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THE VARIETIES OF USER EXPERIENCE

BRIDGING EMBODIED METHODOLOGIES FROM SOMATICS AND PERFORMANCE TO
HUMAN COMPUTER INTERACTION

by

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Faculty of Technology

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Dedication

to my mother
Helena Johanna Smeets Schiphorst
your memory lifts my gaze
and fills my heart

Thecla Henrietta Helena Maria Schiphorst

THE VARIETIES OF USER EXPERIENCE: BRIDGING EMBODIED METHODOLOGIES FROM
SOMATICS AND PERFORMANCE TO HUMAN COMPUTER INTERACTION

Abstract Embodied Interaction continues to gain significance within the field of Human Computer Interaction (HCI). Its growing recognition and value is evidenced in part by a remarkable increase in systems design and publication focusing on various aspects of Embodiment. The enduring need to interact through experience has spawned a variety of interdisciplinary bridging strategies in the hope of gaining deeper understanding of human experience. Along with phenomenology, cognitive science, psychology and the arts, recent interdisciplinary contributions to HCI include the knowledge-rich domains of Somatics and Performance that carry long-standing traditions of embodied practice. The common ground between HCI and the fields of Somatics and Performance is based on the need to understand and model human experience. Yet, Somatics and Performance differ from normative HCI in their epistemological frameworks of embodiment. This is particularly evident in their histories of knowledge construction and representation. The contributions of Somatics and Performance to the history of embodiment are not yet fully understood within HCI. Differing epistemologies and their resulting approaches to experience identify an under-theorized area of research and an opportunity to develop a richer knowledge and practice base. This is examined by comparing theories and practices of embodied experience between HCI and Somatics (Performance) and analyzing influences, values and assumptions underlying epistemological frameworks. The analysis results in a set of design strategies based in embodied practices within Somatics and Performance. The subsequent application of these strategies is examined through a series of interactive art installations that employ embodied interaction as a central expression of technology. Case Studies provide evidence in the form of rigorously documented design processes that illustrate these strategies. This research exemplifies 'Research *through* Art' applied in the context of experience design for tangible, wearable and social interaction.

Table of Contents – Volume II

Abstract	5
Table of Contents	7
List of Tables and Figures	9

Appendix A Companion DVD Description

A Companion DVD Description	11
A.1 Companion DVD	12
A.2 Bodystate	12
A.3 Breath	14
A.4 Touch	15

Appendix B Compilation of Somatic Practices

B Somatic Techniques	
B.1 Structural Approaches	17
B.2 Functional Approaches	18
B.3 Western Movement Arts	20
B.4 Convergence Systems	23

Appendix C whisper workshop data

C Whisper workshop data	25
C.1 Design Document, whisper July 2002	29
C.2 Whisper Interaction Models	43
C.3 Workshop 'listen'	51
C.3.1 Workshop 'listen' Script	51
C.3.2 Workshop 'listen' Response Card	52
C.3.3 Workshop 'listen' Response Cards	53
C.3.4 Workshop 'listen' Response Cards Transcription	58
C.4 Workshop 'between'	62
C.4.1 Workshop 'between' Script	62
C.4.2 Workshop 'between' Response Card	65
C.4.3 Workshop 'between' Response Cards	66
C.4.4 Workshop 'between' Response Cards Transcription	70
C.5 Workshop 'extend'	72
C.5.1 Workshop 'extend' Script	72
C.5.2 Workshop 'extend' Response Card	73
C.5.3 Workshop 'extend' Response Cards	74
C.5.4 Workshop 'extend' Response Cards Transcription	88
C.6 Workshop 'mutate'	92
C.6.1 Workshop 'mutate' Script	92
C.6.2 Workshop 'mutate' Response Card	93
C.6.3 Workshop 'mutate' Response Cards	94
C.6.4 Workshop 'mutate' Response Cards Transcription	106
C.7 Workshop 'phase'	110
C.7.1 Workshop 'phase' Response Cards	110
C.7.2 Workshop 'phase' Response Cards Transcription	114

Appendix D heart[h] Workshop Data

D	Heart[h] workshop data	117
D.1	Workshop 'something in the skirt' / 'something between the skirts'	120
D.1.1	Workshop Script	120
D.1.2	Workshop Response Card	123
D.1.3	Workshop Data Analysis Grid	125
D.1.4	Exit Interviews	134
D.1.4.1	Exit Interviews Students	134
D.1.4.2	Exit Interviews Dancers	140
D.1.5	Workshop Response Cards Transcription	152
D.2	Workshop 'resonance within' / 'resonance without'	160
D.2.1	Workshop Script	160
D.2.2	Workshop Response Card	163
D.2.3	Workshop Data Analysis Grid	165
D.2.4	Exit Interviews	171
D.2.4.1	Exit Interviews Students	171
D.2.4.2	Exit Interviews Dancers	187
D.2.5	Workshop Response Cards Transcription	191
D.3	Workshop 'self to self' / 'self to other' / 'self to group'	198
D.3.1	Workshop Response Card	198
D.3.2	Workshop Data Analysis Grid	200
D.3.3	Exit Interviews	207
D.3.3.1	Exit Interviews Dancers	207
D.3.4	Workshop Response Cards Transcription	212

Appendix E design of a tactile semantics

E	Design of a tactile semantics	227
E.1	soft(n) interaction model	229
E.2	Use of Laban Effort / Shape in Data Recognition	235
E.3	move.me Interaction Model	237
E.4	The Journey of a token through the soft-object networked circle	247
E.5	The Journey of a Thrown Object	249
E.6	Data Flow	251
E.7	Self to Self Touch Response	252
E.8	Self to Self Sleep Call Touch Response	253
E.9	Token Ring Response State	254
E.10	Thrown Object	255
E.11	Resonance States	256
E.12	Interaction Modes and States	257
E.13	move.me Sensor Evaluation and Laban Analysis	259
E.14	soft(n) Workshop Response Card	265
E.15	soft(n) Workshop Response Cards	266
E.16	soft(n) Workshop Transcription	269

Appendix F Bound In Publications

F	Bound In Publications	283
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List of Figures and Tables

Figures

Figure II.1	Companion DVD Menu Selection	11
Figure II.2	Laban Effort-Shape Analysis Describes Movement Qualities	17
Figure II.3	History of Somatics Contemporary Influences in Western Practice	18
Figure II.4	whisper workshops Design Process Webpage	25
Figure II.5	heart[h] workshops Design Process Webpage	117
Figure II.6	soft(n) Design Process Webpage	227

Tables

Table II.1	Companion DVD Menu Selection and Corresponding Chapters	12
Table II.2	Companion DVD 'whisper workshop' description of video content.....	14
Table II.3	heart[h] Workshop 1 Participant Observations	125
Table II.4	heart[h] Workshop 1 Response Cards	130
Table II.5	heart[h] Workshop 2 Participant Observations	165
Table II.6	heart[h] Workshop 2 Response Cards	166
Table II.7	heart[h] Workshop 3 Participant Observations	200
Table II.8	heart[h] Workshop 3 Response Cards	202

AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

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Relevant seminars, conferences and art exhibitions were regularly attended at which work was presented, papers were published and interactive art was exhibited.

Signed

A handwritten signature in blue ink, appearing to read 'J. Seno', is written over a faint, light blue rectangular stamp.

Date April 30 2008

A

Appendix A: Companion DVD Description



Figure II-1. Companion DVD Menu Selection

This Appendix includes a description of the supporting video material on the **Companion DVD** submitted with the Thesis. The video has been selected to support the research described within the thesis. Additional video and visual material can be found on the website. <http://www.sfu.ca/~tschiph/>

My research explores embodied interaction through movement, touch and body-state. I bring deep working knowledge and experience from the fields of performance and Somatics to my research. My life-long training in dance, choreography and Somatics techniques include expert knowledge in movement creation, movement analysis, physical and structural techniques (such as Laban Effort/Shape, Feldenkrais and

Appendix A Companion DVD Description

Alexander Methods), and a particular sensitivity to what I consider a kind of “feminizing” of technology.

My professional training in computing, computer programming and systems analysis enables me to conceptualize and design within the field of human computer interaction. My research processes result in working technology prototypes in the form of art installations that are exhibited, tested and validated within the context of an international interactive art community.

Companion DVD

The companion DVD includes three ‘themes’ around which the video examples are clustered: *bodystate*, *breath*, and *touch*. The video selections are designed as support material for the Case Studies described in Chapters 5, 6, and 7. DVD titles and corresponding Chapters are listed below:

DVD menu title	Thesis Chapter
chapter 5 bodystate	Chapter 5 From the Inside Out
chapter 6 breath	Chapter 6 Designing with Breath
chapter 7 touch	Chapter 7 Somaesthetics of Touch

Table II-1. Companion DVD Menu Selections and Corresponding Thesis Case Study Chapters

Bodystate

The first theme includes selections from the development and exhibition of the *whisper* wearable art installation, which explored interaction with one’s own body-state. In these examples body-state is explored by the simple act of attending to one’s body data. The whisper installation uses the physiological data of breath and heart-rate. The goal of the installation is to enable the cultivation of self-observation in such a way that body-state can be observed and shared with others in a networked environment.

Appendix A Companion DVD Description

Many physical techniques in Somatics and performance use self-observation as a mechanism for learning to experience and understand our own embodied physical processes. Within these frameworks, directing attention to the experience of one's state can enable greater access to 'knowing the self', and an ability to share that self (including the data of the self) with others. Under the theme *bodystate*, I have included two selections:

- **whisper installation** 2002-2003; whisper was the first of three wearable prototypes explored in the context of interactive art. **whisper** used kimono-style jackets containing breath and heart-rate sensors. These controlled a real-time visualization projected onto the floor in pools of light. This 7-minute video documents the whisper installation in Cambridge, UK, April 2003, as part of the Respond Festival. The development of this piece initiated the founding of the whisper[s] research group.
- **whisper workshops**; the whisper experience design workshops were conducted in November 2002, and formed the basis of the interaction design used to develop the experience and the technology prototype for the whisper installation that premiered at the Dutch Electronic Arts Festival in 2003. This 2.5 minute video is divided into 4 segments. Each of the four segments shows two examples: 1) video footage from the workshop followed by 2) video footage from the installation. Each segment illustrates how the workshop experience data formed the basis for the design of interaction metaphors, interactive garments, gestural interaction and group connectivity within the installation. Each of the four segments 'clusters' similar interaction concepts and illustrates their interaction. These four segments are described in the table below:

Video Segment	Cluster of Concepts
one	self-to-self; listening; awareness; body-data
two	self-to-other; sharing; play; transfer
three	exchange; permission; control; touch; 'snaps'+ 'islands'
four	self-to-group; extension; body image; creating larger body

Table II-2. Companion DVD 'whisper workshops' description of video content organization

Breath

The second theme *breath* includes video footage from the piece *exhale*, as it was exhibited as a prototype during the Siggraph 2005 Emerging Technologies exhibition. *Exhale* explored one's own relationship to breath in order to negotiate shared breath through a network of skirts that exist in a public networked environment. The goal of the cultivation of self-observation continues in this work. Many physical techniques in Somatics and performance use breath as a mechanism to direct attention to our own physical processes. Within these frameworks, attention to breath is experiential and can effect or control bodystate. Under the theme *breath*, I have included:

- **exhale** 2005-2006; *exhale* was the third in a series of wearable prototypes. In **exhale** breath is used to actuate small vibrators and fans sewn into the linings of skirts. While **whisper's** breath data actuated visualization, **exhale's** breath data actuates physical vibration and the movement of air (fans) on or close to the skin. The placement of these actuators beneath the skirt lining explicitly hides them from the visual sense. In this way **exhale** explores the *legibility* of physical actuation (such as vibration) *without* dependence upon visual perception. This video documents a 'proof-of-concept' exhibition at Siggraph 2005 Emerging Technologies, a showcase for innovation in new technologies. The video describes the concept and underlying context of the research.

