THE UNIVERSITY OF CALGARY

Body Language: Interactivity in Sound and Art

by

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A PAPER SUBMITTED TO THE FACULTY OF GRADUATE
STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE INTERDISCIPLINARY DEGREE OF MASTER OF FINE ARTS

DEPARTMENT OF ART
and
DEPARTMENT OF MUSIC

CALGARY, ALBERTA
SEPTEMBER, 2006

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have viewed and read, and recommend to the Faculty of Graduate Studies for acceptance, respectively, a Thesis Exhibition entitled "Body Language" and a supporting paper entitled "Body Language: Interactivity in Sound and Art" an accompaniment to the Thesis Exhibition, submitted by Philip Baer in partial fulfillment of the requirements for the degree of Master of Fine Arts in Art and Music.

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19/09/2006
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ABSTRACT

This paper supports the interdisciplinary Master of Fine Arts thesis project, Body Language, an interactive sound-art installation employing video-based motion-tracking technology, live video, and immersive sound. This project translates the real-time movements of persons in the exhibition space into an acousmatic sound composition that is projected through an octophonic sound system. Phonetic sounds that have been modified by means of spectral transformations related to percussive sounds are employed in order to produce sonic hybrids, as correlative examples of interactivity between the sounds themselves. Providing a historical-theoretical examination of interactivity related to the project, sound in the arts is historicized in relation to the concept of synesthesia in order to illuminate an understanding of interactivity that sees the synesthetic as a fundamentally interactive concept.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank the members of my supervisory committee.

I give many deserved thanks to my supervisor, Professor Paul Woodrow for helping to steer this work and provide illuminating feedback whenever it was needed, and also for allowing me the great opportunity to explore my field through contributions to his *Einstein's Brain Project*.

I acknowledge a vast debt of gratitude to my co-supervisor Dr. David Eagle, for his many hours of aid, prodding and council within the discipline of music, and without whom this project would not have been possible; for his programming assistance with Max/MSP, and for his kind permission to use his octophonic spatial diffusion program.

Appreciation is given also to Professor Jerry Hushlak for his genuine support, for his always-interesting conversation and wealth of ideas, and for his many contributions to my work over the years.

Thanks are also given to Dr. Leonard Manzara for contributing his time, his insightful questions and expert opinions as external examiner of my thesis work.

My gratitude goes also to Professor Eric Cameron, for his gentle kindness and his always weighty and enlightening words; to Professor of literature and sound poet extraordinaire, Christian Bök; and also to my good friend and colleague, composer and pianist, Anthony Tan.

I give heartfelt appreciation to my family for all their encouragement and assistance, from building walls and cooking meals, to keeping me in their thoughts and prayers.

Finally, to my dear wife, Michelle, who has been the inspiration for this project from the beginning, who has warmly contributed her voice to my work, and who is always first in my heart, I extend the most grateful and loving devotion.

All those to whom I owe my gratitude and to whom I have yet to thank, please know that you are recognized in these words of appreciation, and that all your contributions have not gone unnoticed.

THANK YOU ALL!

To my Angel and our Cherub,
my wife and son,
Michelle and Jonathan.

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What would be truly surprising would be to find that sound could not suggest colour, that colours could not evoke the idea of a melody, and that sound and colour were unsuitable for the translation of ideas, seeing that things have always found their expression through a system of reciprocal analogy.

Charles Baudelaire, The Painter of Modern Life[1]

Valéry said that a man is infinitely more complicated than his intelligence.
Wouldn't you say the same of a computer?

RACTER, The Policeman's Beard is Half Constructed[2]

Always Historicize!

Fredric Jameson, The Political Unconscious[3]

1. INTRODUCTION

This paper examines ideas about interactivity in the sonic arts as they relate to the interactive sound-art installation and Master of Fine Arts thesis project, Body Language. I draw connections between two reciprocal concepts of *synesthesia*[4] and the history of *sound in the arts*, as they relate to issues of interactivity.

The Canadian Oxford Dictionary defines *synesthesia* as "the production of a mental sense impression relating to one sense by the stimulation of another sense, as in the association of certain sounds with colours".[5] I will here make a distinction between two different types of synesthesia, which I term *actual* and *conceptual*, and relate them to an aesthetics that I call the *synesthetic*.[6]

Actual synesthesia is the case of physiological synesthesia as defined above, whereby a human subject H either is or is not a synesthete,[7] one who experiences a secondary sensation in a certain sensory modality as the result of a stimulus applied to another modality.

I refer to *conceptual* synesthesia as a case of the metaphorical use of the first concept, as when discussing art as a synesthetic experience, so that, for example, we can speak of hearing a silent, inner scream in Edvard Munch's painting "The Scream" (Appendix A - Plate 1),[8] or of touching, smelling, or tasting the oysters in Hemingway's descriptions of enjoying a meal in A Moveable Feast.[9] The conceptual synesthetic always describes a cross-sensory experience that springs from the imagination, from metaphor and from the interplay of the various senses in created works, such as works of art. It can refer equally to any cross-sensory experience that is implicated in the creation of such works. From this

point onward I will mean the conceptual synesthetic, whenever I use the term synesthetic.

I am using the synesthetic concept in its conceptual or metaphorical sense to historicize an understanding of interactivity that finds underlying implications between *the visual in sound,* and *the auditive in vision.*

Three central questions asked are:

- What is the relationship between the *composer, performer,* and *audience,* or the *art object* and *human experiencer* in interactive works of art?
- What effects do psychoacoustics play on the interactions of listeners in interactive sound-art works?
- How does interactivity in the arts affect the relationship between technology and the body?

Body Language is derived from the artist and composer's ongoing interest and research into interactions between the movements of physical bodies in space and computer systems capable of playing, generating, and manipulating sounds. In Body Language, participants' movements trigger sound events in real-time. The position of bodies in space determines what sounds will be heard and when. The interactive sound-art installation that encompasses this work will be discussed in detail in section 4 – The Project.

The title, Body Language, describes a relationship between bodies as physical objects—that have mass, that occupy space, and that have the ability to move—and language as a province of the mind.[10] Through the movement of persons in space, and the phonetic sounds that they trigger, physicality is related to the

mind. In this sense, the project can be thought of as exploring connections between roles of *the physical* and *the mental.*

2. MOTIVATIONS

2.1 Embodiment

Interactive sound artworks, such as when there is two-way communication between a person and a computer, differ entirely in their presentation from the typically static, pre-programmed presentation of composed sounds in concerts. In the concert setting the mind of the audience member is usually situated so as to fully attend to the sonic information presented, processing its meaning as the piece progresses while his or her body remains inert to the process.

In contrast to this approach, I am interested to see if I can create a work that engages the audience member's body as much as his or her mind, one that allows multiple explorations of connections between the physical and the conceptual.

The challenge in attempting this is to do so without letting the apparatus of the technological interface get in the way. The body of the audience member and all his or her attendant senses ought to receive preference over the technology behind the compositional process. Only in this setting is the participant audience member truly free to explore relationships between the sounds one hears and the movements one chooses to make with one's body.

I have two central motives for wishing to engage the bodies, as much as the minds, of potential audience members. The first is a desire to situate my work within the growing tradition of interactive works of art (understood broadly to

include works in music, dance, drama, et al[11]), thereby engaging the incumbent dialogue of issues of authorship or the status of *artwork* versus *human experiencer*. The second is an interest in new research that counters the prevailing Cartesian conception of dualist thinking, offering instead a holistic view of mind and body that is both integrative and interdependent.[12]

2.2 Explorations in Sonic Interaction

My creative approach in working with sound has always been to find points of interaction between different sounds. Whether this is achieved entirely through the use of materials—such as striking an object with another object (the most simple, real-world case of interaction)—or through sophisticated and complex digital signal processing (DSP) techniques, the nature and outcome of sonic interactions are the driving force behind my explorations in sound.

My use of the term "interaction" as it relates directly to sound implies that it is the sounds themselves that are interacting—this is precisely the case. I have sought wherever possible to create sounds that are hybrids of other sounds, sonorous instances of interaction proper, which are the product of two or more sounds in true interaction with each other. This means that the sounds heard in Body Language are of a type that cannot otherwise be experienced without the aid of special manipulations in the sound studio. (This subject will receive explicit attention in section 4.4.1 – Sonic Interactions.)

This strategy is based on my belief in the theoretical maxim that all creative outpourings benefit from a certain kind or degree of self-reference, where each of a work's constituent parts functions, at least loosely, as a correlative for the

whole. This strengthens the position of any one part of the work in relation to the rest, and enables a critical cohesion of ideas, which are intrinsic to the work.

3. PROBES

3.1 Augmented Bodies

The desire to enhance the level of interaction with the world seems to be a pervasive and profound characteristic of the contemporary cultural-technological landscape. From the Internet and chat rooms, to technologies employing global positioning systems (GPS), to interactive television, to virtual reality: everywhere one turns there seems to be a new technology promising a new means of interacting with the world.

Whether this stems from a deep-rooted fear of the insignificance of humankind, a fear of death or of leaving behind no trace, it must be that we necessarily harbour such a strong belief in the inadequacies and impermanence of our bodies that we feel this sustained desire to technologically augment ourselves. Technology will enable us to overcome our insufficiencies! Through technology we will become 'better' human beings! Isn't the purpose of technology to make possible the worlds we are otherwise only capable of imagining?

But technology necessitates mediated experience and guarantees our infusion into phantom bodies. Media prophet Marshall McLuhan said, "Technology performs radical psychic surgery on the human sensorium,"[13] and social theorist Paul Virilio states "that every technology is born with an accident in mind, an uncanny accident."[14] Just when we thought we might overcome the limitations

of our bodies we find ourselves entrapped within the phantom bodies of mediated, technological experience. Instead of the augmented body we were promised we have lost our connection with the body we had.

Interactive technologies, particularly those pioneered by interactive artists, are an attempt to put the body back into technology, to ground technology in the body.[15]

3.2 Interactivity: Sound in the Arts

Douglass Kahn is fond of saying that "sound saturates the arts of this century" and "none of the arts is entirely mute".[16] He elaborates a viewpoint about sound that marshals all manner of auditive phenomena including ideas about sound, sounds actually heard, or heard in myth, or sounds that are heard only by idea or implication.[17] *Acousimage*, literally "the heard image", is a term I have devised to describe this concept of visual ⇨ auditory synesthesia, where images or texts can conjure up sounds in the minds of viewers.

At the same time, sound has the reciprocal capacity to evoke images in the minds of listeners. Sound divorced from its originary source by its projection through the loudspeaker, describes a type of sound known as *acousmatic*[18] (after Pythagoras, who lectured his disciples from behind a curtain or veil), because the source or cause of the sound is unseen. Recorded sound thus acquires the synesthetic potential to suggest to the listener the visual association of its original cause. "Cinema for the ear"[19] is the phrase used since the 1980's to describe a concentrated way of listening to music that employs real-world sounds, in order

to bring into play the memory of real-world experiences as the imagined source of those sounds.

In the discussion that follows I will draw connections between these two synesthetic concepts and the history of sound in the arts, as they relate to issues of interactivity. Areas of primary concern in this paper are the various and complex issues surrounding interactivity in the arts: What is interactivity? How does interactivity in the arts affect the traditional relationship between the art object (work of art) and the viewer (human experiencer)? Or, in the context of performative works: How does interaction challenge the roles of the composer, performer, or audience member?

These questions are addressed in terms of artistic disciplines employing sound, or those arts that are either directly or indirectly concerned with sonorous intent. I will restrict my discussion of interactivity to the sonic arts for the following reasons:

I will focus my exploration of interactivity in the arts on the synesthetic in the arts, as a special type of interactivity. I will argue that synesthesia between audition and vision (and vice versa) in the arts is paramount to the development of interactive works, since the synesthetic experience is, in essence, always-already an interactive one. It is also here established that showing one kind of example of the synesthetic in art, namely between sounds and images, as being inherently interactive is enough to show the necessary truth of the hypothesis, because even if other cases do not logically follow there will still remain one logically sound example. Therefore, in historicizing sonority in the arts I trace a

concept of interactivity that is inherently synesthetic, and so provide a key example of the roots of interactivity in the arts.

