when it utters in its arcane (hieratic and magical) language of hint and intimation something that cannot be set forth, that does not correspond to words. It has many faces and many thoughts, and in its remotest depth it remains inscrutable... It is formed by organic process, like a crystal... Indeed it is a monad,[3] and thus constitutionally different from complex and reducible allegories, parables, and similes... Symbols cannot be stated or explained, and, confronted by their secret meaning in its totality, we are powerless.[4]

Thus according to Ivanov, engaging with a work of art opens a connection to a core point, where we are powerless and being played. Here things simply emanate and take on form and identity. Yet it is difficult to describe this point as either location or moment, as habitual perceptions – time passing and space being constant – do not apply. It thus might be more suitable to say that at this point, time and space are disjointed. This links in with Deleuze's three syntheses of time, which provide a means of thinking about this

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[1] Donald W. Winnicott, *Playing and Reality* (London: Routledge, 2005), p.64.

[2] Vyacheslav Ivanov (1866 - 1949): Russian scholar and poet of the early part of the 20th century.

[3] Monad: a term used by Greek philosophers to describe God or the first being, or the totality of all being. Monism therefore is the concept of 'one essence' in metaphysical and theological theory. According to Leibniz' monadology, monads are irreducible units that make up the universe. But unlike atoms, monads are completely independent, and possess neither material nor spatial character. Because of this, even materials objects are ultimately only perceptions.

[4] Ivanov in Andrey Tarkovsky's *Sculpting in Time* (Austin TX: University of Texas Press, 1986), p.47. In this publication, Tarkovsky relates his own cinematic work repeatedly to Ivanov's thinking, for example by saying that "there are some aspects to human life that can only ever be faithfully represented through poetry" (p.30).

disjointment. Connecting the syntheses of time with Deleuze's 'asymmetrical synthesis of the sensible' (which holds that there are two orders, extension, which concerns itself with perceptible qualities, forms and expressions, and depth, which concerns itself with intensities) provides a useful way of 'understanding' how some experiences are by nature more disjointed than others.

To illustrate this point, this practice showed that disjointed experiences could come about relatively easily by engaging with a biofeedback system in explorative play. This is because explorative play connects extension with intensity: the core processes of explorative play, which were identified as paradox, vertigo and intuition, can be imagined as revealing resonances between extension and depth. For example, when a paradox disrupts the habitual perception of present and past (like Proust's character tasting the madeleine), players may become aware of the limitations of habitual perception, the awareness of the present is intensified, and vertigo and intuition can set to work. Vertigo is a passive movement that intensifies players' engagement and draws them deeper into the vortex of play. Like a self-intensifying feedback loop, it causes ever more resonances (players exploring themselves exploring etc.) and while players become more intensely immersed in play, imperceptible essences set to work, which, as Ivanov says, 'remain inscrutable'. Only their external manifestations can become perceptible to the player as sensations. Yet the working of the essences can also lead to intuitions: qualities that ascend from the depth of play and resonate in the player. Thus, according to Bergson, intuitions are not definable by the player, although they will eventually find form, expression and cognition through the player. This obscure movement of intuition – from 'inscrutable essence' to cognition – may explain why it is often the case that explorative playing allows for new thoughts and experiences to emerge. Explorative play thus transpires as a method that allows the exploration of the resonances between extension and depth in practice.

Concluding observations

At the end of this research it becomes thinkable that the kinds of interactions that emerge in explorative play with complex systems are themselves generative by nature. This has a number of implications for future practice. One of these is that complex systems involving playful interactions can bring forth 'creative' and unique responses, regardless of players'

level of expertise. In traditional interactive art practice, active control of events or manual dexterity are often key, and play environments that allow for explorative play are in the minority. Yet there are great benefits in fostering explorative play. For instance, it emerged in this research that explorative play with a biofeedback instrument could initiate transformative experiences. These were usually described as enjoyable but also unsettling in some ways (the accounts of workshop participants reflect this as a mixture of delight and consternation). This underlines that, within complex systems that involve explorative play, creativity and transformation are not only found in the activities of the artist and/or the system, but become also *activated in participants' play*. This latter kind of creativity and transformation is not, as it may seem, just a by-product of participative generative art practices. It rather is an intrinsic part of the artwork, where participants' cognitive understanding of the generative can get interrelated with their sensations and experiences.

Another implication is a rethinking of creativity in relation to group participation. For example in this research, group play sessions revealed that creative and unique responses do not only occur within individuals, but can also emerge from a collective. This 'collective creativity', which can find expression in many formless exchanges,[5] may again initially appear as a random by-product of practice – especially since it cannot be predicted or controlled. Yet again, here may be great benefits in exploring this phenomenon further. For example in this research, the impulse to communicate one's play experiences to a fellow player could be encouraged by supportive facilitation: in the group sessions it could be observed how explorative playing almost forced its players to attempt the communication of what happened to them during play, despite their realisation that conventional language could not convey it very well.[6] Therefore those who facilitate explorative group play need to be aware that the communications taking place during or after play – or their absences – do not merely serve social purposes, but often also signal major shifts to play stages. This observation could also be extended to non-verbal modes of

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[5] 'Formless' is not to say that exchanges between research collaborators are informal. On the contrary, these exchanges often rely on an agreed schedule of what will take place, and how long this may take. It is essential to have obtained consent before attaching research participants to sensors or taking video recordings of them, and because explorative play evokes improvised rather than intended responses, participants' consent cannot even be taken for granted once it has been obtained. It is therefore important to remain aware of the fact that participants could withdraw their consent at any time.

[6] This hints at a connection between explorative playing and the relational and generative aspects of emergence (in other words 'exchange' and 'communication'). However, in the frame of this research, this connection could not be fully followed up.

communication, which –paradoxically – can ease communication at times. For example at the *Parip* conference (2005), where participants asked for an explanation of 'the science behind' sensing and sonification,[7] a non-verbal demonstration of the biofeedback instrument seemed not only to communicate more directly what was involved, but also renew participants' interest in listening to the biofeedback composition. This observation led to increased use of practice demonstrations later on, one of which was recorded in connection with the final performance (DVD: section 'Show and Tell'). Therefore, developing a greater awareness of the communicative aspects of participatory practice seems useful, as it may uncover new methods for facilitating play. Moreover, it may reveal more about the patterns of play, which seem to vary between 'internally' engaging with such works and communicating 'externally' what happened. Since these dynamics seem to be more pronounced in group sessions, research into the dynamics of this group play could lead to new knowledge.

A further implication is to recognize the value of direct sense experience on the side of the participants. This research revealed that self-observing changes in the body whilst hearing these articulated as sound was a transformative experience for some. But although *observing* participants having transformative experiences can deepen a researcher's understanding of explorative play and generative processes, only *becoming* a player lets this aspect resonate in the researcher. Thus new insights into generative art might be obtained when the interactions taking place within it are viewed from several perspectives. In this research, the participant's perspective was as important as the artists' or researcher's perspective (which is not always the case). The participant's perspective here necessarily meant being immersed and being played, and so for instance one workshop participant, having spent much time trying to control the biofeedback instrument, realised that 'silences and stillness mean something with this equipment' just as he gave up trying to control it.[8] Only a researcher who had *experienced* a similar phenomenon could understand the impact of his insight.

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[7] Due to technical difficulties the officially scheduled workshop at the *Parip* 2005 conference could not be delivered. The session referred to here took place afterwards, once these difficulties were overcome.

[8] From the context it seems he did not only have the actual equipment in mind, but also how this was used in connection with sound composition and facilitation. This was what made participation meaningful to him.

However, the above statement also shows that participants rarely plan how they will understand an experience; to them it simply happens in one way or another. To someone immersed in explorative play with a complex system, it may therefore not be at all obvious or predictable why events in the system unfold the way they do. Perceptually, the system may not follow the laws of cause and effect, or a linear progression of time, although structurally it may do. Artists who work with complex systems, on the other hand, have different perspective and can – at least to some extent – control the circumstances in which these artworks are encountered. An 'unwanted' cognitive reading of a work may therefore be strengthened if any external differences between objects are emphasized, as this distracts from the unfolding relationships within and between objects. An 'unwanted' cognitive understanding may also be encouraged if participants' interactions are pre-planned, or built around cause and effect, as this may lead participants to misinterpret the complexities in the system as a much simpler chain of events. Conversely, the sought after intuitive understanding could be strengthened if participants are drawn deeper into explorative play. To that end, this practice employed a sound mapping system and a compositional strategy that allowed the biofeedback sounds to become easily distinguishable to the listener. The play environment also influenced participants' perception: an informal space with low lights often helped to address nervousness and increased the focus on the sounds; while screening participants from public scrutiny could help them to deepen the immersion in play. Furthermore, this practice made greater use of autonomous participation, because practice showed that participants who proceeded in an order of their own choosing and explored actions 'meaningful' to them could let go of rule-based play with greater ease. Self-conscious players, on the other hand, whose engagement may have been blocked by too much thinking,[9] could often be reconnected with explorative play through responsive facilitation: when the facilitator, for example, introduced movement or listening activities that could provide a mental focus point.

Yet artists are not only able to influence the circumstances in which generative artworks are encountered, but can also subtly instigate a less purposeful engagement with the work. This can allow participants to perceive the qualities that emerge from the complex systems themselves more fully. The key implication of this kind of engagement is that the planning

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[9] A similar block can affect Western dancers who begin to engage in Butoh dance. This has been described by Paul Roquet (*Towards the Bowels of the Earth* (Davis, California: Palupalu Publishing, 2004)) and is referred to in chapter 6.

of the interactions that will eventually take place should be left open. This is because, from the perspective of an explorative player, participation can be disempowering if it remains restricted to fixed patterns of interaction. The only way to avoid this restriction is to employ interaction patterns that are themselves transformable through play. Thus while a predefined situation may be helpful to set off play, only the progressive transformability of this situation can accommodate more open and explorative kinds of play. But this also implies that, once such open play takes hold, nothing should be expected to remain intact,[10] which makes open play a challenging concept that is not easily put into practice.

An interesting attempt in this direction has recently been made within the field of video games.[11] With a focus on the simulation of evolutionary processes, the video game *Spore* tried to introduce self-generative developments as part of the game play, and encourage non-teleological exploration on the side of its players.[12] However, it may be argued that this was not fully achieved. While many activities within *Spore* elicit more creative and explorative responses from players than other simulation games,[13] some fundamental rules, for example that evolution is teleological, still cannot be changed. This has the consequence that the general direction of evolution taking place in *Spore* remains linear. In addition to that, evolutionary progress in *Spore* is marked by five pre-defined evolutionary 'stages' that lead its player from a microscopic to a macroscopic world.[14] Yet in a real evolutionary process, such 'stages' are not known to the ones immersed in it; they only gradually reveal themselves, and only become identifiable as 'stages' in hindsight. Thus rather than allowing for a detached observation of self-generative evolution taking place, or a vertiginous experience of evolution taking hold of the player's creatures, *Spore* wants its

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[10] This may even lead to the total erasure of the initial play situation.

[11] Many video games employ fixed interaction patterns to enable linear role-play, chance-based or competitive kinds of playing. Interesting for this research therefore are those games that encourage open and explorative playing. Interactive music games like *Electroplankton* (Indies Zero, 2005/6, developed by Toshio Iwai for Nintendo DS) or the action/ sandbox game *Grand Theft Auto IV* (Rockstar Games, 2008) are examples of video games that offer players idiosyncratic and non-linear ways of engaging with the game content.