Touch

The sense of touch has been a theme in my art-work since 1995 and in my somatics training since 1984. The videos selected in this theme illustrate my historical exploration of tactile interaction. They span a 7-year period and illustrate a range of expressiveness and application. In these art-works touch and tactile interfaces are used as an exploration of *active touch*¹ in experience. In particular, experience that 'attends' to our inner state through touch. Touch is sometimes called "the first sense", and is associated with intimacy and empathy. Touch is also an important sense in the field of somatics. The selected art-works remain influential in my research trajectory today. For example, my latest art-work entitled *soft(n)* (2005-2007) further articulates concepts that I began to develop in 1995, and builds on the semantics of caress shown in the FlowField Video. The *touch* theme includes four video examples:

- **Bodymaps: Artifacts of Touch** (1995-1997), was the first interactive artwork that bridged the tactile aspect of my somatics training with my background in computer design. This work is autobiographical in nature and has an intensely personal, sensual, sometimes disturbing quality. At the time of Bodymap's inception the 'hand' in HCI was used primarily as a pointing and clicking device or as a command-based driver of interaction, remaining divorced from its tactile nature. I was interested in counter-pointing the prevalence of goal-directed interaction, exploring interaction that simply 'made space' for the existence of experience for its own sake. In Bodymaps, the treatment of the video and audio content was influenced by Luce Irigaray's book "Marine Lover", an essay written to Nietzsche in a lyrical dialogue form, interrogating him 'from the point of view of water'².

¹ *Active touch* is defined by J.J., Gibson in *The Senses Considered As Perceptual Systems*. Gibson identifies that touch can be simultaneously Objective and Subjective "the same stimulating event has two possible poles of experience, one objective and the other subjective. There are many possible meanings of the term *sensation* but this is one: the detection of the impression made on a perceiver while he is primarily engaged in detecting the world". pp 99.

² In *Marine Lover*, Irigaray ruptures conventional discourse, writing in dialogue form in a lyrical style that defies distinctions among theory, fiction, and philosophy. A leading French feminist and psychoanalyst, Luce

Appendix A Companion DVD Description

- **Felt Histories** (1998-2000), continued the artistic and technological theme of *Bodymaps*, but extended its technological exploration to include real-time mixing of video and sound through a networked system. Its thematic content was biographic in nature, based on an aural history of my mother's memories of her upbringing as a Dutch child in a large Catholic family, exploring the tensions between her femininity and the physical nature of her body and bodily memories.
- **FlowField** (2001-2002) is a 'proof of concept' based on an initial implementation of an input *semantics of caress*. Flowfield was funded by the Advanced Systems Institute (ASI), and was a collaboration between Tactex Controls Inc., UBC (Sid Fels), and TechBC (Thecla Schiphorst). Timothy Chen, a Masters' student at UBC contributed the work on the particle field interaction while my contribution to the project was the development of a heuristics for tactile recognition based on Laban Effort/Shape analysis. The Effort/Shape system defines the taxonomy for movement qualities in 3D space, and this was applied to *touch*. In the video this is implemented on the Tactex MTC Express Tablet.
- **Tactile Fabric Prototype** (2005-2007) illustrates the first fabric tactile prototype developed during the design process of *exhale*. Following from Flowfield's implementation this research had been successfully ported to PDAs that enable data to be derived from hand-sewn tactile arrays constructed from textiles, conductive foam and conductive fabric. Recently, this was applied to *soft(n)* (2005-2007) a group of networked soft objects that communicate to one another based on qualitative attributes of touch (*how* inter-actors touch the objects).

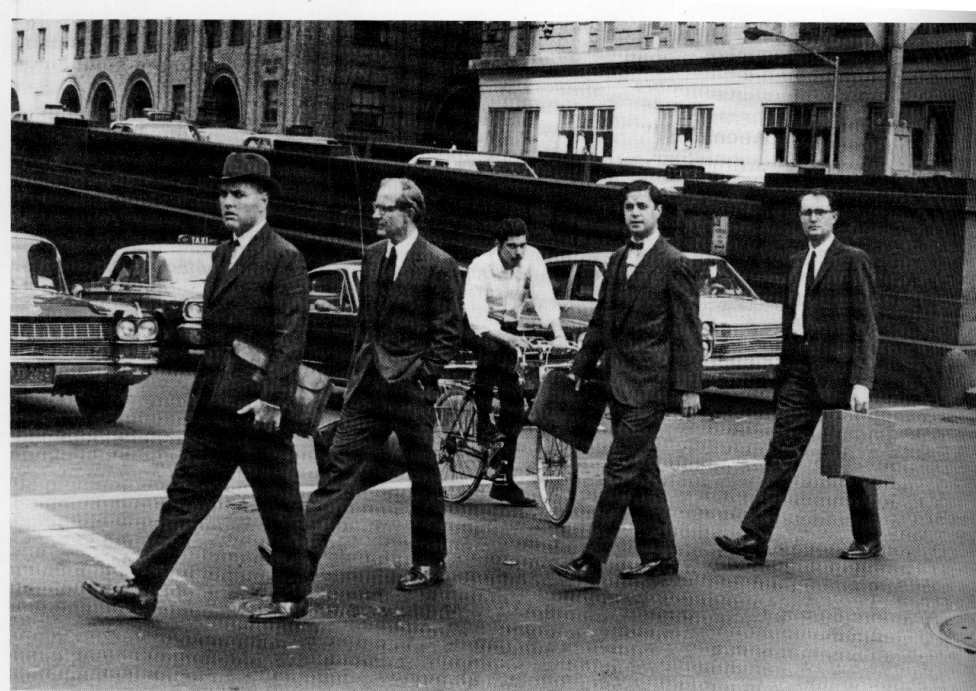
Please refer to my online web CV for complete citations, projects and supporting materials including video, image galleries, and full descriptions of credits.

<http://www.sfu.ca/~tschiph/>

<http://whisper.iat.sfu.ca>

B

Appendix B: Compilation of Somatic Practices



Four Businessmen on Park Avenue © Bonnie Freer.

All in general phase of weight transference, all show pronounced verticality. Second from left most distinctive (also most unaware of camera) because anticipatory twist in upper body accompanies his Free Flow, Sudden Time, and Direct Space, which is in contrast to the more Bound Flow and Neutral Effort of the others.

Figure II-1. Laban Effort-Shape Analysis Describes Movement Qualities (from Bartinieff, 1980)

Introduction

This Appendix presents a compilation of Somatics bodywork Practices, and provides descriptive material to support Chapter Two's historical analysis of Somatics. The techniques listed are limited to the Western systems illustrated within Chapter Two; they include Structural Approaches, Functional Approaches, Western Movement Arts and a small selection from Convergence Methods. Techniques that are not included here are Eastern forms: Eastern Energetic Systems, Eastern Movement Arts and a number of Convergence Systems rooted in Eastern Practices.

Each of the practitioners identified on the following page in **Figure II-2. History of Somatics Contemporary Influences in Western Practice** is contained within this compilation¹.

¹ The Categories and summaries described here are taken from Mirka Knaster's comprehensive descriptions of contemporary mind-body practices. See Knaster, M. (1996). *Discovering the Body's Wisdom*, Bantam Books.

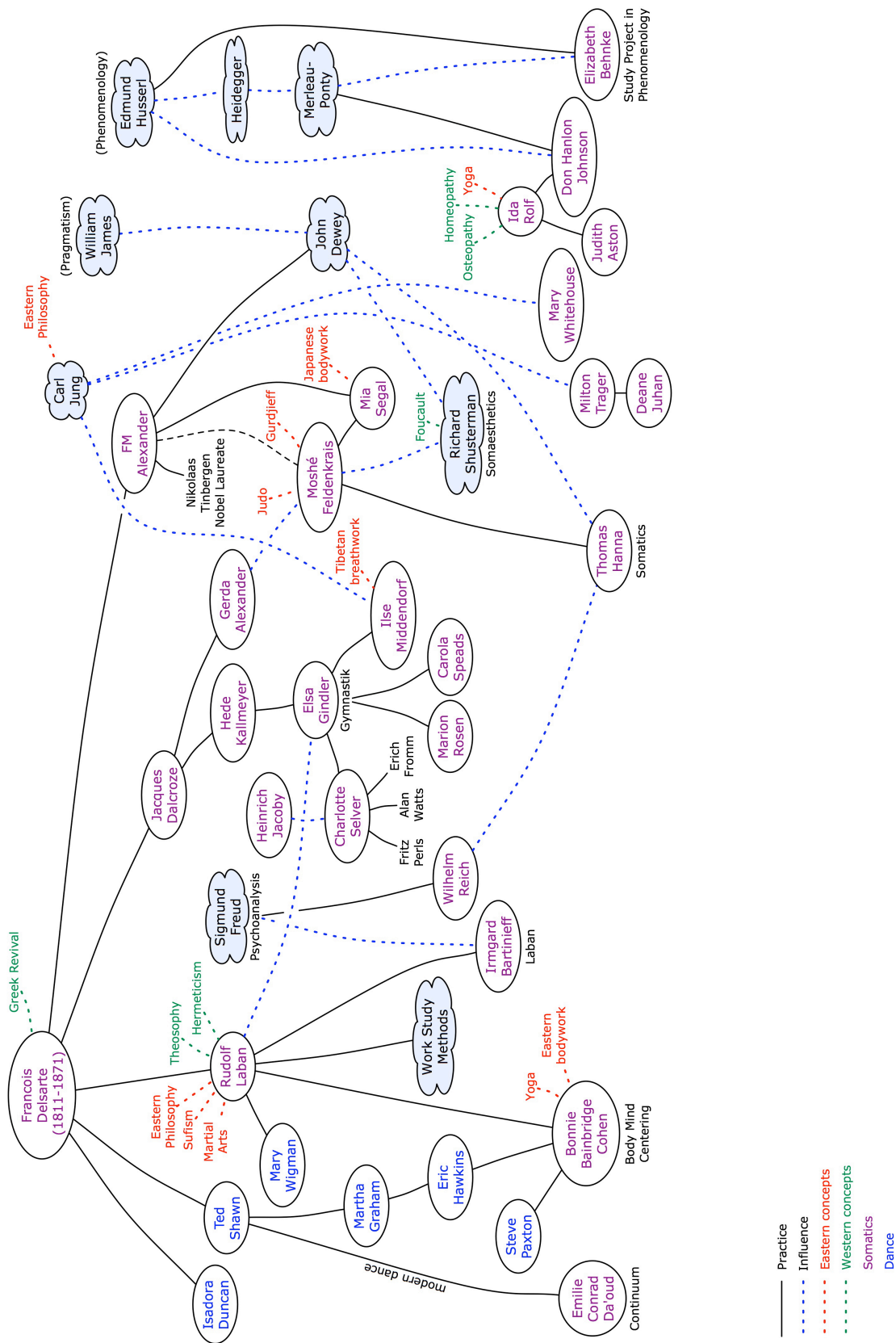


Figure II-2. History of Somatics Contemporary Influences in Western Practice

Appendix B Compilation of Somatic Practices

B.1 Structural Approaches

B.1.1 Rolfing

Rolfing is the tree trunk from which other structural bodyways have branched. Also known as Structural Integration, it is the creation of **Ida O. Rolf** (1896-1979). It is both a systematic approach to releasing stress patterns and dysfunction in the body's structure and an educational process of understanding the relationship between gravity and the human body.

Rolf viewed the body as an architectural unit made up of several blocks or segments – head, shoulders, chest, pelvis and legs. The position of each one is relevant to the others and is determined by the length and tone of muscles and fascia.

B.1.2 Aston-Patterning

Judith Aston was teaching movement education to dancers, actors, and athletes at a college when she found her way to **Ida Rolf's** hands because of significant injuries she had sustained in two car accidents. Immediate improvement convinced her of the value of Rolf's work. Building on Rolf's postural ideas, Aston created the first full movement education system for Rolfing. In 1971 she began training Rolfers and others in Rolf-Aston Structural Patterning and Movement Analysis, and she assisted them in learning how to use their bodies with greater ease, which resulted in a "softer" Rolfing style.