3.2.1 Origins & Traditional Roles

> Convention tends to demarcate: a painting is a painting, an opera is an opera; a visual artist is a visual artist, not a musician or a composer... It works like a wall surrounding a closed system - fencing in, fencing out. Embracing this concept means turning one's back to reality as it is: a tangle of circumstances, events and developments; a perpetual state of madness [in which] people have always striven to find a system...
>
> -Paul Panhuysen[20]

The traditional view of the arts is that audience members quietly attend to the music, and viewers gaze intently on the work of art—in each case the work is static and unaffected by the attention or the gaze. No matter how much contemplation takes place, the music remains a sound, and the painting remains an image.

Interactivity, on the other hand, implies that the work itself is altered, or in some way affected by the actions of participants. In interactive works, creative processes can fashion paintings out of sound, and symphonies out of bodily movements. Interactive works inherently dissolve boundaries and create multiple connections between the senses.

In 1877 Thomas Edison created the phonograph and forever changed the landscape of sound. Sound that was previously singular and fleeting became a whole field of sound—verifiable, reproducible and permanent. There are two most significant consequences of this.

Now that sounds were separated from their source, they could be employed, like objects, in the construction of musical works (though it was not until the development of microphones and the ubiquitous availability of magnetic tape in the late 1940's that composer Pierre Schaeffer established his concept of *Musique Concrète*, or "concrete music", and began the rigorous systematization and use of recorded sound).[21]

The second consequence was the change in the way people listened; recorded sound revealed the surrounding environment of sound, a totalizing field of sound,[22] full of background noise that could finally be heard, suggesting the auditive equivalent of visual artist, Paul Klee's dictum,[23] to *make the inaudible, audible*. Composer and artist John Cage would later famously take this up with his sound experiments and compositions involving contact microphones to reveal the inner sounds of materials and living organisms.

There is an increasing shift toward the *extra-musical* in music, the synesthetic realization of sensory otherness in sound. The ability to hear previously unheard sounds led to the discovery of noise as a valuable and interesting source of ideas. The Italian Futurist, Luigi Russolo, in his 1911 "Art of Noises" manifesto, states that "musical sound is too limited in qualitative variety of timbre...we must break out of this narrow circle of pure musical sounds and conquer the infinite variety of noise sounds".[24] Significantly, the Futurists' search for expanded ideas about sound, however, was propelled largely by a substantial body of writings, and not by actual sonic achievement (although it is noted that Russolo's "Intonarumori", although not particularly successful, were influential devices in the creation of noise sounds, and which eventually found their use in the emerging medium of animated cartoons).

The Futurists also championed radical aesthetic ideas about technology. Their interests in the total field of sound extended to the visual environment, incorporating a synesthetics of movement and time. Extending concepts of multiple viewpoints derived from Cubism, they further developed the capture and representation of movement and time in painting and photography, producing *blurry* or *field effect* images. Umberto Boccioni's, *Dynamism Of A Cyclist* (1913), and Marcel Duchamp's, *Nude Descending A Staircase* (1912) are prime examples.[25] Their emphasis on capturing and incorporating movement and time would become a central ingredient or theme in interactive works.

Marcel Duchamp, primarily a visual artist who is regarded by many as being ahead of his time, was already experimenting with a degree of interactivity in his work. His *readymades*, every-day objects appropriated for display in the art gallery, often exploited the suggestion to touch and manipulate them in some way. His *Bicycle Wheel* (1913) involved an actual bicycle wheel attached to a stand so that observers could spin it and be mesmerized by the patterns of the motion it made.

Equally important were his experiments with randomness and chance, particularly notable in his musical works. *Sculpture Musicale* (1912-1920/21), consists of merely a note on a small piece of paper, once exhibited as part of his *Green Box* (published 1934). It details a set of instructions for realizing an event using unpredictable elements that result in a multi-sensual, evocative experience, rather than a structured work.

A similar case of the synesthetic was developing between language and sound in the Dadaist Avant-Garde. *Sound Poetry*, as the confluence of language and

sound, originates with Dadaists such as Kurt Schwitters and Richard Huelsenbeck. Kurt Schwitters' *Ursonate* (1926-32), which begins with the famous line "fmsbwtazdu", takes phonetic and vocal experimentation to new levels with its treatment of language as musical material.[26] At the Cabaret Voltaire in Zurich, Huelsenbeck created his "Simultaneous Poem" (1916), with multiple performers who provoke the audience into action and response by sounding nonsense words, guttural vocalizations, contrapuntal beats, singing and whistling.[27] The motivation for engaging a participatory audience, which Dadaism instigates, finds its proper realisation in interactive works today, with its privileging of the human subject for the completion of the work.

The Avant-Garde group of artists, performers, and musicians known collectively as Fluxus, further championed concepts of audience participation, the increased responsibility of participants, the infusion of multiple art forms in their work, and also an eminent use of unpredictability and chance. These would become some of the defining characteristics of interactive works in the arts. In 1963, Fluxus member Alan Kaprow initiated his *Fight: Four Happenings*, claiming that "you will become a part of the happenings; you will simultaneously experience them".[28] A decade earlier, John Cage presented his *Williams Mix* (1952), exploiting the unpredictability of 600 randomly cut and reassembled pieces of audiotape to form a four and a half minute long chance composition, which he broadcast on an octophonic speaker setup.

3.3 Related Work

Interest in interactive media projects which in various ways sonify the movements of human performers have become increasingly numerous and

sophisticated in recent times. A new field of interactive locative media artwork has emerged which employs various technologies to achieve multi-person tracking of geographic location, which can then be creatively mapped to all manner of media experience. The current increase of interest in such work is being motivated by a number of factors, not least of which is a cultural interest in the ways that technology both enhances and radically transforms the body;[29] but also, I suspect that the primary drive stems from the increased availability of new technologies that allow previously cumbersome or inaccessible areas of creativity to be explored.[30]

I will outline four contemporary projects that use various kinds of locative technologies to present audience members or participants with an interactive media experience employing the sonified results of persons' movements, or the movements of natural phenomena. These are the *Wind Array Cascade Machine* (2003) and *Si(g)n(e)* (2004) by audio artist Steve Heimbecker,[31] *BigEye* (1995) by programmer Tom DeMeyer (with Ray Edgar) at STEIM,[32] *Very Nervous System* (1986) by interactive media artist David Rokeby,[33] and *SICIB* (2001) by group of composers and programmers Morales-Manzanares, et al.[34] All of these works share significant features with the Body Language project by being in some way interactive while relating motion to sound in real-time. These examples will serve as case-studies of recent work related to the thesis project, Body Language, and will provide a contemporary context for the project.

Heimbecker's *Wind Array Cascade Machine* captures information about the movements of air currents and packages it for networked streaming over the Web. He uses a large-scale array of 64 motion sensors forming an eight by eight unit grid to map the movements of the wind in an outdoor space. This

information can then be translated into other forms and used to create media installations like that of his *Si(g)n(e)* project. *Si(g)n(e)* takes the data about air direction and velocity and converts it into sound, by mapping the 64 motion sensors to 64 sine wave generators. The interaction in this work is between a natural phenomenon, wind, and the system that Heimbecker has created to express this in sound. As a result, Heimbecker's audience in this case is a passive one, which cannot directly affect any of the outcomes of the work, but merely observes. It is interesting to note that had the 64 sensors been devised to observe the motions of persons in space, rather than air currents, this work would have been a truly interactive one. Nevertheless, I have decided to include it here because of its parallels to Body Language, its unique means of creating the synesthetic experience of listening to movement.

BigEye, from Amsterdam's Studio for Electro-Instrumental Music (STEIM), is another system that translates motion into sound. *BigEye* is a computer program that translates real-time video information into MIDI messages,[35] which can be used to control synthesizers, sequencers, samplers or other audio equipment. From the system's website: "The user configures the program to extract objects of interest, based on color, brightness and size...(up to 16 simultaneously)...and their position is checked against a user-defined series of 'hot zones'".[36] MIDI events are triggered every time an object crosses one of these zones, for instance turning on or off notes, or creating a pitch-bend. As well, the speed, position and size of moving objects can be mapped to different MIDI events. So, for example, using *BigEye* one could track the simultaneous movements of 16 individual dancers and from this synthesize complex musical results. *BigEye* is therefore similar to Body Language in its overall interactive capabilities, however its

deployment of motion tracking is slightly different. Whereas *BigEye* can follow the separate movements of up to 16 moving objects, Body Language employs an averaging routine that always reduces any number of moving objects to one by continually calculating its centre of mass.[37]

Interactive media artist, David Rokeby, is known for his unique and challenging interactive media installations involving sound. His *Very Nervous System* (*VNS*) utilizes video-based motion tracking to identify the gestural information of a performer. This information is mapped to synthesized sound using complex computer algorithms so that a performer is capable of incredibly subtle articulations in sound by moving his or her body. He describes the interaction as

> a complex but quick feedback loop...(which) is subject to constant transformation as the elements, human and computer, change in response to each other. The two interpenetrate, until the notion of control is lost and the relationship becomes encounter and involvement.[38]

While the Body Language system is much simpler, it has a similar effect of creating an interaction that is responsive and intimate. Both systems "detect any movement within a defined active performance area...(and focus) the image analysis...on motion rather than color or shape information".[39] However, *VNS* compares each video frame to the preceding frame to extract both position and motion information, while Body Language compares each frame to a static background image to measure position only. Depending on the performance of its user, *VNS* can synthesize abstract sound or clearly recognizable musical expression in response to gestural performance, whereas Body Language plays from a large set of previously composed samples in response to the exploration (through sound) of positions in space.

Sistema Interactivo de Composición e Improvisación para Bailarines (*SICIB*), roughly translates as the Interactive System for Composing with Improvisations of Dancers, and it does just that—it generates music in real-time in response to bodily movements. *SICIB* is the most sophisticated of the projects discussed here, but also significantly divergent. Unlike *BigEye, Very Nervous System,* or Body Language, *SICIB* uses sensors that are attached to the bodies of dancers and detectors placed strategically elsewhere in order to track their movements. This allows for a much more detailed and very accurate description of the choreographic movements of dancers, as well as their overall positions in space. Interactions occur with a high level of efficacy toward improvisation, so that both musicians and dancers can engage in expressive dialogue together. The authors elaborate:

> With SICIB, choreography does not need to be adjusted to a fixed, pre-determined musical piece: dancers can freely improvise their movements and map these improvised gestures to music generated in real time. SICIB can also be considered a virtual instrument in which music is produced through body movements, opening new possibilities for music performance and composition. Finally, SICIB allows musicians and dancers to interact and improvise dialogues during the course of the performance.[40]

Whereas Body Language and the other video-based systems described previously can accommodate any kind of casual participant, *SICIB* is more clearly suited for a performance setting where the performers are trained experts with the system and the audience members are passive observers. SICIB allows some of the most highly expressive and improvisational explorations between movement and music, however the experience for audience members remains outside of interactivity and so is all the less impactful. Rokeby captures the

profound significance of interactivity for participants when he observes of his *Very Nervous System*: "after 15 minutes in the installation people often feel an afterimage of the experience, feeling directly involved in the random actions of the street".[41]

4. THE PROJECT: BODY LANGUAGE

> RACTER demands of us a unique theory of writing—a "robopoetics" that can take into account the extraordinary circumstances of such mechanical expression. RACTER is a mindless identity, whose very acephalia demonstrates the fundamental irrelevance of the writing subject in the manufacture of the written product. The involvement of an author in the production of literature has henceforth become discretionary. Why hire a poet to write a poem when the poem can in fact write itself? Has not the poet already become a virtually vestigial, if not defective, component in the relay of aesthetic discourse? Are we not already predisposed to extract this vacuum tube from its motherboard in order to replace it with a much faster node? The irony here is that, while the witless machine knows much less about poetics than even the most artless amateur knows, falderal written by the mechanism invariably outclasses doggerel written by the rhymester.
>
> – Christian Bök[42]

Informing my work are connections between the work of sound poets, like Kurt Schwitters and his *Ursonate*, and computer systems that can generate incredible wordings (or voicings) of unusual creative and linguistic merit. Speech engines, online conversation bots, and artificial intelligence projects such as Stelarc's *Prosthetic Head* (2003), all employ interactive means of generating linguistic and

auditive creation where a *user* or *participant* is more or less responsible for the outcome of the work.

Body Language is alike in its overall function; it consists of participants' actions co-authoring a sonorous *text* that is spatially determined. The synesthetic relationships between bodies in motion, language and acousmatic sound all work interactively together to bring about myriad possibilities of meaningful, artistic experience.