[12] *Spore*, computer game for Microsoft Windows and Mac OSX, (Electronic Arts, 2008). See also http://www.mindatplay.co.uk/spore.html [accessed 12.07.09].

[13] Before working on *Spore*, chief designer Will Wright developed *The Sims* (computer game for Microsoft Windows, Mac OS, Linux, PlayStation 2, Xbox, GameCube (Electronic Arts, 2000 onwards), which again is a simulation game that allows players a great amount of choice between objects, but little variation to the overall rules.

[14] Evolution in *Spore* is modelled as five stages: cell, creature, tribe, civilization and space.

players to (re)construct a particular evolution.[15] Here explorative playing is not powerful enough to exceed the predefined rules of interacting and to self-generate interaction.[16]

Likewise, this practice has also not succeeded in fully implementing open play. By definition, research sessions cannot accommodate open play: the direction given by the research question is necessarily at odds with a complete disinterestedness in predictable outcomes that would be required. Thus the biofeedback composition, for example, had to communicate the link between the physiological process of the performing body and the corresponding sounds that could be observed in a particular way, and consequently participants could not significantly alter it.[17] This limited the possible interaction with the work from the outset. Despite these limitations, trying to shift interaction towards more open play is a worthwhile undertaking, as it encourages a fresh thinking about the nature of processes underlying interaction and play.

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[15] The limitation of evolution in the game is exacerbated by *Spore* relying on players' conscious choice. *Spore*'s 'creature creator', for example, provides a range of limbs, actions and expressions for the assembly of various creatures, which means actively choosing between things. The limitation this creates is reminiscent of a pre-defined world where new things cannot emerge by themselves. Furthermore, the notion of expansive evolution is also questionable, as it neglects the notion of an ecological balance.

[16] Whether explorative play can ever be successfully commercialized is an interesting question. Attempts in this direction have already been made, for instance in the biofeedback computer game *Journey to Wild Divine* (http://www.wilddivine.com/servlet/-strse-72/The-Passage-OEM/Detail [accessed 08.07.09]), or more recently with the Yoga exercises in Nintendo's *Wii Fit*. While both games offer multimedia versions of well-known exercises used in stress reduction and meditation, *Wild Divine's* New Age look and feel may not easily appeal to a mainstream audience. Maybe for this reason it only enjoys "thousands of fans worldwide" (http://www.wilddivine.com/forum/viewforum.php?f=7 [accessed 08.07.09])). The *Wii Fit* Yoga, on the other hand, draws more directly on a well-established practice with striking similarities to explorative play: like explorative play, Yoga works through physical sensation and with a focus on the present. Like explorative players, Yoga practitioners can experience loss of control, and transformation of their habitual perspectives during or as a result of their engagement with the practice. The main difference is, however, that while explorative play is *purposeless*, Yoga builds human characteristics like explorative play into a *structured* practice framework. This is done for a *purpose*: attaining a greater understanding of human perception, as well as the nature of things. Now, in answer to the question as to whether *Wii Fit* Yoga is a successful commercialization of explorative play: any structured framework already limits explorative play, and the involvement of a games console adds further limitations. The most obvious of these is that *Wii Fit* Yoga provides the practice instructions, but lacks the feedback and guidance only an experienced teacher can provide. For this reason alone some leading Yoga practitioners have already criticised that *Wii Fit* Yoga is "not a replacement for a regular Yoga practice" (http://wiifityoga.com/ [accessed 08.07.09]).

[17] For example, a multi-user workshop held at the University of Wales, Newport (October 2008), allowed participants to alter some of the biofeedback sound timbres (by varying the FM synthesis in the Max/MSP patch for instance), but not any major structures of the work, such as the mapping system.

Appendix A: Biofeedback and its creative application

Biofeedback refers to physiological changes in the body that occur during states of emotional arousal (joy, anger, fear) or relaxation (meditation, daydreaming, sleep). Different types of measurements can be taken to read the biofeedback; these include the muscle tension (Electromyogram or EMG), rate and depth of breathing, rate of eye movements (Electrooculogram or EOG), pulse and blood flow (Electrocardiogram or ECG), stress levels (Galvanic Skin Response or GSR), or brain wave patterns (Electroencephalogram or EEG). A combination of different measurements usually provides a more accurate result than one method alone. Biofeedback sensors are usually non-invasive, in the sense that they are simply applied to the skin, and use electrical impulses to assess the current mental state of their wearer. This data is then fed into a reference tool and presented as a graph, number or sound.[1] Biofeedback technology has been approved for various applications in medicine, science and entertainment: researchers at the Heidelberg Teaching Hospital, for example, use it in the rehabilitation of spinal injuries after accidents.[2] Researchers at the University of Karlsruhe currently develop a Bluetooth ECG shirt that will allow for easier constant monitoring of patients' heart rates,[3] while researchers at the University of Graz work on a brain computer interface (*BCI*) for creative, medical and entertainment purposes.[4] Biofeedback devices are already available that, for example, improve the urinary continence in women,[5] or in the area of sport monitor the heart rate during running or cycling.[6] Biofeedback also plays a part in the

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[1] Source: BioControl Systems, Brownsville, California (online) http://www.biocontrol.com [accessed 17.06.08] biofeedback sensors and interfaces [accessed 17.06.08]

[2] Orthopädische Universitätsklinik Heidelberg, *Wenn der Ärmel den Gelähmten Arm Bewegt: Eine Million Euro Forschungsgelder für Querschnittgelähmte: Orthopädische Universitätsklinik Heidelberg Entwickelt FES-Hybridorthese*, Press release, 2007, online http://orthopaedie.klinikum.uni-heidelberg.de/presse23.110494.0.html [accessed 24/05.09]

[3] This is similar to the lightweight ambulatory physiological monitor introduced here http://www.nasatech.com [accessed 09.07.09].

[4] Institute of Human-Computer Interface, Graz University of Technology, http://www.dpmi.tugraz.at [accessed 24.05.09]

[5] This application, arguably one of the most successful biofeedback training devices, is sold under the name *FemiScan* (http://www.femiscan.com [accessed 08.07.09]).

[6] http://www.polar-uk.com [accessed 08.07.09], for instance, sells heart rate monitor chest belts and watches. Although the use of biofeedback monitoring is widespread, it is important to remember that a biofeedback

ongoing research of human affect sensing, wherein the MIT affective computing research group led by Rosalind Piccard plays a leading role.[7] The *Rememberence Agent,* for example, is a wearable computer device developed by this group, which can help to recognise the faces of acquaintances or remember what was discussed at the last meeting.[8] The most commonly available biofeedback game applications may be the small galvanic skin response kits sold as 'Lovemeters' or 'Lie detectors' by toy stores and newsagents. However, within the last ten years, a range of biofeedback games such as *Freeze Framer* or *Journey to Wild Divine* have also become available.[9] Although particularly *Journey to Wild Divine* is marketed as an adventure game, its core purpose is stress reduction and relaxation training. Another biofeedback game is *ThoughtCaster*.[10] Using a wireless headset and three EEG sensors it assesses the brain activity of children with concentration disorders and hyperactivity. The game rewards improved concentration patterns during games. More recently, a headset has been developed that uses players' brainwaves to affect interaction in video games.[11] As this is not marketed for its potential for health and well-being, but simply as a new interface device, biofeedback technology is once more on the threshold of becoming a well-known technology.

Earlier use of biofeedback in art and music

Although already developed in the 1930s, biofeedback has only become available for artists' use in the 1960s. Much of the early work has been documented in David

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response merely indicates activities in a person's mind, but does not reveal their content or cause. Although in the US lie detectors (galvanic skin response sensors) and penile plethysmographs (measuring the penile blood flow) are used to assist in court cases, they have been proven to be unreliable and are not approved in the UK; particularly so since biofeedback responses can be 'faked' by practicing breathing techniques or projecting mental images.

[7] *MIT Affective Computing Group* (online) http://affect.media.mit.edu/ [accessed 24.05.09]. The *MindGames* research group led by Gary McDarby at the MIT Europe also conducted a range of interesting research projects into human affect; however, this branch only operated from 2000 to 2005 (http://medialabeurope.org/mindgames/ [accessed 08.07.09].

[8] Starner, Thad and others 'Augmented Reality Through Wearable Computing' in *Presence*, Volume 6 (1997) No. 4, pp. 386 - 398, also as MIT Media Laboratory Perceptual Computing Section Technical Report No. 524 downloadable from http://affect.media.mit.edu/publications.php [accessed 24.05.09]

[9] *emWave PC* (formerly called *Freeze-Framer*) is developed and distributed by the Institute of HeartMath in California (http://www.heartmath.com/ [accessed 08.07.09]). *Journey to Wild Divine* is available from http://www.wilddivine.com/meditation-products.html [accessed 08.07.09].

[10] http://www.wired.com/science/discoveries/news/2000/12/40475 [accessed 08.07.09]

[11] http://emotiv.com/ [accessed 08.07.09]

Rosenboom's *Biofeedback and the Arts: Results of Early Experiments.*[12] It shows that sound artists such as Pauline Oliveros, Alvin Lucier and David Rosenboom were amongst the first to translate participants' biofeedback into sound. Oliveros created works and projects like *Deep Listening*, *Initiation Dream*, *Software for People*, *The Roots of the Moment* or *Sonic Meditations*. In some of these, brainwaves triggered electronic percussion instruments; in others they create resonant, reverberant spaces. Rosenboom used participants' brainwaves to generate a complex sound composition in pieces like *On being Invisible* (1976/77). Thus biofeedback was popular amongst sound artists and experimental composers; John Cage, for example, took part in early biofeedback sonification experiments (see figure 16).

Figure 16: Video image of John Cage during alpha feedback (videotape by R. Teitelbaum; photo courtesy Shigedo Kubota, image in David Rosenboom, *Biofeedback and the Arts*, p.48).

The reason for its popularity may have been twofold: on the one hand, biofeedback emerged at the right historic moment. Developments within science and technology that enabled the exploration of space coincided with a cultural revolution that set up anti-war and civil rights movements. Biofeedback then was seen as a technology that could allow people to influence their environment by thinking and feeling. Futuristic and participative at the same time, this technology was strangely in tune with its socio-political climate. The second reason is that playing with biofeedback is intuitive rather than cognitive. Early biofeedback users felt they could communicate their states of being relatively easily, particularly since the four main types of brainwave patterns used – beta, alpha, theta and delta – are directly linked to emotional states. Rosenboom describes these four states as follows: Beta waves are characterized by "a highly vigilant state of unfocused attention, a state in which one seems right on the edge of making rapid and complex abstractions,

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[12] David Rosenboom, *Biofeedback and the Arts* (Vancouver: A.R.C. Publications, 1976)

logical conclusions, calculations, observations or insights." It is "highly creative and productive." Alpha is a "Zen-like state of high attention without specific focus, an object of attention, or the subject being engaged in making differentiations or abstractions." It is characterized by "open focus, clarity and alertness." Theta can be "associated with Yoga-like states of deep relaxation, or perhaps day dreaming-relatively unfocused. This state has more passive, but attentive, qualities." Delta finally is characterized by "states of very deep sleep, states of anesthesia, or other relatively unconscious states."[13] Despite its popularity, biofeedback became almost forgotten in the 1970s. Rosenboom explains this as follows:

> Achievement of success with biofeedback requires discipline, intense and regular practice, and often meditative skills. These were consistent with views held in the 1960s of transcendence and the idealism of cultural transformation. These ideals faded with the rise of 'yuppi-dom' in the 1970s, as disillusionment grew when earlier hopes for change were seen to fail or to be forgotten and, in the 1980s, as self-realization was replaced by the necessity of socio-economic self-validation.[14]

Since the 1990s, however, there has been a remarkable revival of biofeedback, which coincides with more intense explorations conducted within the field of generative art. This revival may have been catalyzed by advances in wearable technologies, computer processing power, sensor miniaturization, digital signal processing, and availability of wireless communication protocols such as MIDI, Bluetooth or Infrared. As a result of these developments, biofeedback technology has undoubtedly become more accessible. However, perhaps the more interesting task is to observe whether any of the views held in the 1960s have also undergone a revival, and have re-emerged in new works and by a new generation of practitioners.