B.1.3 Hellerwork

Joseph Heller, a former aerospace engineer, studied with **Ida Rolf** and **Judith Aston** and became the first president of the Rolf Institute in 1976. Three years later, he left to found his own system for rebalancing the whole body.

Hellerwork is an integrating process that combines three components. Connective tissue manipulation helps realign your body and release chronic rigidities. Movement reeducation teaches you greater body awareness and stress-free methods of engaging in daily activities. Guided verbal dialogue assists you in recognizing the relationship among your body, emotions and attitudes, dealing with memories that surface, and discovering new ways to handle stress.

B.2 Functional Approaches

B.2.1 The Alexander Technique

Australian-born **Frederick Matthias Alexander** (1869-1955) discovered his functional approach when doctors couldn't cure him of the recurring loss of his voice. Given his profession as a Shakespearean reciter, this was not an insignificant liability. Through self-observation and self-sensing, he became aware of an unconscious propensity to pull his head back and down. Once he began inhibiting this pattern of exerting pressure on his neck, he healed himself of throat and vocal troubles as well as of respiratory and nasal difficulties he had suffered since birth. Alexander concluded that the root of these and other discomforts – such as tennis elbow, fatigue, and shoulder pain – is misuse of the body.

Gradually he organized a method for converting faulty "use" into improved coordination; this method became known as the Alexander Technique.

B.2.2 Gerda Alexander Eutony

Gerda Alexander Eutony (GAE), the work of **Gerda Alexander** (1908-1993), was originally a method of relaxation, which she developed into a sensory-motor learning process or system of mind-body consciousness. Born in Germany, she was not related to F. M. Alexander. She was a teacher of Eurhythmic Education, a system of education based on music and movement that was founded by **Jacques Dalcroze**.

The word *eutony* – well-balanced tension or tonicity – is derived from the Greek *eu-*, meaning “good” or “harmonious,” and the Latin *tonus*, meaning “tension.” Central to GAE is working with tonus regulation of all the body’s tissues, from the skin and muscles to organs and glands.

B.2.3 Sensory Awareness

The students of somatic pioneer **Elsa Gindler**, who taught in Germany until her death in 1961, have carried her work to many parts of the world, incorporating it in all kinds of therapies and skills training, from overcoming speech disorders to working with psychiatric patients and teaching music. **Charlotte Selver**, the best-known Gindler student in the United States, coined the term *Sensory Awareness* for her style of teaching. It has influenced many innovators in the evolution of their own disciplines, such as **Fritz Perls** with Gestalt Therapy.

Also known as *sensory re-education* or *conscious sensing*, Sensory Awareness (SA) aims at helping you attain clear, direct perception and authentic experience that goes beyond intellectual understanding. Philosopher **Alan Watts** called SA “living Zen” because of its similarity to meditation and its achievement of a state of mind-body unity. There is neither a set series of courses to complete in Sensory Awareness nor a recipe of any kind, no guided images, structured movements, specific positions, or anatomical training, just simple inquiry.

B.2.4 The Mensendieck System

The Mensendieck System of functional movement techniques originated at the end of the nineteenth century with **Bess Mensendieck**, a medical doctor. She believed that the postures we assume and the movements we make regularly at work, play, and rest shape and condition our bodies. The results we get – bodies that are slender and lithe or heavy and awkward, vital and strong or weak and racked with pain – depend on whether we use the proper muscles in all our activities. Mensendieck developed a series of “movement schemes” or exercises that require a minimum of physical effort and time for reshaping, rebuilding, and revitalizing.

B.2.5 The Feldenkrais Method

The Feldenkrais Method is a learning process that brings about new, more efficient, more comfortable, and healthier ways of movement through tapping into the vast potential of the central nervous system. **Moshe Feldenkrais**, its creator, believes that our human capacity for learning, “incomparably greater than that of any other living creature,” provides us with the extraordinary opportunity to build up a mass of learned responses. But along with the gift comes “the special vulnerability” of developing poor behaviours. Using physical experiences, not words, the Feldenkrais Method presents your brain with new information and retrains it to accept an improved image, which replaces the old, distorted one.

Appendix B Compilation of Somatic Practices

B.2.6 Hanna Somatic Education

Thomas Hanna (1928-1990) was a philosophy professor before he turned to somatic education. After directing the first Feldenkrais training program in the United States in 1975, he founded the Novato Institute for Somatic Research and Training and started *Somatic: Magazine-Journal of the Bodily Arts and Sciences*, of which he was editor. Hanna Somatic Education (HSE) is based on the original ideas of **Hans Selye**, the endocrinologist who recognized stress as a cause of disease, and of physicist **Moshe Feldenkrais**. Hanna noted that in response to the unending stresses and traumas to which we are subjected, the sensory-motor system reacts with specific muscular reflexes. He called them *Red Light reflex* (startle response), *Green Light reflex* (Landau arousal response) and *trauma reflex*.

B.2.7 Body-Mind Centering

Body-Mind Centering (BMC) is **Bonnie Bainbridge Cohen's** comprehensive educational and therapeutic approach to movement to help release the stress, fear, aches and pains, and restrictive habits and perceptions that keep you from functioning at your best. Through a special kind of awareness – “active focusing” – you can open to new options in thinking, feeling, and moving with greater ease, coordination, balance, and integration. In turn, this enables you to prevent injuries, face challenges, and expand your creativity.

B.3 Western Movement Arts

B.3.1 Laban-Bartenieff

Rudolf Laban (1879-1958) was a Czech choreographer, dancer, and teacher who worked with great figures in European modern dance. He studied the movement process not only in dance (folk and modern) but also in martial arts, factory assembly lines, and everyday actions. While exploring the basic principles of movement structure and purpose, Laban developed an internationally used system of movement notation: Labanotation records body movement like a score records music. He also evolved the system of movement analysis that now bears his name – Labananalysis.

Laban's student **Ingrid Bartenieff** (1900-1981), a German dancer and choreographer, applied his work to physical therapy, particularly with polio patients. Acutely aware of the psychological implications of movement, she also helped found the **American Dance Therapy Association**. Both Laban and Bartenieff abhorred a mechanistic approach to movement, which they considered not only inefficient but also harmful for an individual's self-image.

Formerly known as **Effort-Shape**, Labananalysis or Laban **Movement Analysis (LMA)** is a comprehensive system for discriminating among, describing, analyzing, and categorizing the patterns and variations of how we move – anything from a conversational hand gesture to a complex action. Because its standardized terminology makes possible precise communication about nuances of movement, LMA can be applied in a variety of professions: dance, choreography, athletic coaching, fitness, body disciplines and therapies, psychotherapies, acting and directing, teaching, even ethnology.

B.3.2 The Pilates or Physicalmind Method

For most of this century, the Pilates Physicalmind Method was virtually unknown outside of the performance community, especially dancers, where it produced lithe and lean bodies without aerobics or weight lifting.

Physicalmind is concerned with economical movement. It relies on kinesthetic monitoring in developing balanced muscle use for ease of motion. As an inside-out approach that combines sensory awareness with physical training, Pilates can lead to mental equilibrium as well. **Joseph Pilates**, the method's originator, believed that ideal fitness is "the attainment and maintenance of a uniformly developed body with a sound mind fully capable of naturally, easily and satisfactorily performing our many and varied daily tasks with spontaneous zest and pleasure."

B.3.3 Ideokinesis

Lulu E. Sweigard, Ph.D., coined the term *Ideokinesis* to describe her particular approach to neuromuscular reeducation. Taken from the Greek, *ideo-* means "idea" and *kinesis* means "motion." Ideokinesis is thus a process of using mental imagery to change motor patterns. Sweigard based it on the pioneering work of her own teacher, **Mabel Elsworth Todd**, who taught at Columbia University in the 1920s and 1930s. Before her death, in 1974, Sweigard spent many years teaching in the dance department of the Julliard School in New York. Especially in Todd's and Sweigard's time, using imagery was a radical departure from the long-established method of exerting conscious, voluntary effort to "put" and "hold" parts of your body in better alignment.

The premise of Ideokinesis is that the nervous system directs and coordinates all postural alignment patterns, muscle use, and skeletal movement. In order to change your posture or movement patterns, you first have to change neurological activity.

B.3.4 Contact Improvisation

In the early 1970s modern dancer **Steve Paxton** began experimenting with the rolling, falling, and partnering skills of the **Japanese martial art Aikido**. Contact Improvisation evolved out of these explorations as a play between the body and the physical forces that rule its motion – momentum, gravity, inertia. Contact is a movement form, an unstructured dance, or "art-sport" that unfolds spontaneously – you improvise in the moment rather than follow a formal series of steps.

B.3.5 Continuum

Emilie Conrad Da'oud studied ballet and non-Western dance in New York before spending five years as a choreographer with a folklore company in Haiti. Through her experiences there, she realized that how we move, talk, and think is primarily a cultural construct, but that beneath culture are essential biomorphic movement common to all life forms. In 1967 Conrad began teaching this primary movement process as Continuum.

"Movement is something we are rather than something we do," she says. "We are verbs, not nouns." But we use only a fraction of our movement vocabulary.

A basic premise of Continuum is that wave motion is fundamental to all living creatures and reflects our evolutionary origins in an aquatic environment. We carry the movement of water in every cell of our body. Deep within us a dance is

Appendix B Compilation of Somatic Practices

always going on. We are always moving, even if we appear paralyzed (Conrad prefers to call it “hypnotized”). There are micromovements at an internal level that we can’t easily observe externally.

B.3.6 Kinetic Awareness

Dancer-choreographer **Elaine Summers** was born in Australia in 1925 and raised in Boston. When she was only twenty-seven years old, orthopedic physicians diagnosed her as having osteoarthritis and said that in five years she would be unable to walk. Summers decided to find a way to forestall the doctors’ dire predictions. She studied with **Elsa Gindler’s** students **Carola Speads** and **Charlotte Selver** and experimented on her own. Kinetic Awareness (KA), Summer’s method of body reeducation, evolved out of her response to her own need for healing. Instead of becoming a wheelchair-bound invalid, she resumed her dance career.

B.3.7 Authentic Movement

Mary Starks Whitehouse trained with dancers **Mary Wigman** and **Martha Graham** before developing, in the 1950s, a process she called “movement in depth.” It was an outgrowth of her understanding of dance, movement, and depth psychology. Some of Whitehouse’s students developed the work for use in personal analysis, performance and choreography, dance therapy, education and ethnology. One of them, **Janet Adler**, established the Mary Starks Whitehouse Institute in 1981 to further her mentor’s discipline after her death two years earlier. The work is now commonly known as Authentic Movement (AM).

At the core of AM is the bodily felt sensation of moving and being moved – the conscious awareness of what is happening in your body. That experience is in contrast to everyday habitual, unconscious movements, done automatically for utilitarian ends – for example, reaching to open a door. In an AM session, you suspend that kind of purposeful “doing it” in favour of “letting it happen.” This allows you the possibility of perceiving where movement comes from inside you – the unconscious impulses and images that move you – and what it reveals about yourself. For Whitehouse, the “body is the physical aspect of the personality, and movement is the personality made visible.”

B.3.8 Skinner Releasing Technique

Joan Skinner, a professor of dance at the University of Washington in Seattle, has been dancing since she was a young child. After college, she became a member of the **Martha Graham** and **Merce Cunningham** dance companies. One night, during a grueling four-month bus tour, she ruptured a spinal disc in the middle of a performance. As long as she rested, it would heal, but as soon as she went back to class, it would break down. Working with an Alexander teacher enabled her to dance again.

Combining the **Alexander Technique’s** principles of alignment and movement with imagery, in the 1960s she began evolving the Skinner Releasing Technique (SRT) into a system of kinesthetic training. It employs two categories of images: *specific*, which deals with experiencing effortless movement of specific body parts, and *totality* or *image cluster*, which cultivates an overall state of multidimensional awareness, but it also can be the opportunity for a fresh, unconditioned response to arise, one that allows new kinesthetic patterns of muscle use to emerge.