4.1 Project Description

vowels

IPA	examples
ʌ	cup, luck
aː	arm, father
æ	cat, black
ə	away, cinema
e	met, bed
ɜː	turn, learn
ɪ	hit, sitting
iː	see, heat
ɒ	hot, rock
ɔː	call, four
ʊ	put, could
uː	blue, food
aɪ	five, eye
aʊ	now, out
oʊ əʊ	go, home
eə	where, air
eɪ	say, eight
ɪə	near, here
ɔɪ	boy, join
ʊə	pure, tourist

consonants

IPA	examples
b	bad, lab
d	did, lady
f	find, if
g	give, flag
h	how, hello
j	yes, yellow
k	cat, back
l	leg, little
m	man, lemon
n	no, ten
ŋ	sing, finger
p	pet, map
r	red, try
s	sun, miss
ʃ	she, crash
t	tea, getting
tʃ	check, church
θ	think, both
ð	this, mother
v	voice, five
w	wet, window
z	zoo, lazy
ʒ	pleasure, vision
dʒ	just, large

Table 1 – International Phonetic Alphabet (IPA) symbols chart for English

These 44 uniquely identifiable sounds, called phonemes, from which the entire spoken English language can be constructed, are the sonic building blocks of Body Language. Using a technique devised by the artist[43] the spectra of these

sounds have been transformed by other sounds derived from physical materials such as metal and glass, in order to create sonic hybrids of *the verbal* and *the physical*. Try to imagine what kind of space these sounds evoke. Where do they take you? Body Language attempts to explore connections between bodies as thought processors and minds as bodily functions.

Body Language is derived from the artist's ongoing research into interactions between the movements of physical bodies in space and computer systems capable of generating and manipulating sound. In Body Language, participants' movements trigger sound events in real-time, and the position of bodies in space determines what sounds will be heard and when.

The uninitiated person, on first encountering the work, is confronted by a darkened room lit in the centre by a soft pool of warm, glowing light. Near the entranceway is a monitor screen that seems to echo the glow of the room, and there is a low, vaguely *breathing* sort of sound that seems to envelop the space. A thin, white perimeter line traces the edge of the lighted area in the centre, demarcating it and setting it off from the darkened space around it, while also providing an opening to the entranceway.

Upon entering, a female voice circles around, once, twice, and again, and again; or, wait...was it just a piece of glass vibrating? Step. Again. Perhaps a metal cylinder being spun, like a prayer wheel that is speaking? Step. And again. Maybe it was a wooden instrument of some kind, being blown by the whispered voice of the wind?

As the participant wanders the space, he or she begins to realize that the sounds emanating from speakers obscured by the darkness surrounding the room seem

to be tied to the movements he or she is making. Try stepping to the left? The voice says, "fff". To the right? "Luh". Forward, then. "Scraape!" Suddenly the space is alive with a multiplicity of sounds, all of which seem to be voices, yet distorted somehow, more physical and raw.

This description serves to illustrate a possible encounter with the work, in order to (*synesthetically*) conjure a sense impression of the work. It also describes a little bit of the interactive way in which the project engages the human experiencer of the work.

4.2 The Sounds

Works employing phonemes and parts of speech would seem to be a part of the general interest of the times—a zeitgeist of artistic interest in and exploration of the importance or significance of language. Montreal acousmatic music composer Robert Normandeau's recent works[44] employing onomatopoeias come to mind, as do Saskatoon based artist Ellen Moffat's audio art installation *Nervouse,*[45] and famed American artist Bruce Nauman's transformation of the Tate Modern's Turbine Hall through the exclusive use of sound and language in *Raw Materials.*[46]

Body Language takes recordings of spoken phonemes as the basic starting point of the sonority of the piece. These are 44 separate recordings of a female vocal performer sounding each phoneme twice, capturing 2 different timbres of performance: casual speech and whispering, which were recorded so that they would contrast with each other.

Also, a series of recordings were made using contact microphones to capture the raw materiality of sound in solid objects. Metal, glass, wood, and stone objects were recorded by attaching contact microphones to them, and then performing a number of sound producing actions to them. These were percussive scraping, scratching, hitting, and grinding, as well as *resonating* the material through electro-mechanical means.

The two sets of sounds, phonetic and material, were then *cross-pollinated* using two different techniques (I describe these in section 4.4 The Process). The result of these techniques produced a total of 176 unique, yet sonorously related sounds with which to work.

4.3 The Process

This section details my working process, by which I produced all of the sounds that can be heard in the Body Language sound-art installation and thesis project.

The source material for all of the sounds was digitally recorded to high-resolution audio at a sampling rate of 96kHz and a bit-depth of 24-bit using a MOTU 896HD audio interface on a Pentium 4 (2.5GHz) and an Athlon 64 (3000MHz) PC computer system. This sampling rate and bit-depth was maintained for all digital signal processing employed in the production of sounds for the piece.[47]

There are two main production techniques that I have used in the creation of this work—a digital signal process that I call *Spectral Morphing* and an electro-mechanical process that I call *Resonance Transference*. The next three sections will describe these techniques in detail.

4.3.1 DSP – The "Spectral Morph"

Spectral Morphing[48] is a term I have adopted to describe the technique of digital signal processing (DSP) that applies the spectral information about one audio file as a filter for another, thus altering the spectral and therefore timbral properties of the resultant sound. An example of the type of computer program capable of doing this is Waves Audio Ltd.'s VST spectral plug-in *Morphoder*.[49]

In essence, this is a computer process that is achieved by feeding two audio sources through the spectral DSP function, the resultant output of which is a new sound that exhibits timbral characteristics of both originary sounds. As in visual media, where the term *morph* describes two images that have gone through an apparently seamless transition from the first into the second (e.g. a kettle is transformed into a coffee cup), the *spectral morph* appears to seamlessly transform one sound into another.

I have found this kind of sound studio DSP technique to be extremely useful for creating a vocal sonority that is infused with the timbral characteristics of the various materials I recorded for this piece. Central to my intent with the work was the goal of creating sounds that are hybrids between the *human voice* and an internal *materiality* of physical objects. Therefore I have employed the technique of *spectral morphing* to explore the hybrid area *in-between* two sounds. The technique of *Spectral Morphing* allows me to digitally accomplish just this.

4.3.2 Contact Microphones

Contact microphones are used in the amplification of *micracoustics*,[50] very quiet or very small sounds, thus making the *inaudible* audible. These special

microphones, which can be attached to the surfaces of material objects, are able to transduce the tiniest vibrations within that material.

I utilize piezo-electric materials[51] in the form of discs to fashion very sensitive contact microphones. When large amounts of amplification are applied to the usually tiny signal output by these devices, wonderfully alive and often startling sounds can be discovered. I have used piezo-electric devices to record the sounds of wire and string, grass, railroad tracks, the human body, appliances, water, and various mundane objects. All of these experiments have yielded very interesting, detailed and sonorous results.

In Body Language, I use these contact microphones to record various materials ranging from metal and glass, to wood and stone. By hitting, scraping, grinding, or scratching these materials I produced a range of percussive sounds that capture in their timbral characteristics the *internal* properties of the materials which produced them. Like Cage, who says, "everything we do is music, or can become music through the use of microphones...by means of electronics, it has been made apparent that everything is musical";[52] my recordings reveal the wonderfully interesting and lively *inside* space of acoustic materiality.

4.3.3 Resonance Transference

This is the process of using contact microphones together with special speaker components to modify the spectra of a sound by involving its interaction with a sympathetic resonant material. This rather verbose, but accurate definition describes the second and most unique half of my method of working with my recorded sound material.

I started out with the aim of introducing levels of interactivity into the sound material itself. I wanted sounds that could literally interact with each other, influence and modify each other. I decided on an approach that would involve the interplay between the spectra of two sounds. This would achieve the level of interaction I wanted within the sounds, as well as manifest in ways that ought to be both perceivable and interesting to the ear.

My approach involves attaching contact microphones to a resonant material, such as a crystal container, then also attaching another piezo-electric device, only this time fashioned so that it will function as a tiny speaker. With this apparatus, it is possible to *play* a pre-recorded sound *into* the material, thus causing a sympathetic resonance between the sound and the material. This inherently interactive process between the material and the original sound (also derived from a material, because all sound is physical vibration), means that the resultant sound is a hybrid product, retaining only (mostly) the attributes that the two original sources share.

Half of the sounds heard in the Body Language project are produced by this technique. I have taken one set of the original recorded phonemes (the spoken ones—as opposed to the whispered ones), and treated them to this process. This produced an interesting hybrid set of the original 44 sounds, forming the last of the sonic material I required in the piece.

4.4 The Compositional Structure

When activated by a participant, Body Language creates a lively and textured, sonorous environment where there can be clearly heard vocalizations and

percussions, sonic gestures based on vocal and percussive material, and a number of evocative, ambient textures.

Sounds in the project are organized around a three-layer structure, where there are three sets of possible sounds that can be simultaneously heard. I refer to these as the *foreground, middle ground,* and *background* layers.[53] Each layer consists of a corresponding set of sounds whence one can be selected and played, so that there can be at least one sound playing from each layer for a minimum total of three simultaneously heard sounds.

I have arranged the compositional possibilities of my source material in the interactive realization of the piece so that foreground sounds have the greatest presence and detail over middle ground or background sounds, which have been treated so that they have less weight and draw progressively less attention. The treatments that accomplish this are a progressive reduction in the gain or volume of middle ground and background sounds, progressively longer overall timeframes in middle ground and background sounds, and the use of repetition and seamless looping in background sounds, as well as a reduction in the level of spectral activity or animation in the background sounds.

The set of foreground sounds contains 176 unique sounds, with a randomly selected repetition of 16 of them in order to make one sound for every point on a 12x16 unit grid, for a grand total of 192 possible sounds. Foreground sounds have the shortest proportional timeframe, and range in duration from 214ms to 1s384ms. These sounds consist of the hybrid phonemes and material-object percussions described in the preceding section.

Foreground sounds are the most directly interactive element of the project—they are triggered immediately by the movement of participants across invisible geographic boundaries in space, where each sound corresponds to a particular geographic zone (zones are divided exactly corresponding to the 12x16 grid so as to match one sound to each zone).

These sounds are also the loudest overall and can occur the most frequently. A very active participant in the installation space can create a continual stream of foreground sounds in response to his or her movements.

The set of middle ground sounds contains 18 possible sonic gestures. Middle ground sounds range in duration from 2s948ms to 25s241ms. These sounds are derived from similar source material as that of the foreground sounds, however they have been arranged as longer and more *musical* sonorous gestures, employing polyrhythms, dense textures, and sometimes multiple instances of studio manipulation involving the twin techniques of *Spectral Morphing* and *Resonance Transference,*[54] as well as additional DSP techniques such as comb-filtering, time-shifting, resonant filtering, and convolution reverb processing. They have also been subjected to further DSP, such as equalization, to control their spectral content and maintain a sympathetic relationship to the sounds of the other two layers.

Middle ground sounds are indirectly interactive and are triggered in relation to the number of interactive foreground zones crossed by a participant. This value can be adjusted, however the default is set at 26, which I have found to offer a good intermediate between very active participants who trigger occurrences fairly often, yet not too often so as to overwhelm the composition, and quite

cautious participants who will nevertheless trigger middle ground sounds still often enough to adequately explore them.

The set of background sounds contains only 3 possible ambient textures, which range in duration from 41s854ms to 10mn20s796ms. These sounds are more subdued and repetitive, consisting of multiple, complex and seamless, overlapping loops of source material related to the other two layers.

The first background sound, labelled *background1*, is comprised of very slowed down vocal samples which have been looped and layered to create a low, soft textured rumble reminiscent of slow breathing. The second sound in the set is *background2*, which consists of comb-filtered, hybrid phoneme-percussion sounds, heavily layered and looped, and then subjected to a spectral morph DSP so that it evokes the sound of a mechanical crowd becoming a soundscape of birdsong. The third and final sound is *background 3*, which consists of a single vocal performance of the English phoneme *v* that has been stereophonically layered and endlessly looped at continually migrating loop points so that the sequence starts as a recognizable utterance of *v* and slowly becomes evocative of something like a swarm of bees, then transforms back again to utterances of *v*.

Background sounds are also indirectly interactive, and are triggered when a participant has crossed exactly 192 geographic zones in the 12x16 unit grid, thereby creating a one-to-one relationship between the number of possible foreground sounds and the changes of background sounds. However, this value can also be adjusted so that background changes will occur either more or less frequently, if desired. When these sounds are triggered they are also looped so that they will continue to play until a new background sound is triggered.