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[13] David Rosenboom, 'Extended Musical Interface with the Human Nervous System: Assessment and Prospectus' (online) as part of *Leonardo Monograph Series*: Monograph Number 1, (International Society for the Arts, Sciences and Technology (ISAST): 1990) http://leoalmanac.org/resources/emonograph/rosenboom/rosenboom.html [accessed 31.05.08]

[14] David Rosenboom (online).

Examples of recent biofeedback applications in performance and dance:

- Stelarc: *Third Hand.* Stelarc's performances used mainly EMG signals (muscle stimulation) from other parts of his body to control a third hand (1976 - 1996)
- Emily Hartzell, Nina Sobell: *Web Séance* (1994, 1998). A virtual performance using brainwave drawings (A brainwave drawing is a live participant's brainwaves read with electrodes and converted to graphics by a device), web cameras, Closed-circuit monitors, heartbeats of live participants (*Leonardo* Vol. 38 No. 3 p.193)
- Yoichi Nagashima: *Flesh Protocol* (1999 - 2002) with composer Masayuki Akamatsu, performer Masayuki Sumi. Live performance using data from Electrocardiogram, breathing and Electromyogram (muscles) in an interplay between performer and composer
- *CyberPRINT*: A virtual reality dance environment; wireless sensors monitor key physiological signs (respiratory and muscle activity, cardiac activity and the nervous system). Then, this data is sent via radio to a PC used to project colourful 3D renderings on a screen for the audience to watch during the performance. (*Leonardo*, Vol 38, no. 4, pp. 280 - 285)
- Thilo Hinterberger (University of Northampton): *Braindance* – Two dancers improvise movement in real-time to their own sonified brain signals (2005, 2006)

Examples of recent interactive biofeedback installations:

- Christian Moeller: *Light Blaster.* A laser beam directed by the user's heartbeat (in *Interactive Architektur*, Aedes, 1994)
- Joseph A. Paradiso: *Brain Opera.* A set of musical instruments using biofeedback, developed at the MIT Media Laboratory (1995/96)
- Char Davies: *Osmose.* Use of breathing to explore a VR environment, exhibited at *Serious Games*, Barbican Arts Centre (1996)
- Jan Torpus and Michel Durieux: *Affective Cinema.* Using GSR to influence development of video playback, exhibited at *Transmediale 2002*, Berlin
- Mariko Mori: *Wave UFO.* An 11 m long pod. The installation visualised participants' brain waves as graphic symbols and colours (2003)
- Thecla Shiphorst and Susan Kozel: *Whisper.* Using GSR and pulse data to project responsive visuals. Seen at *RESPOND* exhibition, Cambridge 2003
- Michael Pinsky: *Life Pulse* as part of *Panacea,* John Hansard Gallery, Southampton (2004). Long poles with in-built sensors and light bulbs at the top. *Life Pulse* registered and illuminated according to visitors' heartbeats to create ever-changing rhythms and patterns of light (in *Artist Newsletter* August 2005 p.21)
- Christian Nold: *Bio Mapping.* Use of GSR to create emotional map of an environment. *Node* London, 2006 (http://www.emotionmap.net)
- Stephen Boyd Davies (Middlesex University): *Ere be Dragons.* Biofeedback game using GSR to create emotional map of an environment (2006)
- George Poonkhin Khut: *Cardiomorphologies.* Use of heart rate to control a visual display. *Inbetween Time: Festival of Live Art and Intrigue*, Arnolfini, Bristol, February 2006

Appendix B: Databases in the digital arts

(This list of databases was published on http://portal.unesco.org/culture/en/ev.php-URL_ID=2139&URL_DO=DO_TOPIC&URL_SECTION=201.html in March 2007)

Ars Electronica Archive - http://www.aec.at/en/archives
archives of digital media art from throughout the last 25 years.

CACHe - http://www.bbk.ac.uk/hosted/cache/index.htm

Capturing Unstable Media / V2 - http://capturing.projects.v2.nl

Database of Virtual Art (a project of Danube University Krems) - http://www.virtualart.at/common/recentWork.do

Digital Game Archive - http://www.digitalgamearchive.org

Electronic Arts Intermix - http://www.eai.org/eai/

Foundation Daniel Langlois / CR+D Database - http://www.fondation-langlois.org

Gallery 9 (Walker Art Center online exhibition space archives) http://gallery9.walkerart.org/

Heure Exquise - http://www.heure-exquise.org

iMediathek - http://193.175.23.115/imediathek/

Ludwig Boltzmann Institute for Digital Culture and Media Science
http://www.aec.at/de/lbi/

Media Art Archive Vienna - http://www.mka.at/

Multimedia: From Wagner to Virtual Reality (based on the book of the same name, co-edited by Randall Packer and Ken Jordan) - http://www.artmuseum.net/w2vr/contents.html

Net Art Idea Line (Whitney Artport) - http://www.whitney.org/artport/

NETBASE t0 (Institute for New Culture Technologies) - http://www.netbase.org/t0

Netzspannung.org - http://netzspannung.org/index_static.html

Rhizome ArtBase - http://www.rhizome.org/artbase/

Run Me (software art) - http://www.runme.org/

The Thing - http://old.thing.net/

Turbulence.org http://turbulence.org/blog/

Variable Media Network - http://variablemedia.net

Vektor (European Contemporary Art Archive) - http://www.vektor.at/

VideoArt Danemark - http://www.videoart.suite.dk/

Walker Art Collection - http://collections.walkerart.org/

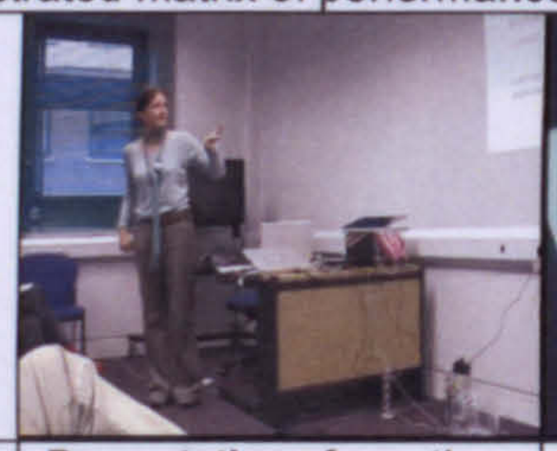
Appendix C: Action research methods overview:

Method:	**Structured participatory action research workshops**	**Open play sessions with multiple participants**	**Presentations demonstrations/ performance lectures, papers**	**Work in progress performances with an audience**	**Self-observation: performing to a camera**	**Self-reflection: research diary, self-reflective writing**
Tools employed:	Non-participant direct observation (video), interviewing, field notes	Non-participant direct observation (video)	Presentation and demonstration, short Q&A at the end	Performance with Q&A at the end, unstructured verbal and mentor feedback	Reflection in action (sweatbox), direct observation (video), experimentation	Reflection on action, brainstorming, evaluating, analysing integrating materials
Focus on:	First session: task based, second session focused on improvisation and immersive play	Open play, group interaction, discovery-based play. At *Parip* this developed as an 'after show' event with voluntary participation.	Are main points of research conveyed successfully? Eliciting peer feedback. Gauging how much of research need to be explained, how intuitive instrument is	Audience engagement, intimacy, immersion	Focus shifted from movement-based compositing (building a performance vocabulary) to non movement-based content	Analysis and evaluation of research field as well as work in progress, reflections on training events, formulating research hypothesis
Venues & dates:	TV Studio, London Metropolitan University, throughout April 2005	*Parip* conference, Bristol, June 2005, Newport School of Art, October 2008	For a full list of presentations, papers and training events see 'Research Activities and Research Training' in research diary	*Fresh! Festival*, May 2005, *East End Collaborations*, Sept 2005, *E-performance*, Dec 2005, *Time, Flesh & Nerve*, June 2006, *FEMF,* April 2008	TV Studio, London Metropolitan University, April 2005, Sept.- Dec. 2005	From 2002 - 2009
Scope of this method:	Valid, significant and appropriate. However the scope was too wide, resulted in too much data. The interviews, for example, were too removed from action.	Appropriate, valid and significant for group play issues. However, the sessions benefited from conclusions drawn from action research workshops.	Appropriate and valid, good opportunity to summarise and present research stages.	Valid, highly appropriate and highly significant: each live performance revealed new and unforeseen insights.	Appropriate, as it allowed for intense work at researcher's pace, significant and valid, as it allowed to see action from an audience member's perspective.	Valid and highly appropriate, produced great amounts of unfiltered data, necessary to synthesise this later on.
Was it effective? Any limitations?	Yes, but strongly led by researcher, very exhausting for researcher and participants.	Effective, especially when pace and scope is driven by participants. Spontaneous and flexible.	Only some feedback in Q&A. Live demonstrations very difficult (lack of access to rooms/ rooms unsuitable).	Not always great amount of verbal feedback, but additional insights gained from video documentation.	Initially effective, then overshadowed by analytic processes of practice.	Effective, but needs to be cross-referenced with other research tools to ensure validity and reliability.

Appendix D: Illustrated matrix of performances and other practice outputs

Still image:						
Type	**Action Research Workshops**	**Performance**	**Open play session**	**Performed installation**	**Performing to camera**	**Performance**
DVD no., patch no, audio rec.	DVD – Participatory research	DVD – Performance archive	DVD – Participatory research	DVD – Performance archive	DVD – Performance archive	DVD – Performance archive
Venue/ event:	**London Metropolitan University**, April 2005	**Fresh**! Festival, Southill Arts Centre, May 2005	**Parip** conference, Bristol, June 2005	**East End Collaborations (EEC)**, London, Sept 2005	Practice space, **London Metropolitan University** Sept – Dec 2005	**e-performance** event, Sydney, December 2005
Space:	TV studio (black / grey box) open space	Theatre space (black box) stage and seated audience	Open play area in theatre rehearsal space (black box)	Office corridor space, audience seated along floor	Black box	Theatre rehearsal space (black box) audience standing
Audience size:	9 participants in all, working individually or in pairs	20 - 25 audience members	4 participants + 6 observers. Then 5 participants + 1 observer	5 audience members at a time (5- 10 mins each); 40 total	1 (reviewing of the piece is delayed in time)	2 performances to groups of 30
Event context:	Sound/ movement/ media practitioners	Explorative live art/ performance/ dance	Mediated live art/ performance/ dance	Explorative live art/ performance	Sound/ movement/ media practice	Mediated live art/ performance
Duration:	2 x 3 hrs sessions per participant	15 minutes, plus 15 mins question time	2 sessions, 1 hour each	2 hours altogether	Sept. - Dec. 2005	15 minutes per session
Costume, lighting:	Exploring different lighting effects: darkness, sunlight, and artificial light. Wearable sensors	Black costume, wearable sensors, stage lights from the sides	4 blue gel diffused lights from above, wearable sensors	Laptop LCD screen as lighting, wearable sensors	Black box, LED lights for face and hands, Wearable sensors	Black costume, LED lights for face and hands, 20 LEDs for room, made lighting part of the performance
Spatialisation:	Quadrophonic	Quadrophonic	Quadrophonic	Quadrophonic	Stereo	5.1 surround
Content/ structure:	Task based, then discovery and immersive play	Movement/ task based improvisation, Butoh inspired	Open play, group interaction, discovery	Audience engagement, intimacy, improvisation	Developing a performance vocabulary of gestures, sound patterns	Movement/ task-based composition, using performance vocabulary
Feedback tool:	Direct observation (video) interviews, notes	Q & A session at the end (verbal feedback), demonstration	Direct observation (video), peer feedback	Verbal feedback, mentor feedback	Improvisation and self observation	Verbal and written feedback
Indicative content of feedback:	You can't go wrong with this… It's mesmerizing I thought her heartbeat was mine…	You have entranced us Use more contrast Clarify the format of the performance Clarify how it works	I could play all night… it's weird how you feel your pulse and hear it at the same time	Haunting, we wont be able to forget your face for a very long time…		Demonstrat[es] audible bodies that seemed like the Theremin all over again. Which is cool but how does it work and why bother?
Aims achieved	+++ - -	+++ - -	++ - - -	++++ -	++ - - -	+ - - - -