B.3.9 Wetzig Coordination Patterns

In the 1930s **Jennifer Rathbone** at Columbia University developed a Manual Tension Test to evaluate neuromuscular tension. She found four distinct patterns: assistance, resistance, posturing, and perseveration. In the 1960s and 1970s, New York choreographer and movement researcher **Betsy Wetzig** investigated the effects of these patterns on the styles of creativity and communication in the Wetzig Dance Company and Sound Shapes, her improvisational group. She noted that each neuromuscular pattern uses a different set and order of muscular contractions to create a specific kind of quality of movement – which she calls *Thrust*, *Shape*, *Swing*, and *Hang* – as well as a trigger center or initiating group of muscles, and an alignment of the body.

These four basic patterns designate the four ways our muscles nervous system, and brain organize themselves. Thus, each pattern also simultaneously includes a quality and type of mental processing. That's because the way we move and how our brain processes information are the same neurological event: Each pattern is both mental and physical.

B.4 Convergence Systems

B.4.1 Rosen Method

Marion Rosen was born in Germany in 1914 and started taking movement classes seven years later. In the 1930s she studied with Lucy Heyer, one of a group of therapists who used massage and breathwork with patients of Swiss psychoanalyst C. G. Jung. Heyer's influences included, among others, Elsa Gindler and Rudolf Laban. When the Nazis forced Rosen to flee, she learned physical therapy in Sweden while awaiting a visa to the United States; she also graduated from the physical therapy program at the Mayo Clinic in Minnesota.

B.4.2 Somatic Experiencing

Peter Levine, who holds doctorates in medial biophysics and psychology, developed Somatic Experiencing (SE) as a short-term, biological, body-oriented approach to shock or highly traumatic experience. He believes that trauma is the result of physiology, not psychology. Thus, healing it is possible without long hours of therapy, the painful reliving of memories, or continued reliance on medication. Instead of emphasizing psychological meaning, as in verbal psychotherapy, SE activates intense responses that are both physiological and emotional. But, unlike certain techniques that seem to favour catharsis purely for the sake of catharsis, SE renegotiates these responses without re-traumatizing the person.

C

Appendix C: Whisper Workshop Data

movement and garment workshops [january 03]
[[see](#)] movement workshop 01
[[see](#)] movement workshop 02
[[see](#)] movement workshop 03
winter residency [rotterdam] - january 03
[[see](#)] space as it is
[[see](#)] lines strings flow
[[see](#)] windows pools dome
[[see](#)] LED garment movement
[[see](#)] garment design ref
[[see](#)] garment sketches
[[see](#)] device
[[see](#)] DEAF Festival garment preparation
experience modelling workshops [autumn 02]
[[see](#)] workshop 'listen'
[[see](#)] workshop 'between'
[[see](#)] workshop 'extend'
[[see](#)] workshop 'mutate'
[[see](#)] workshop 'phase'
[[see](#)] workshop data

Figure II-4. whisper workshops are also online at <http://whisper.iat.sfu.ca/process.html>

This Appendix includes workshop data for the whisper experience workshops conducted during November of 2002. These workshops resulted in the design of the interaction model, garment functionality and technological hardware and software design and implementation. There were five workshops conducted with the following names: *Listen*, *Between*, *Extend*, *Mutate*, and *Phase*. Each workshop had a script and props, and was documented with video and digital photography. Exit response cards were filled out by the participants, and used to develop the interaction model.

This appendix presents the following documentation:

whisper design process

The whisper design process included two residencies in Rotterdam (July 2002 and January 2003). Between these two residencies a series of 5 experience workshops were conducted. These processes marked the development phase of whisper including design of the wearable kimono jacket garment, and design strategies for the hardware and software implementation.

- ***Design Document summer intensive:*** A Design Document was produced as a result of the four-week summer residency in July 2002. The design outlined initial concepts regarding interaction, materials, communication, technology and experience. The design document summarized design strategies for implementation based on initial brainstorming and ideation.
- ***Interaction Model following workshops:*** An interaction model document was produced as a result of the workshops. This document outlined the interaction model as it was developed from the workshop data. The design document outlined the interaction modes (self-to-self, self-to-other, self-to-group), and was used to develop the working art installation.

Individual workshops

For each of the five individual workshops the following data is presented:

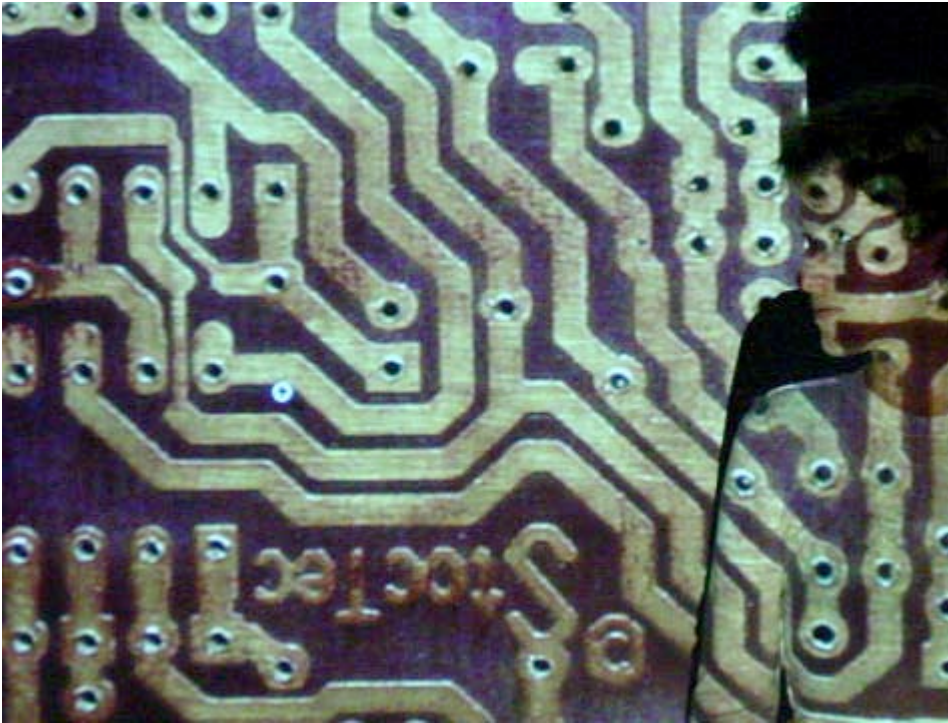
- **Workshop Script:** Used by the narrator to direct workshop participants to explore various aspects of their experience.
- **Workshop Response Card:** The design of the workshop response card enabled workshop participants to give a hand-written account of their experience.
- **Workshop Response Card Data:** The hand-written response of the participants for each workshop.
- **Workshop Response Card Transcriptions:** Transcriptions of the hand-written responses from the workshops.

design document: whisper

~ work in progress ~

draft July 2002

Grammar:	22
A grammar over input, output, transformers, filters and relations hips	22
Sensors	22
Actuators	22
Transformers and filters	22
Relationship / scale:	23
The space:	24
Layout:	24
Environmental objects / reach:	24
Body architectures	25
Hands	25
Arms	26
Torso	26
Spine	27
Head	27
Materiality	28
Wires	28
Antennas	28
Sensors	29
Scale	30
Skin	30
Garment	30
Jewelry	32
Devices	33
Environmental objects	33



Grammar:

A grammar over input, output, transformers, filters and relationships.

Sensors

affordancies scale control vital/non-vital

Heart rate / pulse
Temperature
Brain waves
Galvanic skin response
Accelerometers
Distance
Touch

Actuators

affordancies scale control modalities

Light
Heat
Sound
Wind
Electric impact

Transformers and filters

Transformers and filters need to be explored in the context of the experience of the user.

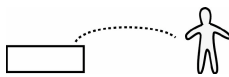
Relationship / scale:



I can see what I do
Body scale: direct feedback



I can see what you do
Inter personal scale: communication



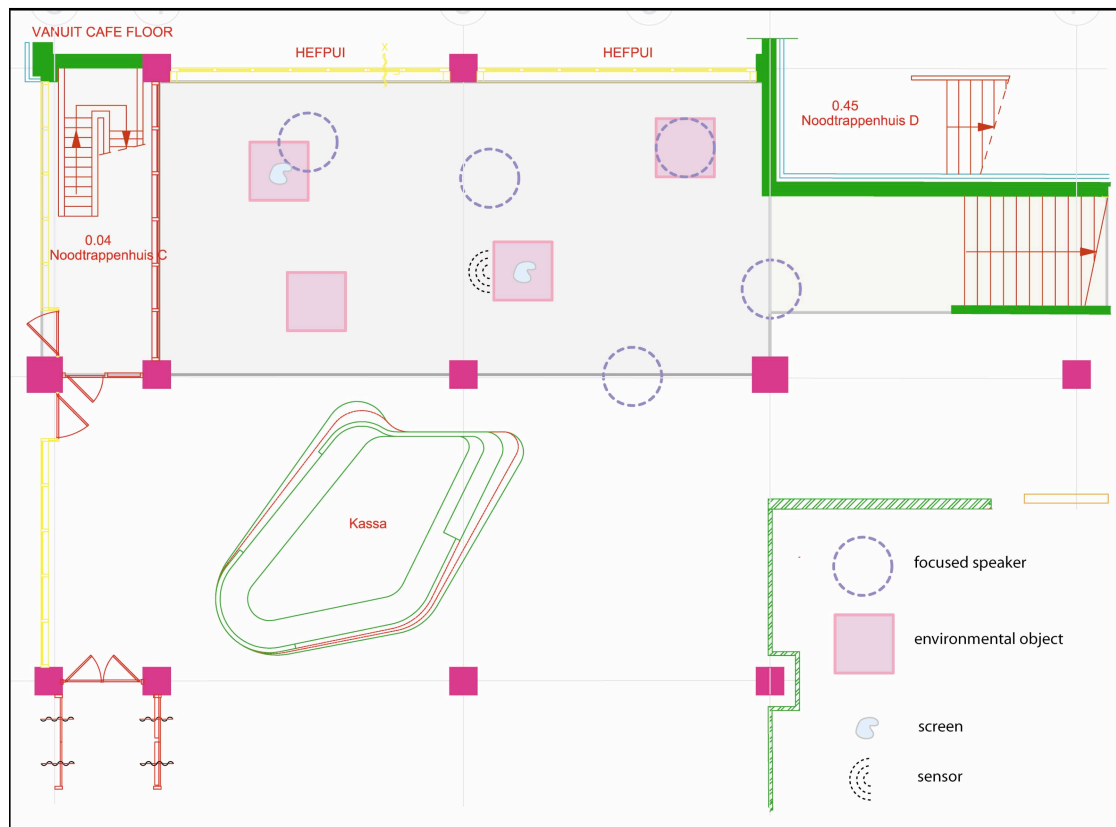
I influence the object / the object influences me...
Body in environment scale: feedback / instrument



I broadcast
One to many / many to many: transmission

The space:

Layout:

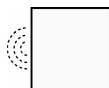


Environmental objects / reach:

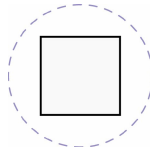
Scale of environmental objects
Affords: sitting / observing / being in the space