4.5 The Program

The software component that comprises the main system of Body Language has been created using Cycling '74's graphical programming environment, Max/MSP.[55] In addition, video-based motion-tracking hardware called the Teleo™ Video Module[56] from MakingThings.com is required for the fully functional operation of the software.

The Body Language Max patch[57] is modular in design and can be divided into the following seven main sections: video matrix, sample triggers, sample players, DSP, spatialization, mixer and output stage, and a colourful GUI. In addition to these, there is also a motion-simulation module that contains a programmed algorithm for computer-generated simulation of a person moving in space, so that (via the motion-to-sound routines) the sound composition can also be entirely computer generated.

The intent of the following discussion is not to present the reader with a comprehensive view into the intricacies of the software, but rather to illuminate some of the key aspects of the work.

In order to facilitate ease of understanding the program, I will focus my discussion on its highest order level, the Graphical User Interface (GUI), as a means of relating user-control to the program's inner workings. The GUI contains a number of elements for the display and control of operations in the Body Language program. (See Appendix A: Fig. 1 – Body Language Program Interface (GUI) for an image of the program's GUI.)

The GUI provides basic instructions for the use and operation of the program. There are controls for turning on/off the audio signal (TAB key) and an indicator that displays the current state, buttons for loading sound files (AIFF or WAVE formats), and for adjusting the Master Gain Level as well as the gain levels for the Foreground, Midground, and Background sound layers. Also, there are 8 level meters that provide visual feedback about the audio on each of the 8 audio channels used in the work. There is a control section for enabling the real-time video feed of up to 2 cameras (camera 1 is disabled in this work), and for setting the initial static image from which all other video frames will be compared in order to determine what in the camera's view is moving. An effects section provides three different types of digital signal processing—filtering, reverb, and phase delay—which can be used to sculpt the sound of the installation, and to tailor it to the specifics of the environment where it is installed. There is also a large grid-like object that displays the centre of mass of moving objects in the space which can also be used as a triggering mechanism in performance, a button for engaging the Simulation mode of the work, and a counter that gives the total running time that the work has been actively operating. Along with the Simulation mode, there is an object that looks like a piano keyboard which can be used to manually trigger any of the Midground sounds, which is useful for performance settings where the composer may want to adjust parts of the performance in real-time. Lastly, a small but significant number box, allows a setting for the number of movements (or steps) required before Background sounds will change.

The most prominent aspect of the GUI, the motion/sound-triggering matrix, is one of its most interesting features, as it gives a very quick indication of the exact

mapping between sounds and position in space. Since the system doesn't actually report the position of persons, but rather only the centre of mass of participants, this means that multiple moving objects get amalgamated into one spontaneous and variable *virtual* object. The GUI allows this extremely complex interaction to be instantly visible.

4.6 Interactions

4.6.1 Sonic Interactions

Interactions between sounds themselves can occur in important and interesting ways. I will elaborate the manner in which my working method synesthetically calls into being concepts and themes of interactivity in my work.

4.6.1.1 Digital Recombination

The process of *spectral morphing* contains an inherent interaction between digitized sounds, which speaks of the synesthetic in terms of media and information systems (see section 4.3.1 DSP – Spectral Morphing for a description of *spectral morphing*).

In *spectral morphing*, the interaction takes place in the digital domain of computing software. Because this is a digital process it is also a conceptual one as well, as media theorist Lev Manovich claims.[58] Manovich's theory is that because computers store and work with information as numbers, they are inherently conceptual in nature. A digitally recorded sound ceases to be a sound when it enters the computer domain, and becomes a sequence of numbers, which are fundamentally conceptual in nature. Conceptual processes allow radical

transformations or recombinations of media because they are essentially abstract, informational processes.

The leap between the domains of sound or image into the conceptual domain of information is a leap parallel to metaphorical transformations. One mode of information becomes another in a synesthetic transaction of forms.

The technique of *spectral morphing* allows sound to become interactive on the conceptual level, availing of almost limitless digital transformation or recombinative possibilities.

4.6.1.2 Interactive Resonance

When one sound produces a sympathetic resonance within an acoustic material, the sound and material can be said to be interacting. The concept of *resonance* is intrinsically interactive. This is straightforward enough. However, if the sound is a recorded sound then the interaction is subtly altered.

In the process of *resonance transference,* where a recorded sound is the source of the sympathetic resonance of a material, the intrinsic sonority of that material becomes activated by the electro-mechanical presence of an absent acoustic material. The absence of the source material of the recorded sound means that there is a conceptual interaction, as well as the purely physical one.

Now we have a case of the physical and the conceptual influencing each other, recalling yet again, the metaphorical synesthetic between sound and information.

4.6.2 Spatialization

The spatial location of sounds is an unavoidable feature of sound. When you hear a sound sweep around you, or rise and fall behind you, it is impossible not to react in some way. Sounds surprise us by the way they move in a very primal kind of way.

At the same time, sounds define our environment; in a sense, they create the space that we inhabit. The synesthetic here is the relationship between perception of sound and perception of space.

The interaction is in the perceived locations of sounds—the spatiotemporal relationship of human perceiver to sound is affected by the psychoacoustic properties of the sounds being heard. In the case of recorded and re-broadcast sounds, especially when spatially diffused through multiple speaker systems, the experienced sense of space can be vastly altered or manipulated.

Body Language uses this kind of interaction by employing octophonic projection of sounds together with programmed algorithms to animate the spatial location of sounds.

An interesting further direction for this work would be to relate the spatial diffusion of sounds through the octophonic audio system to the actual movements of participants in physical space (in semi-or-unpredictable/creative ways), so that a further degree and refinement of interactivity would be introduced.

4.6.3 Co-creator

Co-creation is a type of interactivity in which the user not only manipulates the system but also is responsible for finishing the work itself. In a co-creative interactive work there are four aspects that differentiate it from other types of interactivity.

The first is that it gives the user many options to choose from while participating in the work; the choices made are then analyzed in some way by the system in order to determine the next event in the work. Another important aspect of the co-created work is that it allows for personal variations to be made, making every participant's experience of the work unique. In a co-creative work the user often has to use all of their senses in multi-modal interaction with the work, including the use of their body. Most importantly a co-created work gives the user the ability to create something outside of the already pre-designed expectations of the artist, meaning there is no predictable way to know the work except to experience it for yourself.

Body Language is a co-creative interactive work. Users of the system have to use their entire body to achieve sonic results in the space. The composition of sounds produced by the participant is completely unique to each person because no two people will move in exactly the same way. Even a trained dancer performing predetermined movements will make subtle changes to the way he or she performs each time, making every performance different and un-replicable.

5. CONCLUSION

5.1 Who Is The Author?

Interactive media artworks offer a complex problematization of the work-of-art versus human subject relationship. Questions about the authorship of interactive media works become enmeshed by the tangling of lines between composer, audience, and composition, or artist, viewer, and artwork, when interactivity is present in the work. Unlike traditional works, where there are viewers or audience members who gaze or attend to the work, interactive works introduce a third element, and subtly but significantly alter the roles of the artwork and the human subject.

The three elements of interactive works are the *system*, the *participant*, and the *result*. The *system* is the rules or parameters that define the creation of an experience, as well as all of the software, materials and required equipment, the environment that surrounds the work, and all of the objects in it. The *participant* is the human experiencer, the *interactor*,[59] or subject who interacts with the system, and the *result* is the outcome of that interaction in its entirety, including all consequences. All three of these are necessary to have a complete, interactive *work*. Without the participant (to create an interaction), or the system (to define the rules or operations necessary to create an experience) there are no results (the outcome of the interaction), and the *work* is at best incomplete and unfinished, or simply does not yet exist.

It could be said of a traditional sculpture, painting, or sound composition that, if there were no one there to experience it, the work, in a sense, would not exist.[60] This statement attempts to make an objection to a distinction between interactive

works and traditional works-of-art, by saying that traditional works are just the same as interactive ones because, in either case, when there is no one there the *work* is not there. However, whether this statement would be true or not, there are two important counter-objections that can be made: the first is that the same could be said of *any* work, interactive or not, so there is nothing gained or lost by it and the point is moot; the second is an important distinction between the case-in-point and interactive works, where traditional works are not physically altered by the attention or gaze of human subjects, but interactive works *a priori* are—the presence or absence of a human subject determines the very physical (and otherwise) makeup of the interactive work, whereas the traditional work just is either there or not there, but always remains the same.

When the relationship between the human subject and the work-of-art is entangled as it is in interactive works, the question of "who is the author of the work?" is radically altered. Implications of these embroiled roles are that there is not just *one* work, in interactive works, there are many—the work itself is a different work every time a person engages it and becomes a part of it. The participant interactor becomes a co-creator with the artist, composer, or engineer who designs the system.

5.2 Concluding Remarks

Interactive artworks offer a complex problematization of the work-of-art versus human experiencer relationship. The concept of the synesthetic sheds light on the origins and development of interactivity in the arts by demonstrating the presence of interactivity in prior art forms.

Sound in the arts has been a key medium of the synesthetic tendency. By historicizing sound in the arts I trace a concept of interactivity that is inherently synesthetic, and so provide key examples of the roots of interactivity in the arts.

The project, Body Language, provides an interesting case study of interactivity and the synesthetic. The project illuminates many of the issues surrounding the relationship between the work-of-art and the participatory human interactor in interactive works. The project provides a cross-sensory feedback loop between bodily movement and sound so that a synesthetic experience of haptic-sonified space is created. At the same time, a synesthetic dynamic between acousmatic sounds and the evocation of mentally projected images corresponding to those sounds is formed. In this fashion, multiple mechanisms of interactivity are explored simultaneously, while also engaging issues of authorship about interactive works. In Body Language I have sought ways to offer the participant in the sound-art experience the means to explore this dynamic him-or-herself.

ENDNOTES

[1] Baudelaire, 116.

[2] RACTER, 2.

[3] Jameson's famous directive given in the preface to *The Political Unconscious*, page 9. Jameson's Marxist/structuralist ethics demand that all artistic production must be seen in terms of its social milieu, but where every history is *produced* (written) or *consumed* (read) through a process of narrativising, as an interpretive act.

[4] See Synesthesia, in *The Canadian Oxford Dictionary*. See also, Synesthesia, in *Wikipedia: The Free Encyclopedia* at http://www.wikipedia.org/wiki/synesthesia.

[5] Synesthesia: *The Canadian Oxford Dictionary*, 1998.

[6] Synesthetics, as the confluence of synesthesia experience and aesthetics, is a term I have devised to describe a theory of aesthetics that treats cross-modal sensory experience—whether an actual, sense experience as the result of a physiological synesthesia condition, or a conceptual, metaphorical one as the result of the creative faculties of the mind—as being intrinsic to artistic endeavour and meaning. This concept deserves a full discussion and development in its own right, however I will leave it to a later text in order to concentrate on the topic of interactivity in the arts, which is the foremost concern of this paper. Nevertheless, the concept of the synesthetic as it is defined here will inform this discussion on interactivity in the arts.

[7] Some examples of famous persons known to be synesthetes are writer Vladimir Nabokov, composer Olivier Messiaen, visual artist David Hockney, and physicist Richard Feynman.

See Wikipedia, *Famous synesthetes*.

[8] See Appendix A – Supplemental Images, Plate 1. See also Wikipedia for image copyright information at http://en.wikipedia.org/wiki/Image:The_Scream.jpg.

[9] "As I ate the oysters with their strong taste of the sea and their faint metallic taste that the cold white wine washed away, leaving only the sea taste and the succulent texture, and as I drank their cold liquid from each shell and washed it down with the crisp taste of the wine, I...began to be happy and to make plans."

Hemingway, 6.

[10] For a significant philosophical critique of Cartesian dualism, see *The Concept of Mind*, by Gilbert Ryle. Ryle systematically analyses concepts of will, emotion, self-knowledge, sensation, imagination, and the intellect rejecting the idea of a 'ghost in the machine' and offering instead a 'common-sense' theory of mind, where minds and bodies are just two different sorts of things representing the two different ways we talk about ourselves—our mental selves and our physical selves.

[11] See Wollheim, on *Art and its Objects*, who provides an in depth analytical treatment of aesthetic discourse that attempts to provide an inclusive set of aesthetic criteria by which to define all creative endeavours that may be correctly ascribed as belonging to the umbrella category of *Art*.