Appendix D: Illustrated matrix of performances and other practice outputs

Still image:						
Type	**Presentation of practice**	**Performance**	**Presentation of practice**	**Presentation of practice**	**Concert performance**	**Presentation of practice**
DVD no., patch no, audio rec.		DVD – Performance archive			DVD – Performance archive	
Venue/ event:	**Mindplay** conference, London January 2006	**Time, Flesh and Nerve** event, Lounge Gallery, London, June 2006	**UK Music Acoustical Network** conference, London, September 2006	**Creative Media Research Group,** University of the West of England November 2006	**Florida Electro Acoustic Music Festival,** April 2008	**CODA symposium,** University of the West of England, May 2008
Space:	Seminar room with data projector, seated audience	Section in open plan gallery space, audience seated on floor/ standing	Lecture theatre with data projector, seated audience	Seminar room with data projector, seated audience	Theatre space (black box); stage and seated audience	Lecture theatre with data projector, seated audience
Audience size:	15	40 +	30	10	25 +	15 +
Event context:	Play research	Video/ performance practitioners	Electro-acoustic music/ musicology	Media practitioners	Electro-acoustic music composers	Electro-acoustic sound practitioners
Duration:	20 mins	15 mins	30 mins	30 mins	10 - 12 mins	30 mins +
Costume, lighting:	Not applicable	Projector light responds to biofeedback levels as part of performance, wearable sensors	Not applicable	Not applicable	Stage light from top, wearable sensors	Not applicable
Spatialisation:	Stereo	5.1 Surround	Stereo	Stereo	5.1 Surround	Stereo
Content/ structure:	Presentation of results from action research workshops	Use of performance vocabulary, sound-led composition	Introducing principles for practice, playing stereo recordings of practice	Introducing principles for practice, playing stereo recordings of practice	Stillness, sounds gradually intensified	Introducing principles for practice, playing stereo recordings of practice
Feedback tool:	Q & A session	Video and self- reflection	Q & A session	Q & A session	Verbal feedback, mentor feedback	Q & A session, panel discussion
Indicative content of feedback:	The stages of play you identify are very interesting, I would like to hear more about that	People were interested in your performance: although it was very crowded, they still moved towards you.	Interest in the interface and sensors		Peaceful; Good to hear the whole body coming in… Is it essential to have a performing body there?	Unpredictability is a strength of the work, you should say that more clearly
Aims achieved	++ - - -	++ - - -	+++ - -	++ - - -	++++ -	++++ -

Appendix D: Illustrated matrix of performances and other practice outputs						
Still image:						
Type	**Presentation**	**Open play session**	**Video performance**			
DVD no., patch no, audio rec.		DVD – Participatory research	DVD – Final performance			
Venue/ event:	**Newport School of Art,** October 2008	**Newport School of Art** October 2008	**University of the West of England**, July 2009			
Space:	Lecture theatre	Surround sound studio (grey box) open space	TV studio (black box)			
Audience size:	35 +	12 participants	1 (reviewing of the piece is delayed in time)			
Event context:	Sound/ media arts practitioners	Sound practitioners/ composers	Media practitioners, non-specific audience			
Duration:	30 minutes	2 hours altogether	12 minutes			
Costume, lighting:	Not applicable	Not applicable	Black costume, wearable sensors, stage lights from the sides			
Spatialisation:	Stereo	Quadrophonic	5.1 surround sound			
Content/ structure:		Task based, then discovery (group interaction) and open play	Movement based improvisation, Butoh inspired			
Feedback tool:	Q & A session at the end (verbal feedback),	Direct observation (video), direct feedback	Not applicable			
Indicative content of feedback:	This avoids being stereo-typed as New Age... this goes deeper than I thought: now I understand your point about control and letting go	Hearing differences between participants' physiological data articulated as sound was the most enjoyable and interesting thing	I know this is part of a body but you can't immediately say what it is, it looks alien... my head swirls with sounds			
Aims achieved	+++ - -	++++ -	++++ -			

Appendix E: Thematic index of action research workshops				
	Theme	**observed**	**verbally communicated**	**in**
	Rule-based play: concerned with control, cause and effect, analytical thinking	AG, EJ try to restrain their blood supply to change the sound	"will I get this right?" AR; "I might get it wrong" LH; "if you concentrate you can control it" AM; "am I causing it?" AR; "I am concerned about results" AM; "it is hard to gauge how it works" LH	TEXT
CHANGE	Transgressive play: players stop applying habitual processes and create new ones	CK 15 mins into play turns away form observer, very focused. Just exploring sound changes from lower to middle frequency range; at 20 minutes: walks with the sensor - does walking affect the output? Yes… she attempts not to trigger; Bending down backwards - very low sound; Takes time for sensor to catch up; She notices time delay, waits for output to happen. 25 min: she tries hopping on the spot, reading goes up and down, then she relaxes	"...I felt not pressured so I kept going to see what happens… then all the time it became better… you think 'what would happen if you try something'" AR; "the stress level sensor is difficult to control, but then you just let it happen, you relax into it." CK, "you want the sound to follow the movement but her I have to develop new techniques for improvisation. That takes time" SG;	VIDEO
	Changes in mental states become audible without the player noting	MR describes how AG's eyes are opening and at the same time the sound goes 'ping';	"Mammography" AR; "you can almost see the *sea*" AR	TEXT
	Players say they are conscious of a change from their usual way of thinking; they have gained a different awareness	-	"like an instrument.. difference is that you don't need to know how to play it" AG; "like talking to someone through sound" AG; "unpredictable and yet still linked to the body. I can have control over it or not" AG; "you can't go wrong here" TR; "breathing affects it - there is a difference: the sound feeds back" EJ; "as soon as you move you know it is [connected] to you" EJ; "silences and stillness mean something with this equipment" TR; "it's reading you physically and mentally" EJ; "discrepancy between how we see it and what is really going on inside, like with the sun and moon cycles" EJ; "this is not control but chance based" SG; "divers have to control their heartbeat to go deeper" AM; "when there is light on an object it changes the human response" AR;	TEXT
	Change of thinking not taking place, as participants try to 'ground' this unusual experience within familiar ones, keep applying rule-based play processes in spite of recognizing it as 'not working'	AM tries to repeat movements to trigger the same sound; AM does not understand why fast movements of the arm do not cause fast changes to the blood supply of the limb (centrifugal forces);	"it would be clearer to use [the player's] location rather than blood flow" LH; "too much newness" AM, SG, LH; "you [normally] want the sound to follow the movement" SG; "sounds have to be [pre-] recorded to be more reliable" SG; "this does not work. What if you don't give audio feedback?" AM; "try a visual stimulus" LH, AM, SG; "you are doing 'something artificial about technology'" AM; "use wires to signal 'we are robots connected to…'" AM; "Can we use a drum beat instead?" AM; "we need an external influence" AM, SG; "we need more structure" AM, SG; "when you play you lose awareness of the audience. You are for yourself, not *projecting*." AM	TEXT & VIDEO
IMMERSION	Increased immersion: ecstatic play takes hold, conversation ceases	TR 'waves' and 'taps the space' during play; CK probes and touches the space with her hands, explores different positions;	"sound involves you" AG; "It is like floating…like swimming…like flying… the sounds are like dolphin noises… they are not, but the sound evokes this picture." AR; "you don't notice it [equipment] when you play" CK; "[equipment] is just functional" TR; "I was moving in it, not following it" MR;	TEXT & VIDEO
	Interrupted immersion: ecstatic play obstructed, conversations continue or recommence	Interrupted play: AG workshop 2, AR workshop 1; broken equipment AM, SG; too much and too fast movement AM SG;	"too aware of the sensors on" LH; " I am not ready to move' LH; " I feel like reading a paper" LH; "this is not for busy people, you need to take it in slowly, this is not for loud extroverts" TR; "temperamental, unpredictable sensors" TR; "I'm afraid to break something" LH, EJ; "I can't concentrate" TR, AG; "self-conscious in the presence of the other participant" TR, AG; "space is very ordinary, does not have the magic I usually associate with theatre" AM; "it's the first day, so one is not going into relaxing and letting it go" AM; "daunting	

			for people" LH; "set exercises worked against letting go" MR; "we need more set tasks" AM SG	
VERTIGO	Physical vertigo	AR spinning around	"trying to make myself dizzy" AR	TEXT
	Mental vertigo – memories flooding in	-	"Hospital… ominous… bad results… mammography" AR; "you can almost see the sea" AR; "wear the stress level sensors while going back to a place of childhood and record the reaction as an audio track" AR	
	Spatial vertigo – experiencing an expansion of space	-	"I am the source" AG; "it was like playing the space" CK; "it's you exaggerating effects on the environment, just by being there" CK;	
	Spatial vertigo - contracting the space	-	"I was the magnet" MR; "sit still in a position that is interesting to watch. This draws you in… Sound waves draw the audience in" EJ	
	Spatial vertigo – exchange of dimensions deepens the awareness	-	"exposing the inner processes is an important part of the work" LH; "you think its 'me over there', so you want to go there because you want to hear yourself" CK; "going inside…you get a glimpse of the inside" EJ; "internal processes become external" CK; "opens space out… but more an inner exploration" CK	
	Spatial vertigo – exchange of dimensions causes an awareness of becoming exposed	-	"I felt invaded…the instrument showed things I could not control" AG; it's reading you physically and mentally" EJ; "it's like stripping someone down to the bare bones" EJ, TR; "heart microphone does not bother me, it is not invading my privacy like the other sensors" AG; "it's not intuitive, its like a camera inside your body… like a reader of your anatomy" AM; "it is also exposing" CK	
	Vertigo of losing yourself - expansion beyond individual experience	-	"be part of my bubble" AG, "I felt as if his heartbeat was mine" EJ, "was wondering who wrote this score" Me; I really lost myself MR	
	Ecstatic play: deepest immersion, movement coming to a halt, when addressed players do not respond	Ecstatic play: EJ, TR, CK, MR; twitches EJ; Coming to a rest AR, TR; turning away from observer during play CK, EJ; slowness comes in CK;	"this is not for busy people, you need to take it in slowly, this is not for loud extroverts" TR; "like Javanese gamelan...they structure it using stages of development and slowness…it goes on for days" TR; there is "no need to move...I can just be here" CK; "I could go on for hours" TR;	VIDEO
	Fascination of play with the biofeedback sensors according to players	-	"much more interesting because it is unpredictable and yet still linked to the body. I can have control over it or not" AG; drop in stress levels was "mesmerizing, intriguing, I could go on for hours" TR; "something you need to discover for yourself" TR; "I felt like I really could get into it. I am fascinated by it" CK; "the more I tried to control it the less control I had" CK; "you get feedback from your mental states" CK; "it allows you to explore things about yourself" CK;	TEXT
FACILITAITON	Facilitator's role considered as helpful	touching the participant carefully AR; CK turns to the facilitator when her play has come to an end	"in the background… giving some feel" AG; "intimate" AG; "be part of my bubble" AG; it was good to be able to add a layer of communication and "to know it's ok to talk" AR	TEXT
	Facilitator's role not considered as helpful	Uncooperative participant LH; CK turns away from observer during play; MR says she needs more time to get into using the equipment. She does not like me to stop her all the time.	the facilitator should not interfere with play, as "play will make it obvious" CK; facilitator gave "too much information" LH, AR, SG, AM; "audience will discover what the sensors do" AM SG; there was "so much to take in" EJ; "daunting for people" LH; "set exercises worked against letting go" MR; "we need more set tasks" AM SG; "too much newness" AM, SG, LH;	
SOUND	Sound qualities considered as helpful to explorative play	-	"it's in the tone of people's voices" AR; "heart beat gives it ground" LH; "becoming one with the sound" AG; "it calms you down" AG; heart sounds are "comforting, reassuring" CK; "heartbeat freaks me out" EJ; "it's not just a pump" but amazing EJ; spatialisation "made me move… you *lean towards* the space". This encourages exploration CK; "I felt like moving" LH	TEXT
	Sound qualities not considered as helpful to explorative play	-	"electronic noises are not good to listen to" AR; "car alarm" LH; "heart sounds were the least interesting" CK, "heart beat gives it ground" LH; "try a rhythm, not only pitch" AG; "can we use a drum beat? It gives us *some focus*" AM	