Input: sensors: proximity, touch



Output: focused sound



Output: screen / visualizations

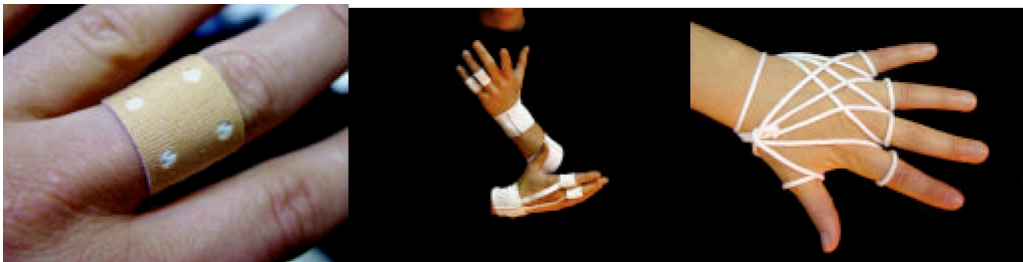


Body architectures

Rings



Plasters



Watches, bracelets



Sleeves



Fabric bands



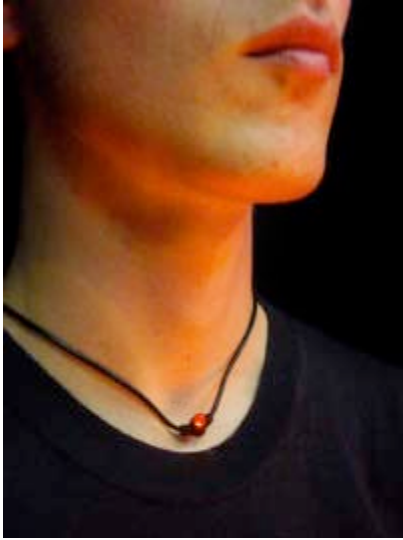
Torso



Breathe / Pulse band



Spine

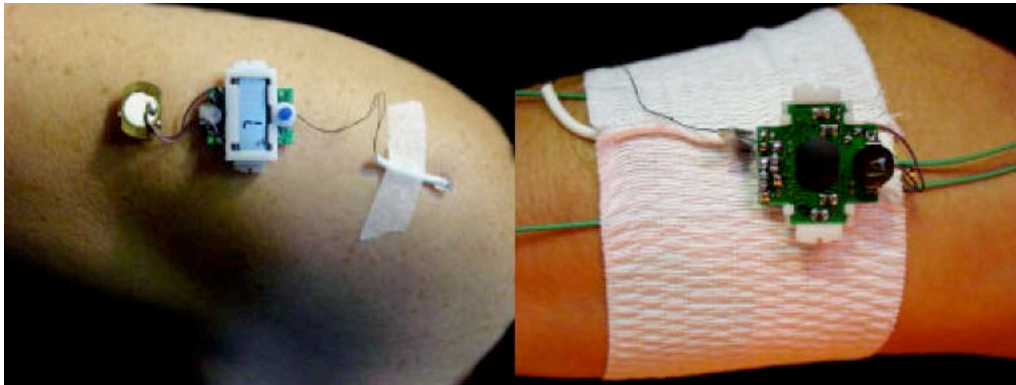


Headband

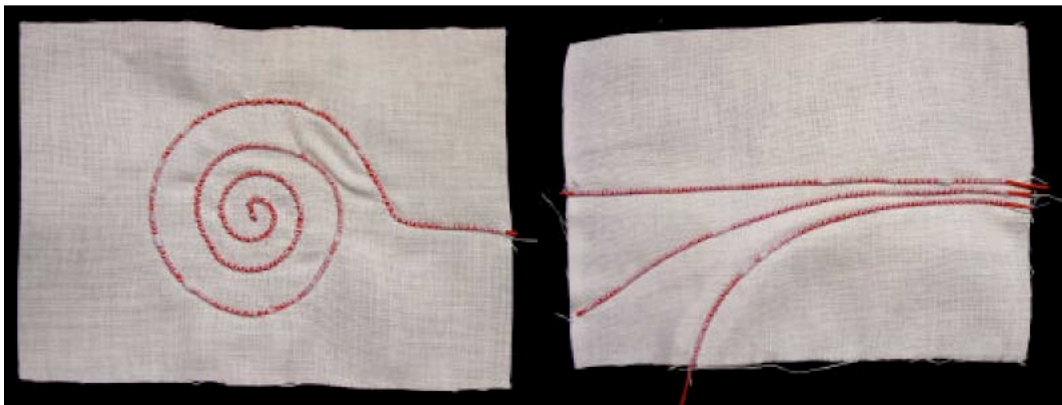


Materiality

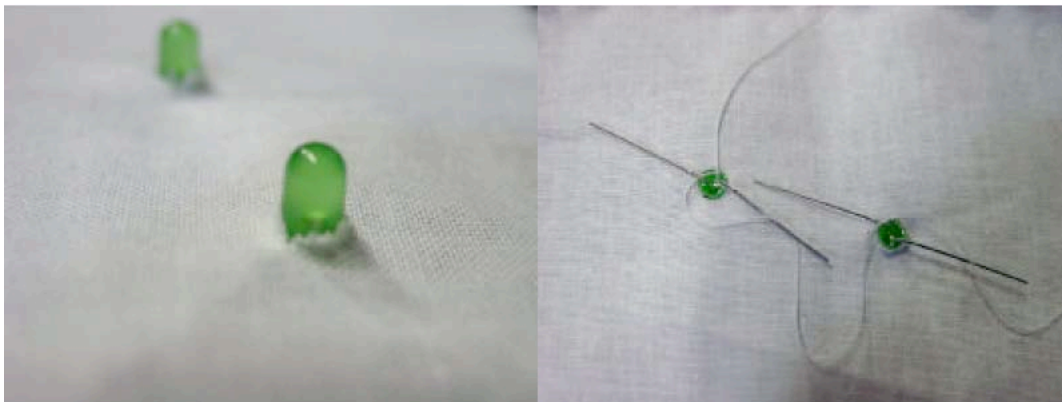
Wires on skin



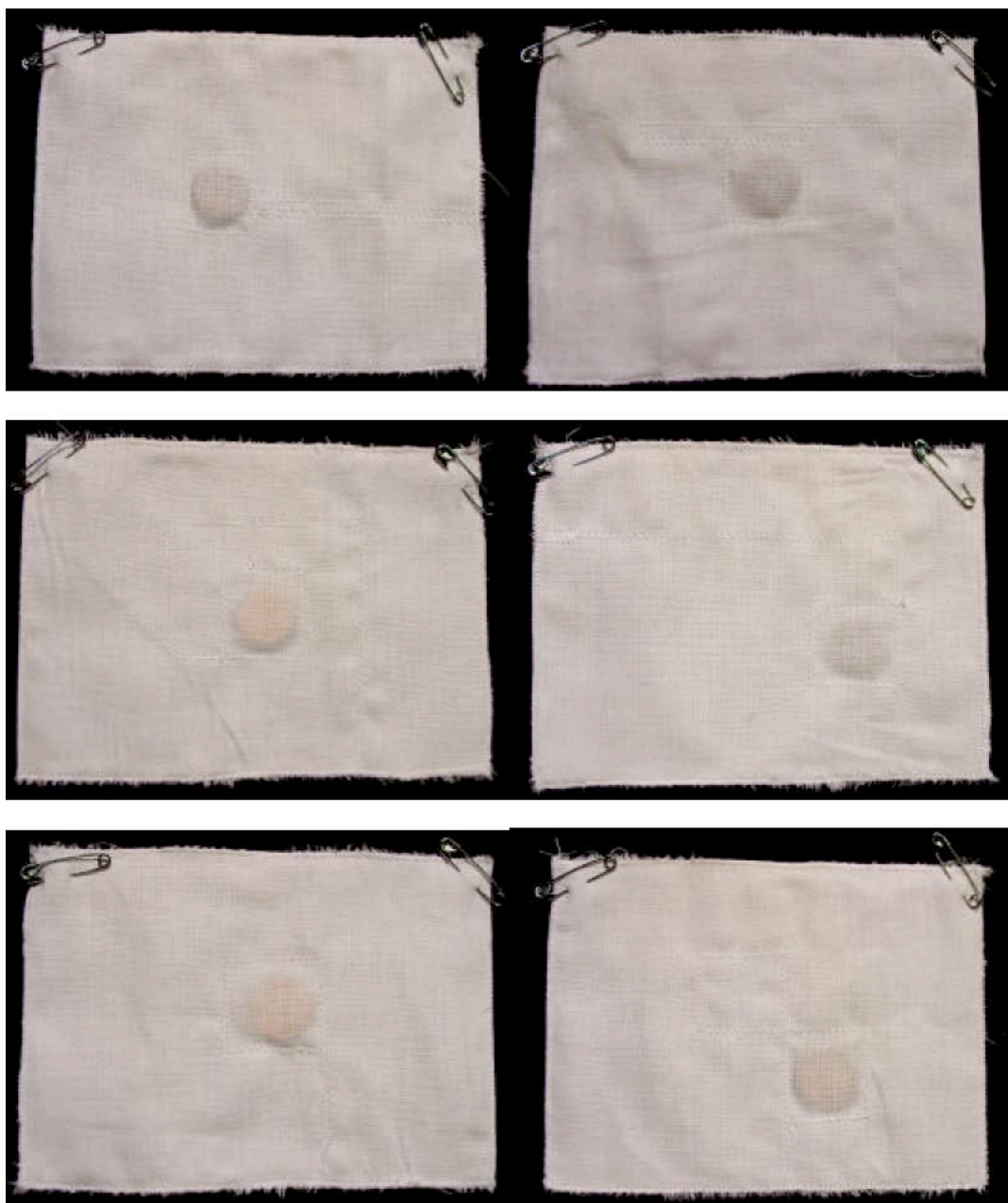
Antennas



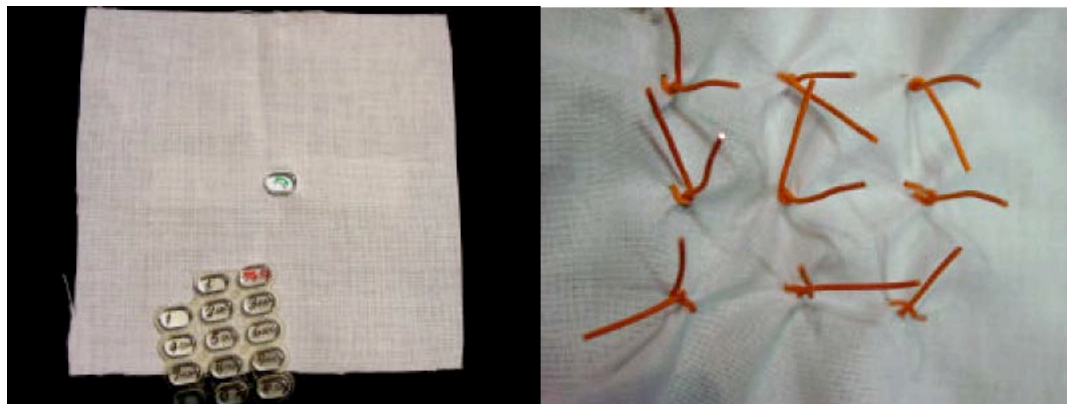
Lights



Sensors



Surface



Scale

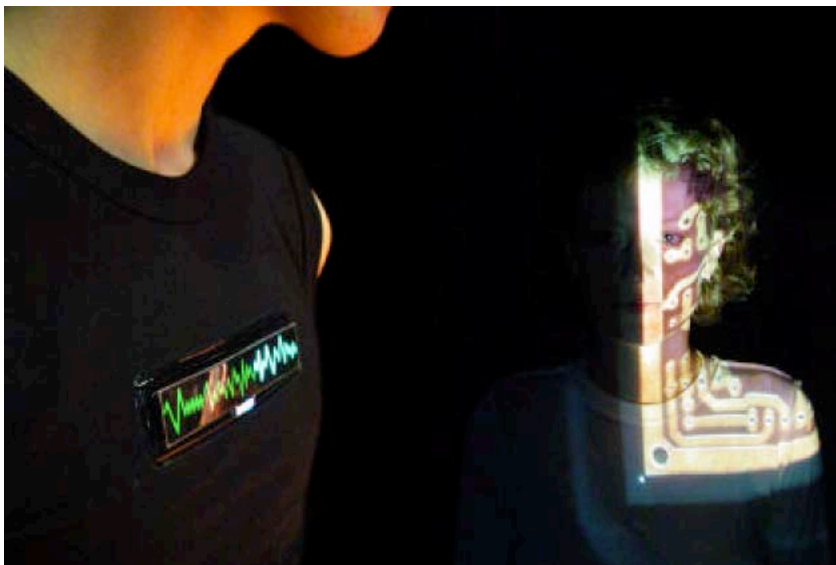
Skin



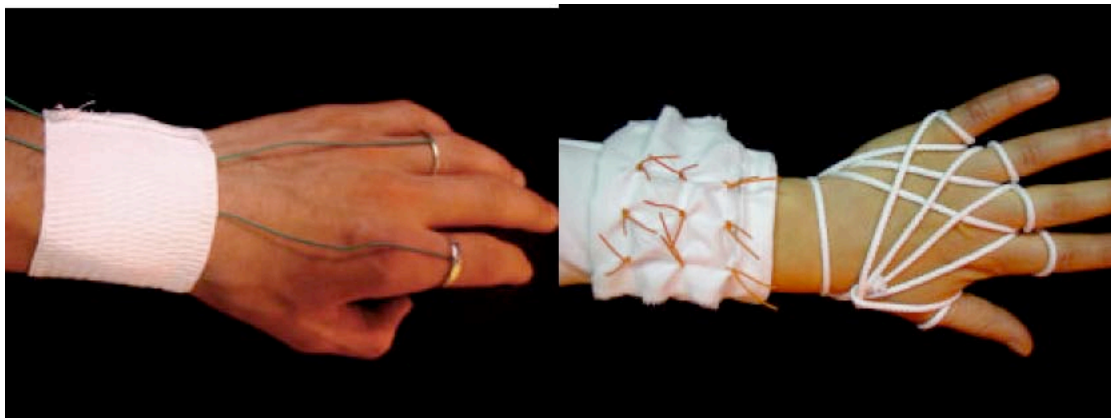
Body / knit



Body / display



Hands / device



Neck / face



Wrist thing



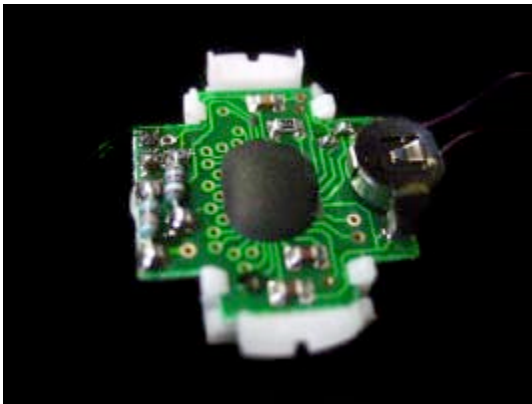
Armband



Zippered up



Devices



Environmental objects

We need to ask:

What is the object? Is it in contrast to the body as 'the other'? or is it an extension of a 'data-leaking' body?

whisper interaction models

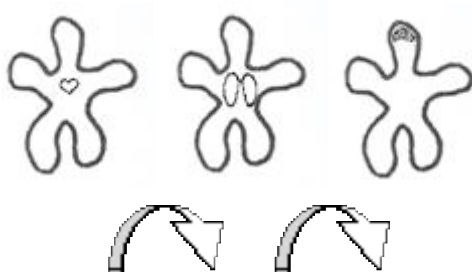
a: self to self



self to self

1. me
who am I?
I am a self
I pay attention to my self
I have a garment
I have data
my data is displayed
my data is changing
I can share my data with myself

2. my data



what is my data?
my data is local to me
my data is my heart
my data is my breath
my data is my brain

Appendix C whisper interaction models

my data has relationships with me

I can play with my data

my data is my heart + my brain

my data is my breath + my heart

my data is my heart + my breath

my data is my heart + my breath + my brain

my data changes me and changes my space

3. my display



I can display my data on myself [local display]

I can play with my display [display attributes and characteristics]

I can select the data I display [?]

I can display my heart, my breath or my brainwaves

heart, breath, brainwave on LED array

how do I display?

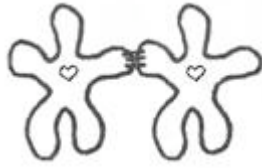


I display myself

as I move

as I get close to someone else

b: self to other [sharing]

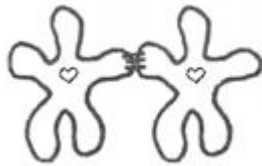


1. my other

I can pay attention to my other

I can move toward my other

I can connect with my other



2. connecting to my other

how do I connect to an other?

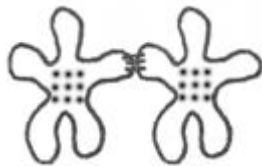
I can connect by moving closer to my other [proximity]

I can connect my choosing to touch my other [intentional connection gesture]

how do I choose?

I can 'snap' or 'stick' on to my other

I can 'touch' my other [hands, fingers]



3. sharing data with my connected other

I can share my data with my connected other

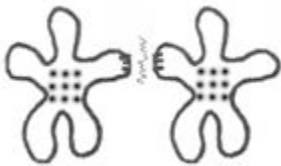
I can share my heart, breath, brainwave

I can give data

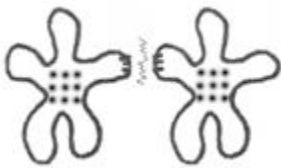
I can receive data

Appendix C whisper interaction models

I can choose which type of data I give
I can display the data I receive
I can play with our shared data
I can display our shared data
I can mix my data with my other's data
I can mix what is currently being displayed on my self
I can see my data seen on my other
On Other's output | display [LED array, speaker, motor]

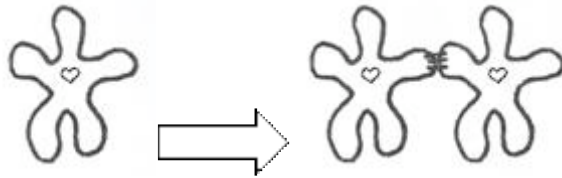


4. breaking connection with my other
I can break a connection with my other
I can break a connection by moving away
I can break a connection by 'unsnapping'
I can break a connection by passing time
I can break a connection by making another connection



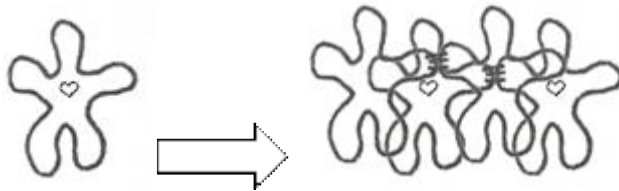
5. displaying others data after breaking connection
I can continue to display others data after breaking connection if I choose

c: self to others [broadcasting]



for future development

d: self to system [space]



1. me in the space

what is the space?

the space is alive

the space is intimate

the space is milky

the space is waiting for me

the space is receiving me

the space is speaking to me

I pay attention to the space

I move through the space

I am a part of the space

I am a part of the data of the space

the space has secrets

the space has intelligence

the space has secret locations

the space knows who is in it

the space knows the parts that combine to make it alive

Appendix C whisper interaction models

the space has data

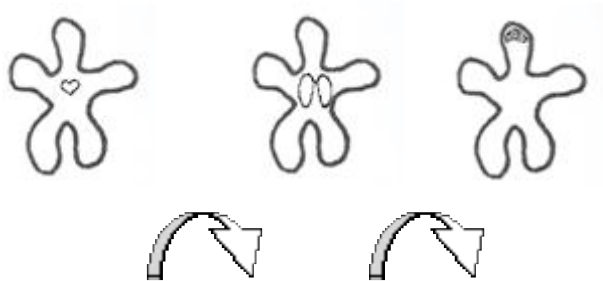
the space displays its data in pools

my data of the space is changing

the space can share its data with me



2. the data space



what is the data of the space?