[12] Relevant areas of research are very wide in scope and cover disciplines ranging from theoretical debates in the humanities and social sciences including philosophy, literary and cultural theory, sociology, and psychology, to developments in the hard sciences including cognitive neuroscience and artificial intelligence. This paper goes so far as to introduce some of these ideas, however it is beyond its scope to adequately cover the research in substantial depth. The interested reader is encouraged to explore further readings on the subject, where the bibliography in Appendix D is offered as a helpful starting point.

See Appendix D: Bibliography on "Technology, Mind and the Body".

[13] McLuhan, *Understanding Media*, 95, as quoted by Arthur Kroker in *CTheory Live: STELARC in conversation with Arthur & Marilouise Kroker.*

[14] Virilio, *Probable Immanence*, in *A Landscape of Events*, as quoted by Arthur Kroker in *CTheory Live: STELARC in conversation with Arthur & Marilouise Kroker.*

[15] Technology has long been associated with awkwardness and difficulty of use, with being cold (especially in the McLuhanesque sense) to human design and purpose, and with causing a kind of enslavement or entrapment of its user because of its poor anticipation of each user's individual requirements. Put another way, technology's relation to humanity can be problematized as an extension of the body which fails to adequately interface, creating a rift between the mind of the user and the technologically enhanced or extended body. Interactive technologies, such as those pioneered and used by interactive media artists, attempt to bring technology *into* the body, as close to the body as possible, to seal the rift and close the gap, or, at least as far as possible, to erase the psychological weight or presence of there being any interface at all so that the user is completely seduced by the verity of the simulation, the technologically augmented human experience, or posthuman experience.

For further reading, see Appendix D: Bibliography on "Technology, Mind and the Body".

[16] Kahn, 2.

[17] Kahn, 3.

[18] From the Greek, *Akousma*, what is heard, the term *Acousmatic* defines a sound that can be heard without knowing its cause, and also designates the distance that separates a sound from its origins. *Acousmatic Music* is an extension of *Musique Concrète*, and is a music that employs recorded sounds that are projected through the use of loudspeakers, so that the originary source is concealed. It often treats the recorded sounds that make up the composition to various techniques of sound processing in order to transform the source material in ways that further play with the simultaneous concealment and revelation of the sound's causative source, as well as seek to reveal the individual creative and aesthetic intent of the composer.

See Wikipedia, *Acousmatic.*

[19] Cinema for the ear is a further refinement of *Acousmatic Music* that treats the composition as a kind of abstract narrative soundtrack, but one in which there is no tangible visual information provided. It relies on the imagination of the listener to conjure images in the mind purely by the mental associations formed by engaging the sound composition through concentrated listening. In order to achieve maximum effect, this music is usually listened to in near or total darkness so that visual distraction is diminished.

For in-depth discussion, see Normandeau, "Un cinema pour l'oreille", 1992.

[20] Overton, quoting Paul Panhuysen.

[21] Wikipedia, *Musique Concrète.*

[22] Kahn, 9.

[23] Klee, 5. In the "Creative Credo" from The Inward Vision, he states that "Art does not reproduce the visible; rather, it makes visible... My aim is always...to make visible the invisible."

[24] Manning, 4.

[25] Jansen, 720 and 724 respectively.

[26] See Kurt Schwitters biography as found on UbuWeb: *Kurt Schwitters.*

[27] Kahn, 48-49.

[28] Cornwell, 204.

[29] See Appendix D: Bibliography on "Technology, Mind and the Body".

[30] For example: *softVNS 2* (for Max/MSP and Jitter) by David Rokeby, which allows a very high level of sophistication with video-based motion tracking for interactive media-art applications.

See "David Rokeby : softVNS.html" at http://homepage.mac.com/davidrokeby/softVNS.html.

[31] Heimbecker.

[32] STEIM, *"S T E I M [products] > BigEye"* at http://www.steim.org/steim/bigeye.html.

[33] Rokeby, *Very Nervous System.* Interestingly, an earlier version of this work by Rokeby was titled "Body Language".

[34] Morales-Manzanares, Morales, Dannenberg, and Berger.

[35] MIDI, which stands for Musical Instrument Digital Interface, is an electronic musical equipment specification and computer language originally published in August 1983 for the purpose of enabling the connection and communication of different musical devices such as synthesizers.

See Wikipedia, *Musical Instrument Digital Interface.*

[36] STEIM.

[37] See section 4.5 The Program.

[38] Rokeby, *Very Nervous System.*

[39] Morales-Manzanares et al, 27.

[40] Morales-Manzaneras et al, 26.

[41] Rokeby, *Very Nervous System.*

[42] Bök, 10.

[43] This is a combination of two processes, each suggested by pioneering figures in the world of sound. The first is what I call 'Spectral Morphing' after a DSP software plugin called *Spectral*

Morpher, part of the *Sound Designers Spectral Suite* developed by Delaydots.com, as well as *Morphoder*, developed by Waves Audio Ltd. (A notable and much expanded toolset from Delaydots.com is the *SpectrumWorx* modular DSP plug-ins.) The second is a special use of contact microphones after experiments by John Cage. My use is a unique combination of these which I use to achieve recorded sounds of the human voice that have the timbral quality of raw materiality in metal, glass, wood, and stone. I describe my working method in detail in section 4.3 – The Process.

[44] Normandeau's work *Puzzle*, from Puzzles CD, empreintes DIGITALes, 2005. *Puzzle* employs door sounds and vocal onomatopoeias in a succession of small pieces that can be superimposed or juxtaposed in any order to create the piece.

[45] Ellen Moffat, *Nervouse*, The New Gallery, February/March 2006. The work involved a complex web of speakers and wires distributed through the gallery, whence emanate a "cacophonic schizophrenia" of voices.

See The New Gallery.

[46] Bruce Nauman, *Raw Materials*, Tate Modern, October 2004/March 2005. *Raw Materials* transforms the space of the Tate Modern's Turbine Hall through the medium of sound using hundreds of precisely timed and looped recordings of fragments of speech collected from 22 of his earlier works, and placed exactly throughout the space so that the listener has to position him-or-herself just so in order to discern the individual fragments of conversation.

See Dexter, Mix Editors, and The Tate Modern.

[47] With the exception of most audio software programs that convert to a 32-bit depth for calculations used in digital signal processing applications, while still maintaining the sampling resolution of the source (such as Waves *Morphoder* and Cycling 74's *Max/MSP*).

[48] See endnote 43.

[49] See Waves website for *Morphoder* at http://www.waves.com/content.asp?id=118.

[50] See *Micracoustic*.

[51] Piezo-electric discs consist of a metal covered by a special, metal-infused ceramic layer that, when they are bent, or when heat or pressure is applied, convert mechanical vibration into electrical energy, and visa-versa.

[52] Kahn, 192.

[53] This nomenclature is used to compare my treatment of the compositional plane to a landscape, where sonic elements can be arranged in a manner that is roughly analogous to depicting a landscape. This is not soundscape, as it does not describe the resultant sound of the composition, but rather the approach I have taken with the compositional process itself.

[54] See sections 4.3.1 DSP – The "Spectral Morph" and 4.3.3 Resonance Transference respectively.

[55] See Cycling '74.

[56] See MakingThings.

[57] Max/MSP uses the term *patch* to describe any complete computer program or nested sub-program. *Patches* consist of graphical program objects contained within a single window and connected together with patchcords.

[58] See Manovich.

[59] I have borrowed the term *interactor* from the discipline of evolutionary biology, where it was first advanced as an alternative to Richard Dawkins' *vehicles* to describe "entities that interact as cohesive wholes with their environments". See Hull, 137, 150, 179, 200-201.

[60] This is a variant of the age-old philosophical thought-experiment: *if a tree falls in the forest, and there is no one in any way to witness it, does it make a sound?*

REFERENCES

Baudelaire, Charles. (Jonathan Mayne, Tr. and Ed.) The Painter of Modern Life and Other Essays. London: Phaidon, 1964.

Beck and Al Hansen Playing with Matches, Californie: Catalogue d'exposition, Plug In Editions, 1998.

Birchfield, David, Kelly Phillips, Assegid Kidané, David Lorig. *"Interactive Public Sound Art: a case study"* Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06). Paris, France 2006

Bök, Christian. "Christian Bök: *The Piecemeal Bard Is Deconstructed: Notes Toward A Potential Robopoetics*", a paper on the website of Ubuweb at http://www.ubu.com/papers/object/03_bok.pdf (accessed February 2, 2005).

Brecht, George. The book of the Tumbler on Fire / Selected Works from Volume 1, Los Angeles: Los Angeles County Museum of Art, 1969.

Ibid., George Brecht: Works 1957-1973, New York: Onnasch Gallery, 1973

Ibid., Vicious Circles and Infinity : A Panoply of Paradoxes, Londres: Ed. Jonathan Cape LTD, 1975.

Buchloh, Benjamin H. D., Rodenbeck, Judith. Experiments in the Everyday: Allan Kaprow and Robert Watts – Events, Objects, Documents, New York/Seattle: Columbia University and University of Washington Press, Miriam and Ira D. Wallach Art Gallery, 1999.

Cage, John. Silence, Middletown: Wesleyan University Press, 1961.

Ibid., Notations, New York: Something Else Press, 1969.

Ibid., Writings 1968-1972, Connecticut: Westleyan University Press, 1973.

Cobbing, Bob (Steve McCaffery and bpNichol). *"Some Statements on Sound Poetry from Sound Poetry: A Catalogue"*. A paper on the website of Ubuweb at http://www.ubu.com /papers/cobbing.html (accessed: Feb 14, 2004)

Cornwell, Regina. *"Interactive Art: Touching the 'Body in the Mind'"*. Discourse 14, No. 2, Spring 1992.

Cycling '74. *"Cycling '74 | | maxmsp"* a website at http://www.cycling74.com/products/maxmsp (accessed: September 9, 2006)

Dexter, Emma. "Emma Dexter: *Tate Modern | Past Exhibitions | The Unilever Series: Bruce Nauman*", a curator's statement on the website of the Tate

Modern at http://www.tate.org.uk/modern/exhibitions/nauman/about.shtm (accessed August 6, 2006).

Dourish, Paul. Where the Action Is: The Foundations of Embodied Interaction. Cambridge, MA: MIT Press, 2001.

Farah, Mary Anne. *"The significance of the Introduction of Electronic Interaction to the History of the Art Object and the Viewer"* a Masters of Art Thesis, Concordia University, Montreal, Quebec, Canada, August 1995

Frank, Peter. Something Else Press, An Annotated Bibliography, New York: McPherson and Co., 1983.

Fox, Jonathan. *"The Différance Engine: Critical Theory and the Computer"* a website at http://tracearchive.ntu.ac.uk/frame/text/fox.html (accessed: July 26, 2006)

Hansen, Al. A Primer of Happenings & Time/Space, New York: Something Else Press, 1965.

Hartzell, Emily. *"Sculpting in Time and Space: Interactive Work"* Leonardo, Vol. 34, No. 2, pp. 101-107, April 2001

Heimbecker, Steve. *"Wind Array Cascade Machine S I (G) N (E)"* a website at http:// www.fondation-langlois.org/html/e/page.php?NumPage=369 (accessed July 3, 2006)

Hemingway, Ernest. A Moveable Feast. New York: Scribner, 2003.

Higgins, Dick. Manifestos, New York: Something Else Press, 1966.

Ibid., Horizons: The Poetics and Theory of the Intermédia, Illinois: Southern Illinois University Press, 1984.

Higgins, Hannah. The Fluxus Experience, California: California Press, 2002.

Huelsenbeck, Richard. Dada Almanach, Berlin: Erich Reiss Verlag, 1920. New York: Something Else Press, 1966.

Hull, David L. (Ed. Michael). "*The Philosophy of Biology*". Oxford Readings in Philosophy. Oxford; New York Oxford University Press (UK), 1998. pp. 137, 150, 179, 200-201.

Humphries, Holle. *"A Philosophical Inquiry into the Nature of Computer Art"* The Journal of Aesthetic Education, Vol. 37, No. 1, pp. 13-31, Spring 2003

Jameson, Fredric. The Political Unconscious: Narrative as a Socially Symbolic Act. Ithaca: Cornell University Press, 1981.

Janson, H.W. History of Art, Fourth Edition. New York: Harry Abrams, 1991.

Kahn, Douglas. Noise, Water, Meat: A History of Sound in the Arts. Cambridge, Massachusetts: The MIT Press, 1999.

Kaprow, Allan. Environments, Assemblages and Happenings, Harry Adams Ed., New York, 1965.

Ibid., How to Make A Happening, New York: Something Else Press, 1966.