Highlighted sections are referred to in the main text
Rule-based, transgressive and ecstatic play are observable sub-stages of explorative play

Appendix F: Technical report

This report introduces the technical realisation of the research. It describes how the biofeedback interface was developed and compares relevant software and hardware components. These include sensors, digitizers, data transfer protocols, software applications and sound analysis techniques. The report also lists to related artworks and research.

Developing a biofeedback interface

When this practice began to enter its experimentative phase (between 2003 and 2005), university research centres involved with biofeedback tended to collaborate with biomedical supply companies such as AD instruments or Guger.[1] Although these companies offer a wide range of biofeedback sensors, amplifiers and interpretation software for purchase to the public, the equipment is clearly built for use in hospitals and research institutes, as it is extremely sensitive as well as robust. The units tend to be large in scale and often need to be mounted on a hardware trolley. Understandably, for the purpose of a good diagnosis a high degree of precision is necessary, but for a performance practice less precision is tolerable. Moreover, the hardware also often communicates exclusively with its own software applications. While this may help to prevent human error in its operation, it makes communication with programming environments and open source applications (such as the ones used by performance artists) difficult. Furthermore, some equipment such as pulse sensors requires a participant who keeps still. This and the lack of wireless communication would greatly restrain a performer. Overall, the medical biofeedback kit was therefore too expensive and bulky. Another supply strand considered were biofeedback sensors used for sports. Particularly for a multi-user version, a cardio group training system was considered, where each participant would be wearing a cardio watch that communicated with a computer.[2] Although this seemed initially promising and more affordable, the software system did not communicate with programming environments and open source applications. More to the point, the data was designed to

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[1] AD instruments: http://www.adinstruments.com, Guger: http://www.gtec.at/content.htm [accessed 09.07.09].

[2] http://www.sportstronics.com/_CTS.htm [accessed 13.05.05].

download onto a computer *after* rather than during a group session. This made it incompatible with the artistic concept of a real-time sound experience and was therefore not pursued any further.

A further source of biofeedback kit was to build parts from scratch following various instructions and circuit diagrams published online.[3] However, it became soon clear that it would take a long time to build, match and calibrate an interface that would reliably measure different biofeedback responses. Therefore in the end, some ready-made parts from medical supplies were interfaced with a commercially available digitizer, which fed the data into a programming environment capable of digital signal processing (see schematic in figure 17). This approach is not uncommon; biofeedback artists and researchers such as Yoichi Nagashima have often built their own biofeedback interfaces. However, for various reasons they are reluctant to share detailed technical details.

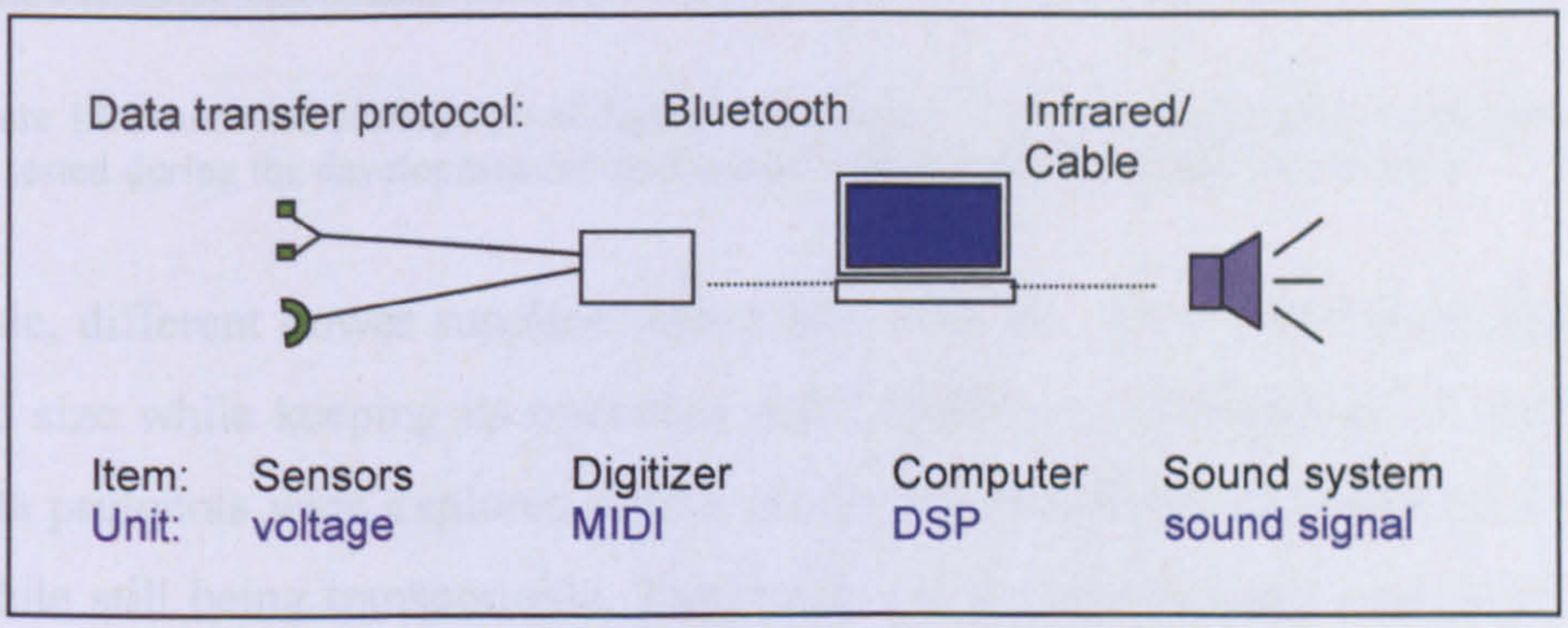

Figure 17: A schematic showing the equipment parts necessary to assemble the biofeedback device used in this research. Illustration by the author.

But even without these details it was still possible to build a portable lightweight system that was less precise than medical equipment, and robust enough to allow its wearer to move and play. To achieve this it was researched how different types of biofeedback data were measured, which hardware parts would be required and how the data would communicate with the software (see figure 18 for some of the components tested).

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[3] These are published, for example, at http://www.hackcanada.com/ice3/wetware/index.html [accessed 09.07.09].

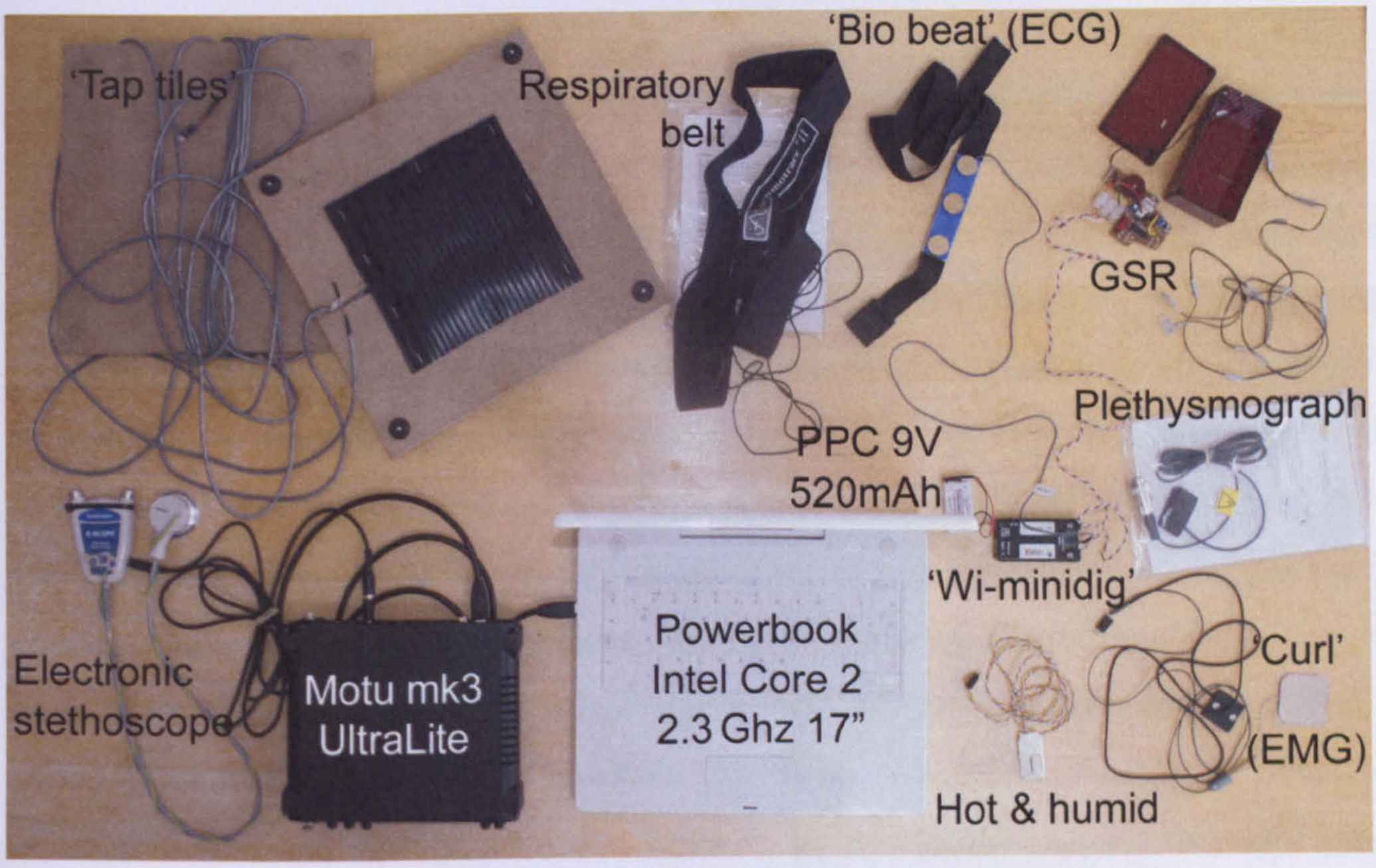

Figure 18: Annotated photograph of digitizers, hardware and biofeedback sensors that were tested during the development of the biofeedback device. Photograph by the author.