the space's data is global

my space has a heart

my space has breath

my space has a brain

the space has a relationship with me

I can play with the data of the space

space heart + brain

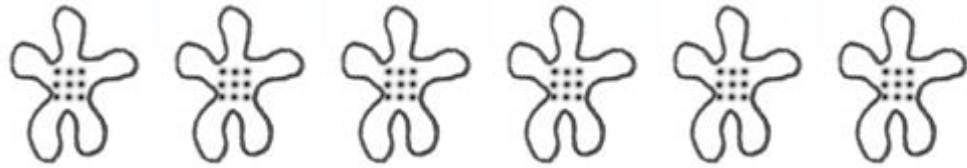
space breath + heart

space heart + breath

space heart + breath + brain

Appendix C whisper interaction models

3. ecosystem display



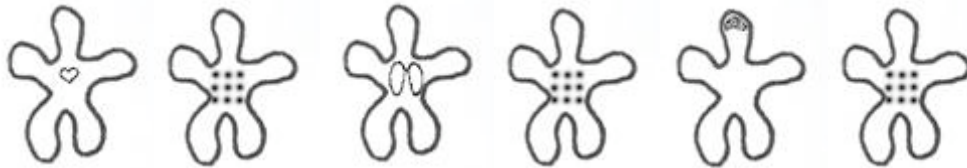
the space reveals its data onto the floor

I can play with the space's display through my position and movement

I can select the data that is displayed in the space

I can display collections of space heart, breath or brainwaves

4. ecosystem sound



the space reveals its sound in intimate pools

I can play with the space's sound through my position and movement

I can select the data that is heard in the space

I can listen to collections of space relationships

C.1 Workshop 'listen'

C.1.1 Workshop 'listen' Script

after memory... please add

the speech:

welcome to the 'listen' experiment | experience

today we will be listening

this is an experiment | experience in two parts

please find a space for yourself

we will be handing out earplugs for the first part

please take a set and put them on

when you have done so we will ask you to listen

you may choose to move very slowly as you listen

please do not speak

[hands out plugs]

I

10 - 15 minutes

[hands out card I]

[collects card I]

we will now be handing out the props for the second part

please take a blindfold and put it on

when you have done so we will ask you to listen

please do not speak

[hands out blindfolds]

II

10 - 15 minutes

[hands out card II]

[collects card II]

<end>

cards says:

the first part is over.

[please take a
minute to fill
out a card]

the second part is over

C.1.2 Workshop 'listen' Response Card


'listen inside'

what did you hear?

how did you hear?

what did it feel like?


... whisper



C.1.3 Workshop 'listen' Response Cards

Listen inside	Listen inside
<p>what did you hear?</p> <p>BELLS MY HEART THE CRACKLE OF MY BREATH</p>	<p>what did you hear?</p> <p>the swallowing my saliva, breathing, scratching my skin, liquid rolling down inside of my organs</p>
<p>how did you hear?</p> <p>FROM INSIDE THROUGH ATTENTION. FOCUS. FROM AROUND choose where to put focus</p>	<p>how did you hear?</p> <p>through the vibration going along my skin, organs, and reaching to my ears.</p>
<p>what did it feel like?</p> <p>LIGHT (as in not heavy) PATIENT CLOSE, NOT CONFINING OPENING, OPEN PRESENT</p>	<p>what did it feel like?</p> <p>I felt self-conscious about all the sound that my body makes. It wasn't sound. It was movement, vibration. I could hear the movement of my body.</p>

Listen inside	Listen inside
<p>what did you hear?</p> <p>POP OF AIR EXPLODING - WHOOSH OF FLOOR FOR OTHER PEOPLE - MY BREATH / MYSELF / SPIT - HANDS TAPPING / FLOOR CRACKING / BONES, HIPPS CRACKING - OTHER PEOPLE SHIFTING - NOISE INSIDE</p>	<p>what did you hear?</p> <p>the swallowing my saliva, breathing, scratching my skin, liquid rolling down inside of my organs</p>
<p>how did you hear?</p> <p>I EXPERIMENTED - COULDN'T DECIDE IF HEARING WAS IMPAIRED - I WANTED TO TALK TO GET A HOLD OF WHERE MY HEARING WAS AT - NOT CLIMB. I STOPPED, BREATHED HEAVILY, LISTENED TO OTHER MOVEMENT. I WAS HEARING FOR A SOUND I COULD MOVE TO</p>	<p>how did you hear?</p> <p>through the vibration going along my skin, organs, and reaching to my ears.</p>
<p>what did it feel like?</p> <p>I WAS MORE AWARE OF THE SOUNDS OF MY OWN BODY. I COULDN'T GET A HOLD ON MY HEARING LOSS, SO IT WAS VAGUE. I WASN'T REALLY SURE THERE WAS ANY LOSS. I FELT LIKE I HAD MY OWN SPACE - I COULD MOVE, CRAWL AROUND AND NOT BE ALONE WAS WATCHING - OR THERE IN THE SAME SPACE.</p>	<p>what did it feel like?</p> <p>I felt self-conscious about all the sound that my body makes. It wasn't sound. It was movement, vibration. I could hear the movement of my body.</p>



what did you hear?

people, fans, squeals of stero, "space" - open places
movement, crawling, hands on other curtains
yelps, laughter, heaps of cameras/slight consumer
equipment

what did it feel like?

intriguing (like a puzzle or game), exciting
(risk of falling / bumping / bumping into things)
playful, felt desire to move head to gain depth, perspective

what did it look like?

monotone, bright/dark eyelid noise
flat.

what did it sound like?

whisper

listen outside

what did you hear?

what did it feel like?

what did it look like?