Kellein, Thomas, Fluxus, London: Thames and Hudson ed., 1995.

Klee, Paul (Norbert Guterman, Tr.). The Inward Vision. New York: Harry Abrams, 1959.

Kostelanetz, Richard. John Cage: Documentary Monographs in Modern Art, New York: The Penguin Press, 1970.

Kroker, Arthur. "Arthur Kroker: *CTheory Live: STELARC Interview with Arthur and Marilouise Kroker*", a live streamed video interview on the website of PACTAC, University of Victoria, Pacific Centre for Technology and Culture at http://www.pactac.net/pactacweb/web-content/videoscroll4.html# (accessed April 26, 2006).

Maciunas, George. Art / Fluxus Art-distraction, New York: Editions Fluxus, 1965.

MakingThings. *"TELEO_VIDEO_MODULE"* a website at http://www.makingthings.com/products/documentation/teleo_video_user_guide/index.html (accessed September 12, 2006).

Manning, Peter. Electronic and Computer Music, Second Edition. Oxford: Clarendon Press, 1993.

Manovich, Lev. The Language of New Media. Cambridge, Massachusetts: The MIT Press, 2001.

Margolin, Uri. *"Experiencing Virtual Worlds: Observation to Co-Creation"* Poetics Today, Porter Institute for Poetics and Semiotics, Vol. 23, No. 4, pg. 707-717, Winter 2002.

Martin, Henry. An Introduction to George Brecht's Book of the Tumbler on Fire, Milano: Multhipla, 1978.

McLuhan, Marshall. Understanding Media: The Extensions of Man. Corte Madera, California: Gingko Press Inc., 2003.

Micracoustic, *"acous-, -acoustical words: acusis to telacousis, part 2 of 2"*, a webpage at http://www.wordquests.info/cgi/ice2-for.cgi?file=/hsphere/local/home/

scribejo/wordquests.info/htm/L-Gk-acous-A-T.htm&HIGHLIGHT=acous (accessed May 15, 2006).

Mix Editors. "Mix Editors: *Visual Artist Nauman Exhibits Raw Materials at Tate Modern Museum*". An article published in Mix available online at http://mixonline.com/mixline_live/Nauman-Raw-Materials-118058/index.html (accessed January 19, 2005).

Morales-Manzanares, Roberto, Eduardo F. Morales, Roger Dannenberg, and Jonathan Berger. "*SICIB: An Interactive Music Composition System Using Body Movements*" Computer Music Journal, Massachusetts Institute of Technology, Vol. 25, No. 2, pg. 25–36, Summer 2001

Momeni, Ali. "Composing Instruments: Inventing and Performing with Generative Computer-based Instruments" a Doctor of Philosophy in Music Dissertation, University of California, Berkeley, 2005

Mondloch, Katie. "*A Symphony of Sensations in the Spectator: Le Corbusier's Poème électronique and the Historicization of New Media Arts*" Leonardo, Vol. 37, No. 1, pp. 57–61, 2004

Normandeau, Robert. *Puzzles*. CD. Empreintes DIGITALes, 2005.

Ibid. *Un cinema pour l'oreille: Cycle d'oeuvres acousmatiques incluant "Éclats de voix", "Jeu", "Mémoires vives" et "Tangram"*. Thesis (D.Mus.) Montreal, Quebec: University of Montreal, 1992.

Overton, Ken. "Paul Panhuysen: *Some Stuff*", online introduction to a paper on Sound Art at http://eamusic.dartmouth.edu/~kov/soundArt/PaperIntro.html (accessed July 8, 2006).

Rabinowitz, Paula. "*The Sound of Reformed Space: Liz Phillips's Responsive Installations*" PAJ: A Journal of Performance and Art, PAJ 72, Vol. 24, No. 3, pp. 35-43, September 2002

RACTER. *The Policeman's Beard is Half Constructed: Computer Prose and Poetry by RACTER*. New York: Warner Books, 1984.

Retallack, Joan. Musicage : Cage muses on words, art, music, Hanovre/Londres: Wesleyan University Press, 1996.

Rokeby, David. "*Soft VNS 2*" a website at http://homepage.mac.com/davidrokeby/softVNS.html (accessed June 24, 2006)

Ibid. "*Very Nervous System*" a website at http://homepage.mac.com/davidrokeby/vns.html (accessed February 17, 2006)

Ruhe, Harry. 25 Fluxus Stories, Amsterdam/Verona: Tuja Books and Francesco Conz, 1999.

Ryan, Marie-Laure. *"Immersion vs. Interactivity: Virtual Reality and Literary Theory"* SubStance, Issue 89, Vol. 28, No. 2, pp. 110-137, 1999

Ibid. *"Interactive Drama: Narrativity in a Highly Interactive Environment"* MFS Modern Fiction Studies, Vol. 43, No. 3, pp. 677-707, Fall 1997

Schedel, Margaret. "Products". Soft VNS2 Review. Computer Music Journal, San Francisco, California Vol. 29, No. 4, pg. 97-98, 2005

Schwitters, Kurt. *"U B U W E B :: Kurt Schwitters"*, a website of Ubuweb at http://www.ubu.com/sound/schwitters.html (accessed May 15, 2006).

Smith, Owen F., Fluxus: History of An Attitude, San Diego: San Diego University Press, 1998.

STEIM, *"S T E I M [products] > BigEye"* a website at http://www.steim.org/steim/bigeye.html (accessed October 22, 2004)

"Synesthesia." Def. 1. The Canadian Oxford Dictionary. Thumb Index Edition. 1998.

Tanaka, Atau and Petra Gemeinboeck. *"A Framework for Spatial Interaction in Locative Media"* Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME06), Paris, France, 2006

The New Gallery. *Nervouse: Ellen Moffat.* Calgary: Derek Beaulieu, 2006.

The Tate Modern. *Raw Materials: Bruce Nauman.* London: Emma Dexter, 2004.

Virilio, Paul. A Landscape of Events. Cambridge, Massachusetts: The MIT Press, 2000.

Waves Audio Ltd. *"Waves - Morphoder"* a website at http://www.waves.com/content.asp?id=118 (accessed August 25, 2006)

Wikipedia. *"Acousmatic - Wikipedia, the free encyclopedia"*, a website at http://en.wikipedia.org/wiki/Acousmatic (accessed August 29, 2006).

Ibid. *"Famous synesthetes - Wikipedia, the free encyclopedia"*, a website at http://en.wikipedia.org/wiki/Famous_synesthetes (accessed September 2, 2006).

Ibid. *"Musical Instrument Digital Interface - Wikipedia, the free encyclopedia"*, a website at http://en.wikipedia.org/wiki/MIDI (accessed September 9, 2006).

Ibid. "*Musique concrète - Wikipedia, the free encyclopedia*", a website at http://en.wikipedia.org/wiki/Musique_Concr%C3%A8te (accessed November 3, 2004).

Ibid. "*Synesthesia - Wikipedia, the free encyclopedia*", a website at http://en.wikipedia.org/wiki/synesthesia (accessed January 23, 2005).

Ibid. "*The Scream - Wikipedia, the free encyclopedia*" a website at http://en.wikipedia.org/wiki/The_Scream (accessed July 28, 2006)

Wollheim, Richard. Art and its Objects: With Six Supplementary Essays, Second Edition. Cambridge, England: Cambridge University Press, 1980.

APPENDIX A: Supplemental Images

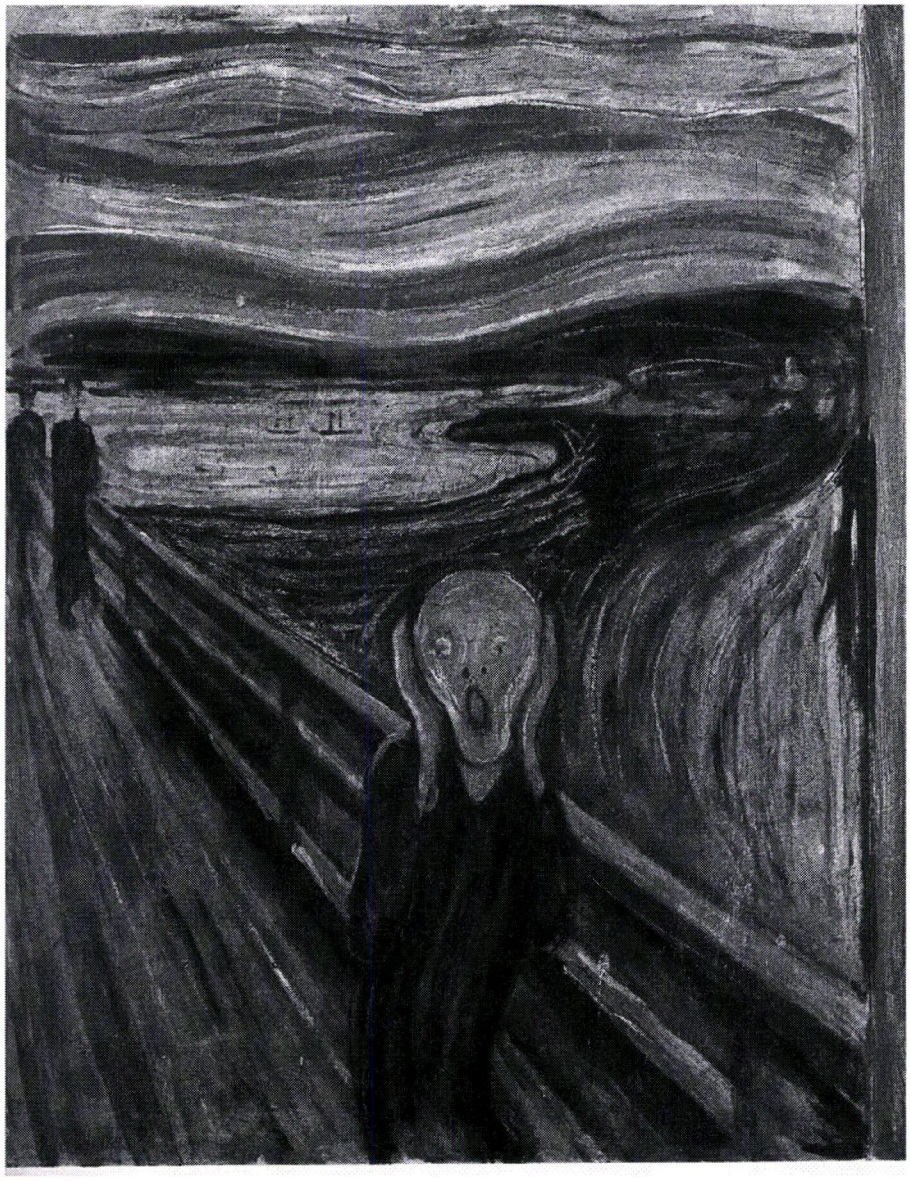


Plate 1 – *The Scream* by Edvard Munch, 1893[1]

[1] See Wikipedia, *The Scream* at http://en.wikipedia.org/wiki/The_Scream. Image copyright: The two-dimensional work of art depicted in this image is in the public domain in Canada and the United States because it was first published more than 95 years ago. This photograph of the work is also in the public domain in Canada and the United States (see *Bridgeman Art Library v. Corel Corp.* at http://en.wikipedia.org/wiki/Bridgeman_Art_Library_v._Corel_Corp.).