For example, different power supplies were tested with the aim of minimising equipment weight and size while keeping its operation safe.[4] Different combinations of hardware as well as data protocols were explored until a match was found that communicated the data reliably while still being transportable. The result was an interface that was small enough to be hidden underneath clothing, which made it possible to distract users' attention from the equipment. Then, towards the end of this research (2009), small-scale ready-made solutions started to become available.[5] This was a long awaited and welcome development. Nevertheless, researching into biofeedback sensing in detail was of great benefit for the progression of this research, as it helped to define the artistic possibilities and limitations provided by each biofeedback sensor type.

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[4] To keep participation non-threatening and enjoyable, only non-invasive biofeedback sensors were ever considered.

[5] http://www.biomuse.com [accessed 09.07.09]

Biofeedback responses

The most popular and also most intuitive biofeedback response is the *heartbeat.* In order to build it into this research practice, a battery powered electronic stethoscope (*Cardionics e-scope II*)[6] that allowed up to two minutes of continuous use was tested first. Although the heart sound was clearly audible, the stethoscope also amplified the voice, breathing, physical movement as well as clothing brushing over the microphone head. It was difficult to wear the stethoscope – let alone move with it – without causing any of these distortions to the signal. The only way to use the stethoscope in a performance would have been in total physical stillness. Although this would have been within the remit of the artistic concept, there were still other problems. The signal was not clear and lacked depth as well as richness; and when the heart sound was greatly amplified there was the problem of acoustic feedback. A cardio microphone (electrolet condenser 10 - 600 MHz) was considered next and equally ruled out, since its signal required too much amplification, which led to the deterioration of the sound quality. It also proved too expensive for a multi-user version, and its voltage requirements were not fully compatible with the digitizer. Moreover, it was bulky and would have drawn the wearer's attention towards itself rather than the sounds produced by it. As direct sonification proved difficult, piezo-electric pulse transducers were tested next. These are attached to a finger, which eliminates sound distortions but requires the participant to keep very still. They also do not work reliably when participants have cold hands; this adds an additional difficulty. Infrared photoelectric sensors (plethysmographs) with adjustable finger straps were explored after that. As plethysmographs supply data streams rather than signals, none of the problems the microphones posed did occur. Moreover, they were robust enough to allow participants to move while wearing them. After some minor adjustments, a certain plethysmograph matched the power supply of the digitizer and was used in performances and group sessions (2005 - 2008) to interpret the blood supply to the limb as well as the finger pulse. But despite this initial success, further practice revealed that precisely because two types of data were measured, it was often difficult to filter out the actual onset of a heartbeat. Like the ocean's tide, the blood supply to the limb provides large data variations. The finger pulse, on the other hand, provides small variations, like the oscillations of ocean waves. Only in some conditions – for example when the blood supply to the limb was low – was it

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[6] http://www.egeneralmedical.com/caresiistetf.html [accessed 09.07.09]

possible to filter out distinct beats. This in turn had a direct implication on the movement during the performance as well as for how long it could be sustained. In 2008 then, a small electrocardiogram sensor (*Biobeat*) became commercially available.[7] In contrast to the plethysmograph, electricity here ran through the body, which required greater caution in its operation. In a research paper,[8] Nagashima describes how the strong and healthy body of his ECG performer could take on greater amounts of electricity than an untrained participant; this alone indicated that using the ECG sensor in a participative version would be difficult. Moreover, the chest belt allowed only for small and careful movements without losing the heartbeat reading. This suggested it only being suitable for more experienced performers. Once placed correctly on the body, however, the heartbeat reading was reliable and could be sustained for long periods of time (anything up to six hours), which makes it ideal for durational performances where the heartbeat would also control the timing of various sound patterns. The chest belt finally allowed wearing the sensor less visibly.

To monitor the *breathing*, a piezo force sensor was explored. This is usually strapped around a participant's chest; the chest expansion during the breath intake stretches this sensor, which produces a voltage that can be measured. In early tests the data obtained from this sensor was crude, which meant the wearer needed to breathe in an exaggerated fashion to effect a change in breathing patterns. Repetitive breathing patterns also seemed to produce less and less data, eventually ceasing altogether, although the wearer obviously never stopped breathing. Therefore, working the sensor demanded a great deal of mental focus, which may disturb a participant immersed in play. It is also problematic to find comfortable chest straps for women and variable straps that fit anyone from children to large adults. For reason of these impracticalities, breathing patterns were not monitored, but it was left to the performer to make the breath audible. This worked particularly well in connection with a *hot and humid* sensor:[9] placing this sensor on the skin resulted in a slow and gradual change from room temperature and moisture to body temperature and

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[7] The BioBeat-50 v1.1 measures the ECG through skin surface voltage http://infusionsystems.com/catalog/product_info.php/products_id/177 [accessed 09.07.09]

[8] Yoichi Nagashima 'Interactive Multi-media Performance with Bio-sensing and Bio-feedback' in *Proceedings of the 8th International Conference on Auditory Display (ICAD2002)* downloadable from http://www.icad.org/node/2776 [accessed 24.05.09]

[9] http://infusionsystems.com/catalog/product_info.php/products_id/67 [accessed 09.07.09]

moisture. When removed, the sensor slowly returned to measuring its environment. Placed in the mouth or used in combination with breathing techniques it produced a faster and more dramatic change. However, the disadvantage of using a sensor in this way was that it focused the performer's mind immediately on controlling the body rather than simply listening to it. Therefore it was abandoned in later performances.

Then a sensor was tested that measures the contraction of small muscles, such as the ones in the forearms. Sensors like this provide an *electromyogram* (EMG) that interprets tense muscles as a higher level of arousal and relaxed muscles as a relaxed stated of mind. However, during early experiments it proved difficult to *gradually* flex the muscles in order to obtain a small or gradual change of data. An untrained participant would find it difficult to operate the sensor in a subtle way. As documented in Nagashima's *Flesh Protocol* performance,[10] a participant needs to make conscious efforts to affect the data and with it the sound. This can focus participants on deliberate actions and prevent explorative play. For this reason it was decided not to measure the EMG in this research.

The *galvanic skin response* (GSR), on the other hand, seemed more suitable, as it worked with an entirely passive physiological response. The sensor has two electrodes that are usually attached to two fingers of the same hand. A small current is introduced and the electric conductivity of the skin between the electrodes measured. Thus the sensors detect increased sweating, which can be a sign of increased stress, excitement or nervousness, as well as decreased sweating, which usually coincides with greater relaxation. These sensors are reliable as well as cost effective. Alternative ways of playing them are to place them over a bony part of the body where they produce less change and then over a fleshy part where the reaction is greater. It thus becomes possible to draw a sonic map of the body using touch, which can help to make the performer more aware of how some of the biofeedback processes 'naturally' take place in the body, emphasizing, for example, localized physiological reactions to stress.

In spite of the wide range of biofeedback responses available, many practitioners prefer to work exclusively with *brainwave patterns* (EEG). This biofeedback type has the advantage that it focuses the performer's mind immediately on controlling arousal or relaxation of the

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[10] http://www.mindatplay.co.uk/fleshprotocol.html [accessed 09.07.09]

body while listening to the sonified feedback. This technology also still carries a trace of magic, as we are the least familiar with hearing each other's brainwave patterns sonified. A disadvantage is the cost of the equipment as well as having to wear a number of electrodes directly on the head. Until recently these electrodes were mounted on something that looked like a perforated swim cap. Only in 2008, a miniaturised version has become available, which reduces the wearer's awareness of the technology and makes it socially more acceptable.[11] However, for this research it was decided not to measure brain waves. Emotional states do not occur in isolation but affect the whole human being, and thus when a participant enters a state of deep relaxation it not only affects brain wave patterns, but also heart rate and breathing patterns. Using an EEG can focus the attention of the performer unduly on thinking, to the neglect of neglect other physiological processes. This can reinforce a perceived divide between thinking and sensations originating in the body.

Finally, the measuring of *eye movements* (EOG) requires a laser that tracks speed and direction of the eye movement. The participant has to sit facing the tracking beam, which sets physical restraints for a performance. The laser unit is also expensive and not easily available. To allow for an experience that is less obviously mediated and also to reduce costs it was therefore decided not to measure eye movements (EOG).

As it is not necessary to measure all biofeedback responses to obtain a clear picture of the participant's emotional state, for this research practice, a small range of sensors were selected that could be equally useful in a solo performance as well as a multi-user version. For the final solo performances, only the galvanic skin response sensors (GSR), and heartbeat (ECG) were used. These sensors can be used in a passive as well as a more active way, which allows the trained performer to employ techniques ranging from physical stillness to improvised movements. For the multi-player version, plethysmographs and the galvanic skin response sensors emerged as the most suitable sensor types. Used mainly passively, these sonify participants' mental states without effort and thus do not require training. They are also cost-effective and only need to be placed on the hands – possibly built into jewellery or a glove – which reduces stressful associations of medical experimentation.

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[11] http://emotiv.com/ [accessed 08.07.09]

Digitizers, hardware and software

Most sensors output data as a fluctuating voltage. This needs to be measured and translated into numbers by a digitizer such as the *iCube*.[12] A more expensive and more bulky alternative to the *iCube* is the *Kroonde Gamma* digitizer.[13] In this research the wireless *Wi-mini Dig* version of the *iCube* was used. It reads data signals ranging between 0 and 5 Volts from the sensors, and translates them into the MIDI protocol before sending them via Bluetooth to the computer. This digitizer is fully compatible with open source software and/or programming environments such as Max/MSP, and widely used by performance, sound and installation artists. It comes with its own software application, but also with external software objects that represent the physical interfaces within Max/MSP. The digitizer is robust enough to be worn in a group performance and can support up to eight sensors. It can be powered by electric mains, a 9V battery pack or a 9V battery. Since 2008, a wireless micro version (*Wi-micro Dig*) that measures about the size of a thumb has also become available. The continuous miniaturisation of equipment makes it undoubtedly easier to attach the technology to the performer's body without drawing unwanted attention to it. For the best translation of the biofeedback data, the *iCube* acquisition rate needs to be set to 10 milliseconds with 12-bit resolution. Although there was a small drop in performance between a cabled *Minidig* and a Bluetooth *Wi-mini Dig*, only the wireless option allows for the desired unrestrained movement during the performance. Moreover, for some sensor types, such as the ECG, it is vital to use battery power instead of a mains supply to avoid any accidental overloads of electricity onto the body. Using a combination of sensors with a standard 9V 250mAh battery limits the reliable use of the digitizer to between 40 to 90 minutes, which limits the possible performance duration. A larger 9V battery pack is available that allows for up to 6 hours of continuous use. This is particularly helpful for explorative work and durational performances.[14] However, the battery pack

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[12] http://infusionsystems.com/catalog/index.php/cPath/21 [accessed 09.07.09]

[13] http://www.cycling74.com/_products/kroonde [accessed 09.07.09]