Island outside

whisper

Spreads of shoes, breath of hand on cloth, fingers on cloth, movement
others, heads in air, breath, cracks in glass, cloth on cloth
Close to my ears - rubbing, grinding, coarse fabric abrasives, movement
beats, buzz, other people's steps, breath, contact with and after, stilling,
apologies

like little soft greases of times and others like jolts or
pin-pricks, quivers, self-consciousness.

blobs of round and sharp shapes, small and large.

What did you hear?

Heartbeat. Ear plugs as they settle, breathe, sleeping sounds from others in the room, humming noise, myself, contact with my own body

How did you hear?

tactile & muffled. Drowning out of other sounds brought quieter sounds to the foreground

What did it feel like?

It felt like being in a womb. Water like.

Robb

what did you hear?


MACHINE NOISE
HUMAN SOUNDS: STEPS, VOICES, MOVEMENT

what did it feel like?

BLIND, DISORIENTED, EMPTY, ATRAID, DISCONNECTED
CLOSED SPACE, VOID, STILL, SILENCE

what did it look like?

IT LOOKED LIKE THE WORLD WITHOUT EYES



whisper

Appendix C workshop 'listen'

listen outside

what did you hear?

Footsteps, breath, sighs, yawns, air conditioning, whooshing, swishing, giggle, watch beep, rustling, squeaking


what did it feel like?

listening to other(s), listening for others, careful, attentive, focused - focused outwards, fun, curious

what did it look like?

light entering through eyelids + blindfold, then "seeing" or imagining shapes of movement, "seeing" location of other(s) + arcs, "seeing" or imagining spatial relationships

whisper



listen outside

what did you hear?

MACHINE NOISE
HUMAN SOUNDS: STEPS, VOICES, MOVEMENT


what did it feel like?

BELONGING, DISORIENTED, EMPTY, AFFRANT, DISCONNECTED
CLOSED SPACE, VOID, STILL, SILENCE

what did it look like?

IT LOOKED LIKE THE WORLD WITHOUT EYES

whisper



listen outside

what did you hear?

breathing of other people, other voices and movements, learning sounds / rhythm, breathing, feeling to give position to other

what did it feel like?

it made me want to be close to push my limbs out all around me. It felt like I wanted to hunt out other people and take them.

what did it look like?

I could feel my position in the room - I knew where people were and the darkness of the curtain on my face. I saw position, height, size and a "feeling" stay away, exploring & touch. I had a responsive sense of others, not just "object". It was very much a game - collecting, processing, manipulating information.

whisper




listen outside

what did you hear?

what did it feel like?

what did it look like?

whisper



Appendix C workshop 'listen'

...listen outside...

what did you hear?

foot steps, walking. rubbing sound of clothes, touching

what did it feel like?

I had anticipation of somebody coming to me touching me. My ears all focused on the sound around me.

what did it look like?

Black shadows moved from side to side following the directions of sound coming to me. Sometimes, they are white shadows. They don't have clear shapes. They are only movements.

...whisper

...listen outside...

what did you hear?

birds (trying to sound like sheep) post. contact movement (in absence of post. contact movement) some of the same things at a pace!

what did it feel like?

colony, unchained e.g. spiral column, fluid

what did it look like?

play doh at point of contact

...whisper

...listen outside...

what did you hear?

Shoes squeaking (or?) rubbing on the floor, breath, other moving. Nothing else.

what did it feel like?

Unknown, void, empty feeling of back, backward, reaching. Infinite space, darkness

what did it look like?

it looked like a memory built up over time, but then destroyed by time. blobs of occupied space arranged in a map.

...whisper

...listen outside...

what did you hear?

people, fans, squeals of steel, "space" - open places moving, crawling, hands on ~~the~~ curtains yelps, laughter, blips of camera/digital consumer equipment

what did it feel like?

intriguing (like a puzzle or game), exciting (risk of falling / ~~hitting~~ bumping into things) playful. felt desire to move head to gain depth perception

what did it look like?

monotone, bright/dark eyelid noise flick.

...whisper

what did you hear?

what did it feel like?

what did it look like?


Taken outside

... whisper

Speech of shoes, brush of hand on cloth, fingers on cloth, movement
of shoes, hands in hair, breathe, cracking joints, cloth on cloth.
Close to my ears - rubbing, grinding, could hear at various times
beats, hear other people's steps, breath, and then at the end of the day, stilling
a person's breath.

like little soft presses at times and others like jolts or
pin pricks, quivers, self-conscious.

blobs of round and sharp shapes, small and large.



C.1.4 Workshop 'listen' Response Cards Transcription

Part A: 'listen inside'

[earplugs]; do not speak

WHAT DID YOU HEAR?

- ° bells; my heart; my breath; the crackle of earplugs!
- ° swallowing my saliva; breathing; scratching my skin; liquid rolling down inside my organs
- ° pop of earplug shifting; my breath, tongue, spit; bones, hips cracking; nose inside; shoes on floor, other people; hands tapping face, chest, floor; other people shifting
- ° heartbeat; earplugs as they settle, breath, slapping sounds from others in the room; humming noise; myself; contact with my own body
- ° white noise; building noise; roar of my spinal column fluids; body thumping [pumping?]; the earplugs themselves; my neck cracking
- ° relative conduction of different body parts as taps, heart beat, blood flow, squeaks of shoes, claps, body air cavity; pops and stretches of connective tissue; movement of clothes over skin
- ° my breath; in, out, deep, shallow, loud, soft, congested, clear, my heart muffled, quiet beneath the breath and outside sounds; the hum of the building and other people's activity

HOW DID YOU HEAR?

- ° From inside; from around; through attention, focus, choice where to put focus
- ° Through the vibration going along my skin, organs, and reaching to my ears
- ° I experimented; couldn't decide if hearing was impaired; I wanted to talk to get a level of where my hearing was at - but didn't; I tapped, breathed hard, listened to others; I was looking for a sound I could measure through memory
- ° Tactile and muffled; drowning out of other sounds brought quieter sounds to the foreground

Appendix C workshop 'listen'

- ° Physically; direct or indirect contact; internally; body fluids; antenna; directionality; body attitude, posture; relation to other objects including people
- ° With less tonal variation; with more percussive sense; internally via conduction along bones to inner ear | mandible, bone jaw
- ° With my ears - even though some of what they were hearing were more through vibrations within, some was unblocked from without. I also "heard" / felt my inner rhythms pulsing, vibrating

WHAT DID IT FEEL LIKE?

- ° Light [as in not heavy], patient, close, not confining, opening, open, present
- ° I felt self-consciousness about all the sound that body makes; it wasn't sound; it was movement, vibration. I could hear the movement of my body
- ° I was more aware of the sounds of my own body; I couldn't get a meter on my hearing loss, so it was vague. I wasn't really sure there was any loss. I felt like I had my own space, I could move, crawl around, and nobody else was watching - or there on the same space.
- ° It felt like being in a womb - water like.
- ° Calming; like an autonomic sense suddenly needed to be directed, paid attention, tried on for fit, a bit like 'trying to listen to' music instead of just background processing it
- ° Ceremonial, relaxing, repeating, variable focus, between sounds and some 'internal dialogue'; it felt like being under water
- ° Normal, I'm alive; Invigorating - breath going in and out with "normal" rhythm, and changing properties; meditation, soothing, flowing; the outside sound was less welcome or smooth, more jarring, interruptive, invasive

Part B: 'listen outside'

[blindfolds]; do not speak

WHAT DID YOU HEAR?

- Footsteps, breath, sighs, yawns, air conditioning, shooshing, swishing, giggle, watch beep, rustling, squeaking
- Breathing of other people; other noise and movements; warning sounds; rhythmic breathing; shuffling to give position to others
- Footsteps, walking, rubbing sounds of clothes, touching
- Shoes squeaking, rubbing on the floor, breath, other moving, nothing else
- Birds (trying to sound like shoes); post-contact movement (in absence of pre-contact movement); some of the something (a) in part 1; e.g., spinal column fluids
- Fan; squeak of shoes, "space" - open places, movement, crawling, hands on curtains, yelps, laughter, beeps of cameras/digital consumer equipment
- Squeak of shoes, breath of hand on cloth, fingers on cloth, movement others, hands in hair, breath, cracking plates, cloth on cloth, close to my ears --- robbing, grinding, coarse fabric abrasiveness, camera beep-beep, other people's steps, breath, contact with another, giggling, apologies
- Machine noise, human sounds, steps, voices, movement

WHAT DID IT FEEL LIKE?

- Listening to other(s), listening for others, careful, attentive, focused outward, fun, curious
- It made me want to be low to push my limbs out all around me; it felt fun, I wanted to hunt out other people and poke them
- I had anticipation of somebody coming to me 'touching' me. My ears all focused on the sound around me.
- Unknown, void, empty, feeling of back, backward, reaching, infinite space, darkness
- Cottony, cushioned

Appendix C workshop 'listen'

- Interesting (like a puzzle or game), exciting (mist of falling/humming, bumping into things), playful; felt desire to move head to gain depth of perception
- Like little soft caresses at times and others like jolts or pin pricks, quivers, self-conscious
- Blind, dissociated, empty, afflicted, disconnected, closed space, void, still, still

WHAT DID IT LOOK LIKE?

- Light entering through eyelids + blindfold, then "seeing" or imaging shapes of movement; "seeing" location of other(s); "seeing" or imaging spatial relationships
- I could feel my position in the room; I knew where people were and the darkness of the curtain on my face; I saw partition, height, size and a "feeling" stay away, exploring & touch; I had a responsive sense of others, not just 'object'. It was very much a game - collecting, processing, manipulating, information.
- Black shadows moved from side to side, following the directions of sound coming to me. Sometimes, they are white shadows. They don't have clear shapes; they are only movements.
- It looked like a memory built up over times, but then destroyed by time, blobs of occupied space arranged in a map.
- Playdoh at point of contact
- Monotone, bright/dark eyelid noise flat.
- Blobs of sound and sharp shapes, small and large.

C.2 Workshop 'between'

C.2.1 Workshop 'between' Script

'between':
welcome to the 'between' experience
today we will explore in between
between has ^{2 Sources} ~~three~~ parts
let us begin ~~the first part~~ the first part
<part a: slowly between> ~~don't read~~
~~the first part is called "slowly between"~~
begin by finding a space for your self
please do not speak
slowly
slowly slow down your movement *simplifying*
<...>
now begin to move into the space
as slowly as you are able,
breathing, seeing, sensing and moving as slowly as you are able,
moving slowly between

< -- >
as you move within the space,
you slowly find some one between

< -- >
move along with and between this some one
< -- >
find a space for both of your selves *too romantic*
< -- >
~~this is the end of part 1: slowly between~~

Appendix C workshop 'between'

~~<part b: sending attention >~~

~~the second part is 'sensing between'~~

please turn to face me

please do not speak

choose one of you to stand directly in front of the other
facing me

[we physically help here if they do not understand]

now please sit down

the person in front will be the receiver |
the person behind will be the sender

make sure that the sender can see me

we will now hand out a piece of cord and a blind^{fold} to the receivers [hands out]
receivers: please put on the blindfold, and place the cord on the floor in front
of you

senders:

we will be repeating a set of -- 'sensing between'
we will randomly select between

'focus your attention directly on the receiver' [show card] or
'de-focus your attention away' [show card]

let us begin

[count]

one <...> end.

two <...>

three <...>

up to a max of
twenty <...>

<experiment 10 min>

part one sensing between in over

please take a moment to fill out the cards [hands out]

receivers: ~~att~~ you will tie a knot in
the string
if you sensed
attention.