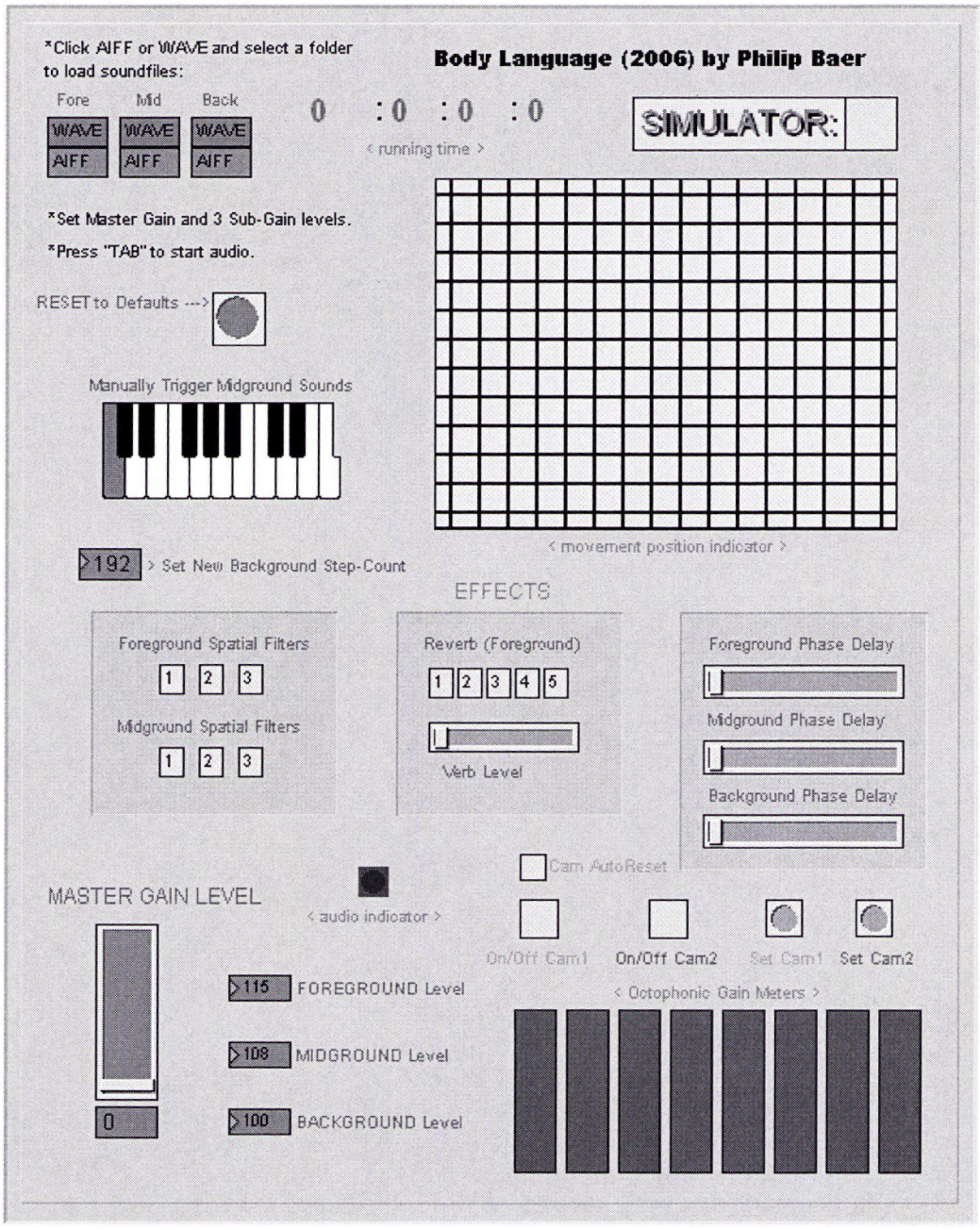
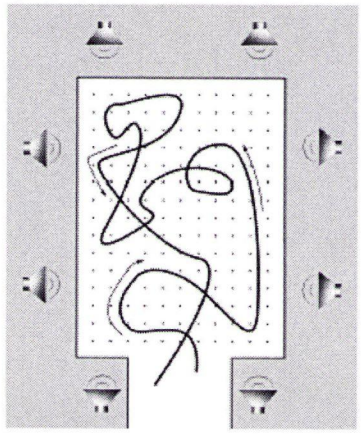


Fig. 1 – Body Language Program Graphical User Interface (GUI)

Title: Body Language
Genre: Interactive Accusmatic Sound-Art Installation
Media: Octophonic Sound, Motion Tracking, and Real-Time Video
Artist: Philip Baer
Date: August 2006



Body Language is an interactive sound-art installation, where the movements of persons in the exhibition space trigger sounds that emanate from the eight surrounding speakers. The position of persons' bodies in space determines what sounds will be heard and when, so that different locations in the exhibition space will trigger different sounds as you move through the space.

The sounds in the piece are all composed of parts of speech, called phonemes. These sounds have been combined with percussive sounds from striking physical materials such as metal, glass, wood and stone. So, as you move through the space, you will hear different combinations of voice and percussion.

This work has been created so that you can explore the many different possibilities offered in sound by moving throughout the exhibit. For example, you could try moving in different ways, such as dancing, jumping, or all kinds of other varied expressive movements (see above diagram). Or you could systematically walk through the space to try and discover all of the different sounds that are mapped to different locations. You will find that the best results occur if there is just one participant with the work at a time. Try to explore the creative possibilities that the work offers, and create you own, unique sound composition as you move.

Fig. 2 – Body Language Artist Statement

APPENDIX B: DVD & Audio CD Contents

DVD Contents:

This disc is divided into 2 sections, which contains the following:

DVD Video (playable in standard DVD players)

- Video performance of Body Language featuring 3 University of Calgary dancers[1] interacting with the system

DVD-Rom Files (containing everything needed to reproduce the piece)

- Original BodyLanguage Max/MSP patches
- WinXP Executable Runtime version of the program
- Screen captures from the program
- Photographs from the 2006 MFA: Graduating Thesis Exhibition at the Nickle Arts Museum (components of the work and images of users interacting with the work)
- All required sound files for the work (High resolution versions as well as CD-Quality)
- A recorded excerpt of BodyLanguage interactive performance, identical to the track on the audio CD (in AIFF format)
- MPEG version of the DVD video
- All logos, texts, and support files for the work
- Interdisciplinary Master of Fine Arts thesis text (PDF)

Audio CD Contents:

Track 1 – Recorded excerpt of Body Language (15:14)[2]

---

[1] Dancers in the DVD video are Jennifer Mahood, Alexandra Contreras-Hill, and Christy-Joy Cunningham.

[2] Composition generated by 1 participant interacting with the system by moving in space.

APPENDIX C: Body Language Installation Instructions

This appendix is provided to describe in detail all that is required to install the exhibition of the Body Language project. The following equipment is required:

- High Resolution Powered Speakers (E.g. Mackie SR450) (x8)

- Power Cords for speakers (x8)
- Power Extension Cords, 20ft (x14)
- Speaker Stands, 5ft (x8)
- XLR speaker cable, 50ft (x4)
- XLR speaker cable, 20ft (x12)

- PC Computer System (E.g. Athlon 64 3000+ w/512MB RAM) (x1)
- LCD Computer Screen, 17" (x1)
- Computer Keyboard (x1)
- Computer Mouse (x1)
- Uninterruptible Power Supply (x1)
- Air Coolant Fan (x1)

- 8-Channel I/O Computer Audio Interface (E.g. MOTU 896HD) (x1)
- MakingThings.Com Teleo Intro Kit (x1)
- MakingThings.Com Teleo Video Module (x1)

- CCD Video Surveillance Cameras (x1)
- 15" Colour TV w/S-Video Input (x1)
- 15" Wall Mount for TV (x1)
- DVD Player (x1)

- Video Data Projector (x1)

- 50ft RCA Cable (x1)
- 25ft RCA Cable (x1)
- 25ft S-Video Cable (x1)
- RCA Cable Extender Connectors (x6)
- RCA Y-Splitter (x2)

- Vinyl Lettering for Title Wall (x1)
- Wall Plaque for Artist Statement (x1)

The following is a diagram explaining the placement of equipment in the space:

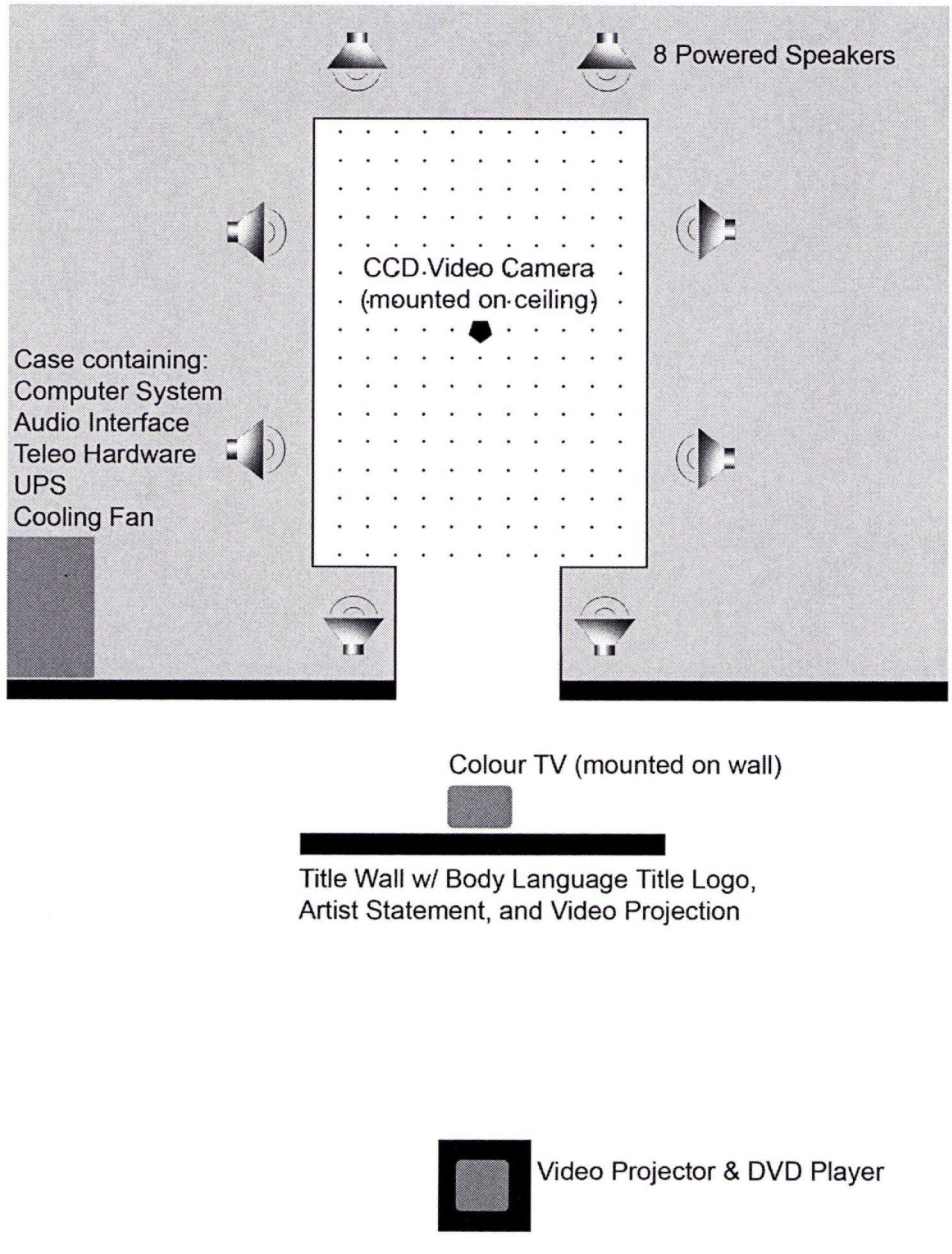


Fig. 3 – Diagram of Body Language Exhibition

Placement is as follows (see Fig. 3):

The Video Camera must be mounted on the ceiling, facing downwards, and placed such that the entire active centre zone is viewable, without displaying any of the surrounding area. Speakers are placed two on each side of the rectangular active area so that a total of 8 speakers are evenly distributed around the space. The height of the speakers should be adjusted so that there is a consecutive difference in height, where one speaker is adjusted to about 4ft height and the next is at 6ft height, and so on around all 8 speakers (this helps to create a more lively spatial effect in the sound).

The Computer System, Uninterruptible Power Supply (UPS), Audio Interface, and Teleo hardware are all placed inside of a constructed plywood case so that they are inaccessible to exhibition participants, but can be accessed when needed by gallery staff, etc. Also, venting in the case should be adequate to provide enough cooling for the normal operation of the computer equipment and other hardware. The cooling fan should be placed inside the case to aid in the venting of air, and should not be noisy enough to be audible over the sound of the work even when standing relatively near by.

Equipment connections are as follows:

The feed from the Video Camera must connect to the *Camera 2* input of the Teleo Video Module hardware. The video camera feed is also split off and sent to the colour TV for live viewing of persons in the active centre zone of the exhibition. All speakers are connected directly to the 8 outputs of the Audio Interface. The DVD Player must be connected to the Video Projector and then placed so that it will project onto the Title Wall (below the vinyl Title Lettering).

All cabling should be arranged such that it is visually unobtrusive and does not interfere with the rest of the work.