[14] A durational performance is a format that exceeds the 'traditional' timeframe of Western performance work (about 90 minutes). Durational performances can therefore last anything from several hours to several days, to even a year. The duration, which is agreed on beforehand, often acts as the structural framework for the performance. A second core characteristic is the focus on duration, the experience of time passing. This highlights the gradual changes time may inflict upon the performer's practice, as well as the audience's reception. Durational performance, as a part of contemporary Western performance art, has gained more exposure recently. For example in 2003, a number of durational performances were exhibited as part of the

weighs about 450 grams and even if it is clipped to a belt or trouser top at the back, the performer clearly feels the weight. Specialist 9V 520mAh batteries – normally used to power microphones in remote locations – ultimately provided the best alternative.[15] For the solo performance the smallest and lightest setup was used, often exposing at least some of the technology to wear and tear. This was a risk considered worth taking. For the multi-user version, the digitizers and their batteries were sealed in plastic boxes and packed into small pouches that could be worn around the waist. The sensor cables came out of the pouches ready to be strapped onto participants' fingers. This reduced the amount of time spent on dressing a participant, allowing for immediate interaction. The Bluetooth communication between digitizer and computer was stable and reliable on the whole. However, too much interference with the digitizers as well as switching them on and off in the wrong order occasionally caused the Bluetooth connection to drop. Therefore a set of instructions detailing the order of steps needed to be followed. Also, occasionally wireless PDA and phone signals in the surrounding area were picked up. With increased technologization, this is an almost unavoidable hazard, as even when the audience switches off all of their Bluetooth equipment, there might still be a device in use nearby. The interference causes a short interruption to the signal, and is as disturbing as an audience member coughing.[16] Another limitation of the work was set by the computer's processing speed, as this determines the speed of the live signal processing, for example the number of signals that can be generated simultaneously, and the latency of the playback. Yet, real-time processing is important, as only then can a participant can make the connection between physical sensation and sound. Some biofeedback sensors such as plethysmographs also require a very detailed data flow, and therefore a Macintosh G3 iBook 900 MHz that was initially used soon proved insufficient and had to be replaced by a G4 Powerbook with

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Tate Modern's *Live Culture* programme in London (http://www.tate.org.uk/modern/exhibitions/liveculture/durationalwallscreen.htm [accessed 27.07.2010]). durational performances also feature in the *Performance Studies International* conference in 2009 (http://www.psi15.com [accessed 27.07.2010])

[15] These rechargeable Lithium Polymer batteries are difficult to obtain (http://www.trewaudio.com/products/ipower/9v/ [accessed 09.07.09]) but provide uninterrupted use of the digitizer for 4 - 5 hours.

[16] Another technical problem occurred at *Parip* 2005 conference, where the four Bluetooth digitizers to be used simultaneously cut each other off. This might have been due to the metal reinforcements in the walls interfering with the wireless communication. In any case, it meant that on this occasion instead of four players using the multi-user version only one could play at a time. It is difficult to assess the reliability of the wireless communication network in a performance place before arriving there, which highlights one unpleasant element of working with live and wireless signal processing. Nevertheless, apart from these occasional problems, the data was transmitted reliably at most times.

1.5 GHz processing speed. This seems to be the minimum specification in order to trace data like the pulse in real-time.

The MIDI data from the sensors was then translated into sound using Max/MSP, a real-time signal-processing programming environment.[17] Max/MSP allows for generative sound compositions and is popular with many sound, performance and installation artists.[18] It was originally developed in the mid-1980s by Miller Puckette as 'Max' at IRCAM (Institut de Recherche et Coordination Acoustique/Musique) in Paris. In 1989, IRCAM developed a real-time synthesizer card to which Puckette connected Max and a set of audio objects. The software was then commercially released as Max in 1990. In 1996, Miller Puckette developed Pure Data (Pd) at the University of California in San Diego.[19] Like Max, Pd processes real-time signals using a graphical interface. In contrast to Max it is available for free, but provides less technical support. Shortly after the release of Pd, David Zicarelli combined the Pd signal processing infrastructure with parts of the exisiting Max environment and added new audio processing parts. He also improved the usability of the interface and added new features. The resulting program, known as Max/MSP, has become popular with ever more plugins and external objects being developed. Apart from Max/MSP and Pd, there are other real-time signal-processing programming environments, such as MIT's CSound[20] or James McCartney's SuperCollider,[21] which could have been used instead. These conduct sound synthesis and signal processing through a text-based language which needs to be learned before a user is able to benefit from the program. This is difficult for users who do not have a background in programmig or mathematics, and for this reason the software was not used here. The graphical interface provided by both Pd and Max/MSP, on the other hand, not only hides the programming involved (Javascript, C and C++) but also invites intuitive use and experimentation. Max/MSP version 5, released in April 2008, now marks a more drastic break away from Pd: through the slick interface it seems to associate itself less with experimenters and self-taught programmers and more with multimedia designers. Other differences between Max/MSP and Pd – apart from

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[17] http://www.cycling74.com/_products/maxmsp [accessed 09.07.09]

[18] http://www.cycling74.com/_section/artists [accessed 09.07.09]

[19] http://puredata.info/ [accessed 09.07.09]

[20] http://csounds.com/ [accessed 09.07.09]

[21] http://www.audiosynth.com [accessed 09.07.09]

usability, technical support and cost – concern the way in which some tasks are executed: it sometimes requires greater mathematical precision and logical planning to construct patches in Pd, particularly when some of Max/MSP's ready-made plugins and objects are not available. In order to be able to spend most time composing and performing it was decided to only use Max/MSP in this project (a sample patcher window can be seen in figure 19).

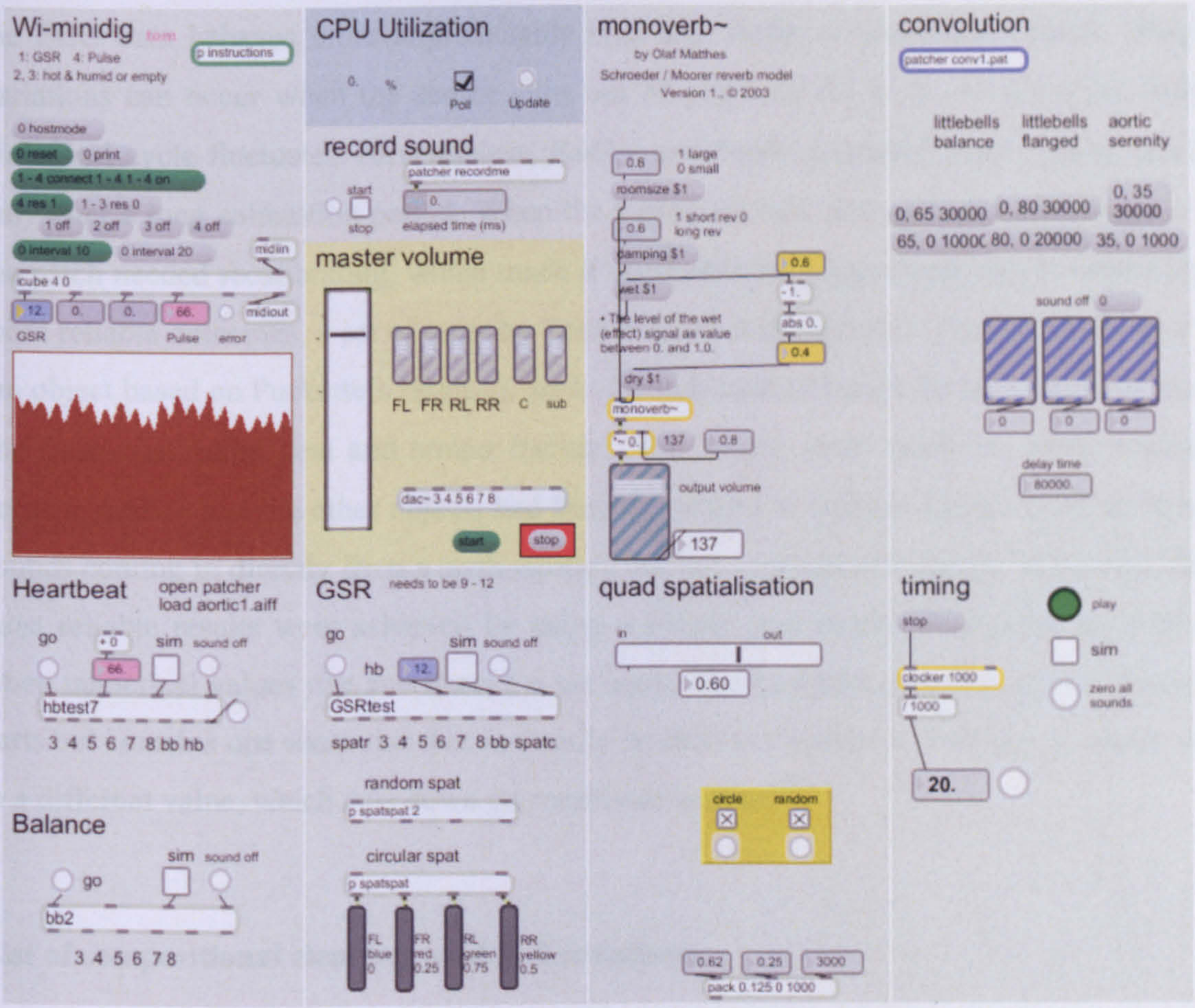

Figure 19: Main patcher window of *Excitations* composition.
Compiled with Cycling 74's Max/MSP 5. Programmed by the author.

The last preparatory stage before the composition could take form concerned the real-time sound analysis of the incoming ECG data. This data analysis was needed to successfully identify the heartbeat. In the composition, the heartbeat was to be sonified in two different ways: using wavetable oscillators and using frequency modulation synthesis. When ECG data was fed into wavetable oscillators, the natural oscillations contained in the data were simply translated into frequencies and – in its simplest form – a pure sine wave tone moving up and down the pitch can be heard. The heartbeat can then be perceived by

listening, as the pitch peaks on the beat. When the ECG data is fed into frequency modulation synthesis, on the other hand, we hear notes, which need to be triggered on the beat. In order to identify the beat reliably, a range of different real time sound analysis tools were therefore explored. The first were *fiddle~* and *bonk~* by Miller Puckette. *Fiddle~* is a Max/MSP object that decomposes sound to detect the frequency. It works particularly well with string instruments (hence the name). *Bonk~* is normally used to identify the attack of percussion instruments. Neither was particularly suitable here, since the ECG data behaves more unpredictable than any violin or percussion sound. Huge variations can occur when the sensor slips out of place on the body, or when the daily biological cycle fluctuates. Nevertheless, *fiddle~* and *bonk~* produced some results, albeit only after a long calibration period. When the biological data changed after an hour or so, the patch needed recalibrating, which made it unsuitable for longer-term use. In search for more reliable outcomes, a set of tools by Tristan Jehan was explored. This included *pitch~* (an object based on Puckette's fiddle~), *bark~* (which uses 25 bands for spectrum analysis) and *beat~* (an audio beat and tempo tracker). The results were much the same, mainly because *fiddle~* and the other objects had been developed to analyse signals (such as heart sounds coming in directly from a stethoscope), but not a stream of integers. In the end, the most reliable results were achieved by using a simple *past* object. *Past* sends an output when numerical values rise and exceed a set mark. The heartbeat consists of four distinct parts but contains one sharp rise that can easily be detected with *past*. *Past* can be easily set to a different value, which cuts down on recalibration time.[22]

List of compositional elements used in *Excitations*:

Random objects by Gary Lee Nelson (downloadable from http://www.timara.oberlin.edu/~gnelson/maxdownloads/downloadmax.htm):

- *Ranf* returns a floating point number between zero and one, used to drive a flange object
- *Rand~* returns a random frequency
- *RandIJ* returns an integer between the lower and upper limits inclusive.