Lighting is as follows:

Only the centre active area should be lit (via diffuse spotlights) so that the surrounding area where the speakers are installed is kept relatively dark. Use of theatre rigging curtains may be employed to hide overhead mounting of lights, cabling and other equipment; these are also useful for shading the surrounding area and preventing light from leaking onto walls. On the title wall, a single spotlight should be used to highlight the title itself. This spotlight should not be too bright however as to obscure or interfere with the projected light of the DVD video from the data projector; as such, an oval shaped illumination is preferable.

The Body Language title logo file can be found on the DVD-Rom supplied with the paper copy of this text, as can the Artist's Statement file. See the DVD listing in Appendix B: DVD and Audio CD Contents under the section for *logos, texts, and support files*.

APPENDIX D: Bibliography on "Technology, Mind and the Body"

Aleksander, Igor. How to Build a Mind: Toward Machines with Imagination. New York, NY: Columbia University Press, 2001.

Arnheim, Rudolf. Entropy and Art: An essay on disorder and order. Berkeley: University of California Press, 1971.

Barrow, John and Frank Tipler. The Anthropic Cosmological Principle. New York: Oxford University Press, 1988.

Barthes, Roland. Elements of Semiology. London: Jonathan Cape, 1967

Ibid. Mythologies. London: Jonathan Cape, 1972.

Baudrillard, Jean (Ed. Mark Poster). Selected Writings. Stanford, California: Stanford University Press, 2001.

Ibid. (Tr. Brian Singer). Seduction. London, UK: Macmillan, 1990.

Blackmore, Susan. The Meme Machine. Oxford: Oxford University Press, 1999.

Breazeal, Cynthia. Designing Sociable Robots. Cambridge MA: MIT Press, 2002.

Brooks, Rodney. Flesh and Machines: How Robots Will Change Us. New York: Pantheon Books, 2002.

Capra, Fritjof. The Tao of Physics: An exploration of the parallels between modern physics and eastern mysticism. 3rd Edition. London: Flamingo, 1992.

Chaisson, Eric. Cosmic Evolution: The Rise of Complexity in Nature. Cambridge, MA: Harvard University Press, 2001.

Clark, Andy. Being There: Putting Brain, Body and World Together Again. Cambridge, MA: MIT Press, 1997.

Colebrook, Claire. Understanding Deleuze. Australia: Allen and Unwin, 2002.

Cope, David. Virtual Music. Cambridge, MA: MIT Press, 2001.

Davies, Paul and John Gribbin. The Matter Myth: Beyond Chaos and Complexity. London: Viking, 1991.

Dawkins, Richard. The Blind Watchmaker. London: Longman, 1986.

Ibid. River Out of Eden. London: Weidenfeld and Nicolson, 1995.

Deitch, Jeffrey. Post Human. New York, NY: DAP, 1992.

De Landa, Manuel. War in the Age of Intelligent Machines. New York: Zone Books, 1991.

Deleuze, Gilles and Felix Guattari (Tr. Brian Massumi). A thousand plateaus: Capitalism and Schizophrenia. Minneapolis: University of Minnesota Press, 1987.

Dennett, Daniel. Consciousness Explained. New York, NY: Little, Brown & Company, 1991.

Descartes, Rene. (Tr. J. Veitch). A Discourse on Method: Meditations and Principles. London: J.M. Dent & Sons, 1912.

Draaisma, Douwe. Metaphors of Memory: A history of ideas about the mind. Cambridge: Cambridge University Press, 2000.

Drexler, Eric. Engines of Creation: The Coming Era of Nanotechnology. Oxford: Oxford University Press, 1990.

Eco, Umberto (Tr. Alastair McEwen). Kant and the Platypus. New York, NY: Harcourt Brace & Company, 1997.

Ibid. The Limits of Interpretation. First Midland Book Edition. Indianapolis: Indiana University Press, 1994.

Ehrenfeld, David. The Arrogance of Humanism. Oxford: Oxford University Press, 1981.

Feynman, Richard. Six Easy Pieces: Essentials of Physics Explained by its Most Brilliant Teacher. New York, NY: Addison-Wesley, 1995.

Foucault, Michel. The Order of Things: An Archaeology of the Human Sciences. New York, NY: Vintage Books, 1973.

Freud, Sigmund. The Interpretation of Dreams. London: Pelican, 1976.

Ibid. *'Beyond the Pleasure Principle'*, On Metapsychology: The Theory of Psychoanalysis. London: Pelican, 1984.

Ibid. (Tr. Joan Riviere). The ego and the id. London: Hogarth Press and the Institute of Psycho-Analysis, 1962.

Fukuyama, Francis. Our Posthuman Future: Consequences of the biotechnology revolution. New York, NY: Farrar, Straus & Giroux, 2002.

Gleick, James. Chaos: Making a New Science. London: Heinemann, 1988.

Gombrich, EH. Art and Illusion: A study in the psychology of pictorial representation. London: Phaidon, 1960.

Greenfield, Susan. The Human Brain. London: Phoenix, 1998.

Hameroff, Stuart and Roger Penrose. *'Orchestrated Reduction of Quantum Coherence in Brain Microtubules: A Model for Consciousness'*, Neural Network World, Vol. 5 No.5, pg. 793-804,1995.

Haraway, Donna Jeanne. Simians, cyborgs and women : the reinvention of nature. London: Free Association Books, 1991.

Hayles, N. Katherine. My Mother Was a Computer: Digital Subjects and Literary Texts. Chicago: University of Chicago Press, 2005.

Ibid. Writing Machines. Cambridge, MA: MIT Press, 2002.

Ibid. How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics. Chicago: University of Chicago Press, 1999.

Hofstadter, Douglas. Gödel, Escher, Bach: An Eternal Golden Braid. London: Penguin Books, 1980.

Hull, David L. (Ed. Michael Ruse). *"The Philosophy of Biology"*. Oxford Readings in Philosophy. Oxford: Oxford University Press, 1998.

Jean Baudrillard (Ed. Hal Foster). *"The Ecstasy of Communication,"* The Anti-Aesthetic: Essays on Postmodern Culture. Port Townsend, Wash: Bay Press, 1983.

Kellert, Stephen. In the Wake of Chaos. Chicago: University of Chicago Press, 1993.

Kelly, Kevin. Out of Control: The New Biology of Machines. London: Fourth Estate, 1994.

Kristeva, Julia (Tr. Leon S. Roudiez). Powers of horror: an essay on abjection. New York, NY: Columbia University Press, 1982.

Kuhn, Thomas. The Structure of Scientific Revolutions. Chicago: Chicago University Press, 1970.

Kurzweil, Ray. The age of spiritual machines: When computers exceed human intelligence. New York, NY: Viking, 1999.

Lacan, Jacques. Écrits: A Selection. London: Tavistock, 1977.

Latham, William and Stephen Todd. Evolutionary Art and Computers. London: Academic Press, 1992.

Latour, Bruno. and Steve Woolgar. Laboratory Life: The Social Construction of Scientific Facts. London: Sage Publications, 1979.

Levy, Steven. Artificial Life. London: Jonathan Cape, 1992.

Massumi, Brian. A User's Guide to Capitalism and Schizophrenia: Deviations from Deleuze and Guattari, A Swerve Edition. Cambridge, MA: The MIT Press, 1992.

Menzel, Peter and Faith D'Alusio. Robosapiens: Evolution of a New Species. Cambridge, MA: MIT Press, 2000.

Merleau-Ponty, Maurice (Tr. Colin Smith). Phenomenology of Perception. London: Routledge, 1989.

McCorduck, Pamela. AARON's code: meta-art, artificial intelligence, and the work of Harold Cohen. New York: W.H. Freeman, 1991.

McGinn, Colin. The Problem of Consciousness. Oxford: Basil Blackwell, 1991.

Moravec, Hans. Mind Children: The future of robot and human intelligence. Harvard: Harvard University Press, 1989.

Ibid. Robot: Mere Machine to Transcendent Mind. Oxford: Oxford University Press, 1999.

Penrose, Roger. The Emperor's New Mind. London: Vintage, 1990.

Pepperell, Robert. The Posthuman Condition: Consciousness beyond the brain, 3rd Edition. Bristol, UK: Intellect Books, 2002.

Peretz, Isabelle and Robert Zatorre. The Cognitive Neuroscience of Music. Oxford: Oxford University Press, 2003.

Rabinbach, Anson. The Human Motor: Energy, Fatigue, and the Origins of Modernity. Berkeley: University of California Press, 1992.

Saussure, Ferdinand de. Course in General Linguistics. London: Duckworth, 1990.

Schrödinger, Erwin. What is Life? Cambridge: Cambridge University Press, 1967.

Searle, John. *'Minds, Brains, and Programs'*. The Behavioral and Brain Sciences, Vol. 3. Cambridge, MA: Cambridge University Press, 1980.

Ibid. Minds, Brains and Science. London: Penguin, 1984.

Ibid. The Rediscovery of the Mind. Cambridge, MA: MIT Press, 1992.

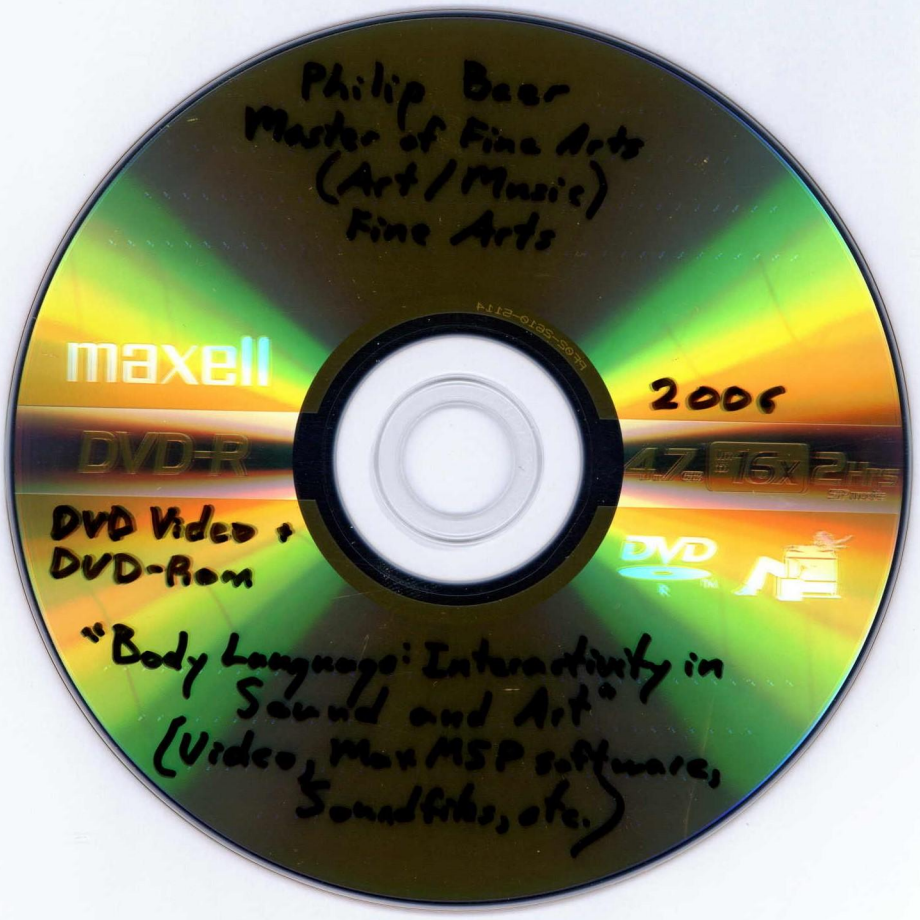
Taylor, Timothy. Strange Sounds: Music, Technology & Culture. New York: Routledge, 2001.

Thompson, Richard. The brain: a neuroscience primer. New York: Freeman and Co., 1993.

Turing, Alan. *'Computing Machinery and Intelligence'*. Mind: A Quarterly Review of Psychology and Philosophy Vol. LIX, No. 236 pg.433-460, 1950.

Wiener, Norbert. The Human Uses of Human Beings: Cybernetics and Society. London: Free Association Press, 1989.

Wittgenstein, Ludwig. Philosophical Investigations. Oxford: Blackwell, 1953.


Philip Baer
Master of Fine Arts
(Art / Music)
Fine Arts
maxell
2006
DVD-R
DVD Video +
DVD-Rom
"Body Language: Interactivity in
Sound and Art"
(Video, Max MSP software,
Soundfiles, etc.)


Philip Baer
Master of Fine Arts
(Art / Music)
Fine Arts
2006
Audio CD
Excerpt of "Body Language" work.
Track 1 - 15:14