[22] Practice has also shown that if the ECG data is very clear, *past* also detects the second, smaller attack of the heart beat, which then needs to be filtered out to avoid triggering the FM synthesis note twice.

Convolution (multiplication of signals in the frequency domain):

- Use of Fast Fourier Transform (*fft~*) and inverse Fast Fourier Transform (*ifft~*) to switch between time and frequency domains
- Use of *delay~* to acoustically separate the convolved signal from its parent signals

Additive synthesis:

- To control amplitude and frequency of each partial of the big bells and singing bowls. The tuning of these instruments was particularly important, as its partials provided the tonal centre of the piece.

Frequency modulation synthesis:

- Used to generate a range of heartbeat notes that would be played on every beat. As their carrier frequency would respond to the live data in real time, these notes would sound slightly differently each time.

Polyphony (little bells):

- Use of the *poly~* object to allow for clusters of little bells

Timing of the piece:

- Use of a timer that finds the number of beats per minute (BPM) by monitoring the actual heartbeats and averaging this over time
- *Clocker* to fade in / out notes on particular heartbeats

Flanging (modulating the delay time of big bells and singing bowls)

- Using *tapin~* and *tapout~* to delay left and/or right channels of notes generated with frequency modulation synthesis
- Using *randIJ* to randomise the depth of modulation over time

Reverberation:

- *Monoverb~* by Olaf Matthes, mono implementation of the Schroeder/Moorer reverb model. Downloadable from http://www.akustische-kunst.org/maxmsp/. *Monoverb~* was used to extend the horizontal spatialisation further into the distance.

Spatialisation (5.1 surround):

- Quad spatialiser, using the Pythagorean theorem ($c^2 = a^2 + b^2$) to calculate the distance c of a travelling sound from each of the four speaker corners, and to set the volume of the sound accordingly (the closer to a speaker the louder the sound).
- Later on a quad spatialiser by Randy Jones (http://www.2uptech.com) was used to translate the location of travelling sounds into sound volume per speaker.
- Use of centre speaker for high frequency outputs
- Use of subwoofer speaker for low frequency outputs

Real time sound analysis (balance board):

- *Loudness~* by Tristan Jehan analyses the spectral or time-domain energy. Tristan Jehan objects were downloaded from http://web.media.mit.edu/~tristan/ >Max/MSP.

Real time sound analysis (heartbeat attack):

- *Fiddle~* Max/MSP object for pitch following and sinusoidal decomposition by Miller Puckette, MSP port by Ted Apel and David Zicarelli. Downloaded from http://crca.ucsd.edu/~tapel/software.html.
- *Bonk~* percussion follower for Max/MSP by Miller Puckette, MSP port by Ted Apel. Downloaded from http://crca.ucsd.edu/~tapel/software.html.
- *Pitch~* pitch tracker by Tristan Jehan, based on *fiddle~* by Miller Puckette.
- *Bark~* auditory model spectrum analyzer by Tristan Jehan, 25 bands.
- *Analyser~* FFT-based perceptual analyser by Tristan Jehan, a single object that outputs many sound analysis perceptual features at once.
- *Beat~* Audio beat and tempo tracker for G4 and higher by Tristan Jehan. Tristan Jehan objects were downloaded from http://web.media.mit.edu/~tristan/ >Max/MSP
- *Past* object (sends a bang when a number within a list of numbers rises above a set value).

List of suppliers of biofeedback sensors, digitizers and software

Data systems and sensors:

http://www.adinstruments.com AD Instruments: biological data acquisition and analysis systems for research and education (offices worldwide, UK based in Oxford)
http://www.biopac.com Biopac Systems Inc.: biological data acquisition and analysis systems for research and education (US based)
http://www.gtec.at/content.htm Guger technologies: mobile biosignal acquisition and processing on the Pocket PC, PC or notebook
http://www.schuhfried.at/eng/biofeedback/physiorecorder_mehr_info.htm Schuhfried: biofeedback equipment seems bulky (based in Austria)
http://www.rochestermed.com/Products.htm Rochester Electro-Medical Inc.: biofeedback and neurofeedback equipment and supplies (US based)
http://www.thoughttechnology.com/sensors.htm biofeedback and neurofeedback equipment and (US based)
http://www.bio-medical.com biofeedback and neurofeedback equipment and supplies (US based)
http://www.gereonics.com/ Gereonics: Electrodes, sensors and supplies (US based)

Particular biofeedback sensors:

http://www.pro-tech.org/scripts/asp/prod_effort.asp ProTech: piezo respiratory effort sensors (US based)
http://www.polar-uk.com heart rate monitors for sport, wrist watches and chest belts
http://www.ciclosport.co.uk heart rate monitors for sport (wrist watches)
http://www.sportstronics.com/CTS.htm chest belt system for 20 participants
http://www.heartratemonitor.co.uk sales point for heart rate monitors
http://www.andromed.com/ The Androsonix is an electronic biological sound sensor at the heart of Andromed's family of products. A single-use sound sensor, the Androsonix is affordable, reliable, easy-to-use and, above all, non-invasive.
http://www.egeneralmedical.com/caresiistetf.html Cardionics e-scope II for the hearing impaired: electronic stethoscope that provides a mono jack out
http://www.bernafon.com Lexis FM transmitter/ receiver, can be used in connection with the Cardionics e-scope II for wireless data transmission
http://www.ufiservingscience.com 1020 photoplethysmograph interfacing
http://www.hackcanada.com/ice3/wetware/index.html instructions and circuit plans for GSR applications and lie detectors
http://www.kosmos.de >produkte >electronic&physik > luegendetector ('lie detectors')
http://www.maplins.co.uk 'Lovemeter' kits

Digitizers:

http://www.cycling74.com/_products/kroonde Kroonde Gamma
http://infusionsystems.com/catalog/index.php Wi-minidig, Wi-microdig

Software:

http://www.cycling74.com/products/maxmsp Max/MSP
http://puredata.info/ Pure Data (Pd)
http://csounds.com/ Csound
http://www.audiosynth.com SuperCollider

Appendix G: Generative Processes

Processes and algorithms used in generative art and music can include linguistic and structural processes, systems which learn, interactive or behavioural processes, creative or procedural processes, mathematical processes, the use of biological or emergent structures, and evolutionary methods.

Linguistic and structural processes generate materials with a recursive tree structure. They have their roots in the generative grammars of language (Noam Chomsky, 'Three Models for the Description of Language' in *IRE Transcripts on Information Theory*, Vol. 2 (1956) pp. 113 - 124) and music (Lerdahl and Jackendoff, *A Generative Theory of Tonal Music* (Cambridge, Massachusetts: MIT Press, 1983)). Artworks are created by building a vocabulary (dance steps gestures, musical expressions) and a grammar that defines how different elements of the vocabulary are to be combined to make a sentence (a grouping of steps, a set of harmonies). This helps to create comprehensible as well as logical pieces. Grammars can work at macro-level (concerning a complete dance performance, harmonies or rhythms) as well as micro-level (individual poses, or harmonics contained in a single note). When the same rules work at macro-level as well as micro-level, a process of self-similarity (or recursive tree structure) can be observed.

Systems that learn are programs that have no given knowledge of the genre they are working with. Instead, they collect the learning material by *themselves* from the example material supplied by the user or programmer. The systems can, for example, isolate the aesthetic code of a certain musical genre or graphic artwork and then use this code to create new similar compositions. Isolating the code is accomplished by comparing the material to a pre-made set of arguments, as well as running a set of tests or rules to check that the new composition is 'complete'. This method of algorithmic composition is strongly linked to studies in cognitive science and neural networks. Thus systems that learn may be referred to by the different type of machine learning they employ, for example supervised learning, unsupervised learning, reinforcement learning, pattern recognition, feature selection, model selection, ensemble learning, artificial neural networks or support vector machines.

Interactive or behavioural processes: artworks are created by a system that seemingly has no further inputs from the outside. For example, *Living Room* by Charles Sandison is an installation where words move and interact with each other along characteristics defined by the artist. Over time these words expose typical human behavioural patterns, for instance 'males' fight over food, 'females' bear children, children grow into adults etc. (these behaviours be seen here: http://www.youtube.com/watch?v=TG0zh0RF934 [accessed 06.08.09]). When *Living Room* was shown at the Shanghai Biennale at the Shanghai Art Museum 2006, the words were not in English. However, their motion and behaviour can still be observed).

Artworks that use creative or procedural processes are designed or initiated by artists or composers. For example in *It's gonna rain* by Steve Reich (http://www.mindatplay.co.uk/ itsgonnarain.html [accessed 07.08.09]) or *Music for Airports* by Brian Eno (http://www.mindatplay.co.uk/musicforairports.html [accessed 07.08.09]), one can hear soundloops being overlaid. Each track has a different duration, and so a constant process of phasing occurs.

Artworks that use mathematical processes employ mathematical equations and/or random events. The most common way to create musical compositions through mathematics is to use *non-deterministic* methods. A non-deterministic algorithm is a mathematical task that involves a number of choice points. The exact outcome of running the task often depends on the choices made underway. Since preferred choices are not given, it remains unpredictable which route will be taken and, in some cases, which outcome will be arrived at. Thus when a compositional process involves non-deterministic methods, this means that the musical outcome is only partially controlled by the composer. A composer may also choose to influence the probability of random events to occur. One such example, where random events influence a composition, is *Imaginary Landscape no. IV* by John Cage (http://www.mindatplay.co.uk/ imaginarylandscape.html [accessed 07.08.09]), a piece involving twelve radios. The length of the piece and the numbers of radios turned on is determined by the composer. However, the exact content of each radio broadcast remains unpredictable.

Using *biological or emergent structures* revolves around the idea that music, sounds, or graphics may be produced by simply 'farming' parameters from an existing complex system, such as the weather. As this system continuously introduces changes and is never entirely predictable, the artwork that 'feeds' off the system will also exhibit these characteristics. An example for 'farming sounds' is *Weathersongs* by Richard Garrett (http://www.mindatplay.co.uk/weathersongs.html [accessed 07.08.09]), which uses a local weather system for the composition of musical pieces.

Using *evolutionary methods* of composing music or generating artworks means to employ genetic algorithms. For instance, a musical piece may be created by applying a genetic algorithm to a set of initial sound elements. This creates a new generation of elements. The algorithm then uses a fitness function to cut out unwanted elements from the set and to refine those that remain in the next application of the algorithm, which creates a new generation and so forth. Thus through mutation and selection, a set of particular sound elements can gradually evolve and begin to shape the composition. *Electric Sheep* by Scott Draves (http://www.mindatplay.co.uk/electricsheep.html [accessed 07.08.09]), for example, mimics such a genetic algorithm.

Generative art and music practices often use a *hybrid approach* that combines several algorithmic models or generative processes. This is because using a single algorithmic model does not always create aesthetically satisfying results. But if different types of algorithms are used together, the strengths of each of these algorithms can be emphasized and their weaknesses diminished. The hybrid approach, therefore, has inspired new ways to construct compositions algorithmically, and led to many new generative art and music practices. Interestingly, many so-called algorithmic projects are also considered to be examples of generative practice. *Algorithmic.net*, for instance, maps algorithmic projects as 'resources' (author, title, date) as well as 'generative systems' (http://www.flexatone.net/algoNet/ [accessed 07.08.09]), while the *Eu-gene* mailing list provides further definitions and links to related generative art projects (http://www.generative.net/links.cgi [accessed 07.08.09]).

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