Appendix C workshop 'between'

part two is sending between

sit so that you are facing one another
change roles so that the sender is now the receiver

{ in this experience we would like the senders to send an image to the receiver
we will give you time to create the image, and then to send the image

senders: create an image you are going to send

<2 min>

senders: now start sending the image
receivers: now receive the image

<2 min>

senders: finish sending the message

this is the end of part two

please fill out the cards we hand out [hands out]

take a moment to write down any additional comments or thoughts you might have

this is the end of the 'between' experience
thank you for taking part

[end]

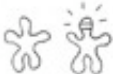
please wait
for us to the
send signal
before you
send

C.2.2 Workshop 'between' Response Card

'sensing between'

what did it feel like?

anything else?



... whisper

C.2.3 Workshop 'between' Response Cards


'sensing between'

what did it feel like?

Trying to communicate but not knowing if anything was going through.

anything else?

... whisper



'sensing between'


what did it feel like?

Nothing.

anything else?

RELAXING. I'M NOT MUCH OF A "SENSING" SORT OF PERSON.

... whisper




'sensing between'

what did it feel like?

SWIMMING IN THE MIND, TUG-OF-WAR
THINKS WITHIN, LIKE WATERMELON
DANCE MOVES BUT WATERMELON DOESN'T
SWIMMING WATERMELON
...
SOMETIMES ANGRY, SOMETIMES WINDING
TEARDROPS.
INTERACTION PATTERN BEHAVIOR.

anything else?

... whisper




'sensing between'

what did it feel like?

Talking without speaking out.
Seeing without looking through.

anything else?

... whisper




'sensing between'

what did it feel like?

anything else?

... whisper




'sensing between'

what did it feel like?

anything else?

... whisper




it - what is it?
if by it, you mean the experience of focusing on the body (my own) + using my body to find another + then make the other feel my attention - if that's what it is, it felt abstract, + strangely disconnected. while in my own sensing moment, I was very able to connect w/ my breath my emotions, my place in the space, but when asked to move with another or communicate, it was very difficult to focus my attention + remain within my physical self.

'sensing between'

what did it feel like?

anything else?

... whisper




① walking or being in space
All my senses focused on the volume of space or air. It felt heavier than when I didn't pay attention before.
② Attention by the partner
I tried to focus on any changes on my feeling of body, especially skin. Sometimes I felt hot, I thought. I'm not sure about this part, whether I imagined myself being paid attention or there was some kind of feeling for the partner.

'sensing between'

what did it feel like?

anything else?

... whisper



NOT SURE. I have no idea about the whole thing.
This is my first time here. I don't know what I should or suppose to do.

what did you send?



anything else?

...whisper

“sending behavior”

A

A GREEK-CAT!



What did you receive?

Not sure
could be a small dog.

Anything else?

My thoughts also may influence my way of seeing
- bechit
- martial combat figure
- super market
...

... whisper

8


what did you send?

ROASTED CHICKEN
ON A PLATE.
GROWN MAN SWEATING WITH PRICE.
PORKS SKIN TEXT
FULL KIDNO PLUMP
WHITE MEAT INSIDE.

anything else?

IT WAS HARD TO HOLD THE
NAME AND SEND IT AT THE
SAME TIME
SEEMED LIKE TWO DIFFERENT
NARRATIVES

... whisper



What did you receive?

They became of 'birds' streaming toward me.
Image ~~former~~ takes form like sand-box.

Anything else?

I sensed 2 images though, similar.

whisper

what did you send?

... whisper

white rabbit, cloud, explosion of air
(white) like the one when a space craft
get launched.
[7 7] inside of building

anything else?

what did you receive?

... whisper

don't know.

anything else?

what did you send?

... whisper

anything else?

what did you receive?

... whisper

texture similar to a rock face with water
droplets. water droplets had special
highlights. slight motion.

blue.

anything else?

C.2.4 Workshop 'between' Response Cards Transcription

Part A: 'sensing between'

[blindfolds and cords to receiver]; do not speak

WHAT DID IT FEEL LIKE?

- ° Trying to communicate but not knowing if anything was going through
- ° Nothing
- ° Swimming in the wind; tree-like falling within, like waterfall, water moves but waterfall doesn't swaying underwater; sometimes pressure, sometimes ingrowing temples
- ° Talking without speaking out; seeing without looking through
- ° It, what is it? If by it, you mean the experience of focusing on the body (my own) + using my body to find another + then make the other feel my attention - if that's what it is, it felt abstract + strangely disconnected - while my own sensing moment, I was very able to connect w/my breath my emotions, my place in the space, but when asked to move with another or communicate, it was very difficult to focus my attention + remain within my physical self
- ° 1) Walking or being in space: all my senses focused on the volume of space, or air. It felt heavier than when I didn't pay attention before; 2) attention by the partner: I tried to focus on any changes on my feeling of body. Especially skin, sometimes I felt hot, I thought. I'm not sure about this part, whether I imagined myself being paid attention or there was some kind of feeling for the partner
- ° not sure, I have no idea about the whole thing, this is my first time here, I don't know what I should or am supposed to do.

ANYTHING ELSE?

- ° relaxing. I'm not much of a "sensing" sort of person.
- ° Interaction pattern broken

Part B: 'sending between'

facing each other; do not speak

WHAT DID YOU SEND? WHAT DID YOU RECEIVE?

- ° A stick cat!
- ° Not sure, could be a small dog.
- ° Roasted chicken on a plate; golden - sweating with juice; potato skin text; full round plump white meat inside
- ° Tiny beams of 'bits' streaming toward me; image takes form of a sand-box; I sensed two images though, similar
- ° White rabbit; cloud, explosion of air (white) like the one when a space craft gets launched, corridor, alley, inside of a building
- ° Texture similar to a rock face with water droplets, water droplets had special highlights, slight motion; blue

C.3 Workshop 'extend'

C.3.1 Workshop 'extend' Script

first draft:

welcome to the extend experience
today we will be extending ourselves

this is an experience in two parts

for the first part we will ask you to put on the shirts
~~that we hand out~~

you can help each other buttoning up
it is ok to talk ~~and~~ make noise
~~(as needed)~~

please work together with your partner to explore the space

sit stand jump walk run

<15 min?>

we will now release you from each other
please take a moment to fill out the cards
[hands out card I]

[collects card I]

we will now be handing out stethoscopes for the second part

stethoscopes are good for listening to the inside. you can
listen to your blood, your heartbeat or your vocal cords,
or bones.

take the stethoscope and familiarize yourself with it. if
you have a black is double-sided stethoscope you will need
to cover the hole with your finger for it to work.

listen to yourself.

when you find a good sound you can offer the earpieces to
someone else if you want - so that they can hear it too.
[show this]

every time you have experienced a sound from your self or
someone else please take a moment to make a note in the
notebook.
[15 min?]

find a partner

— leave 5 min to fill out card.

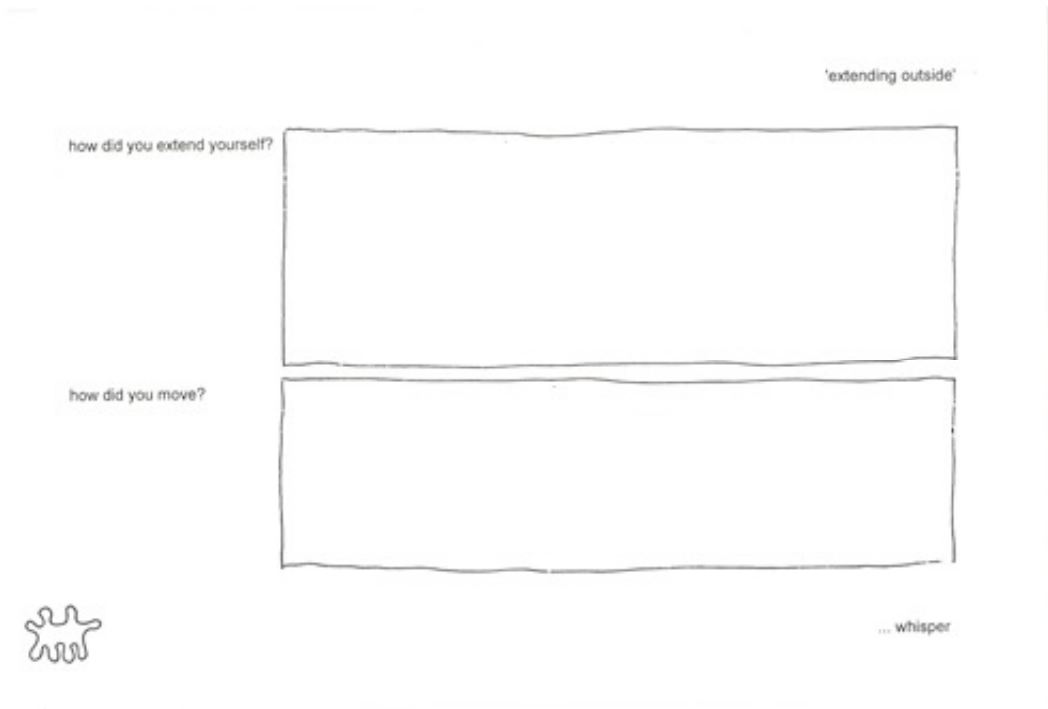
C.3.2 Workshop 'extend' Response Card

'extending outside'

how did you extend yourself?

how did you move?

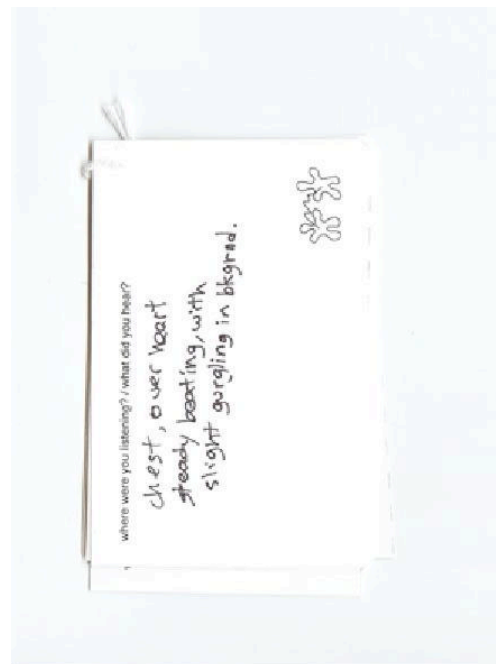
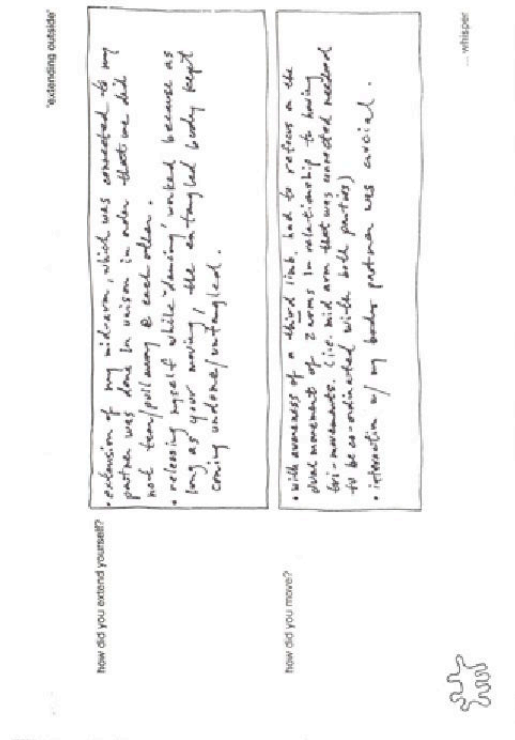
... whisper



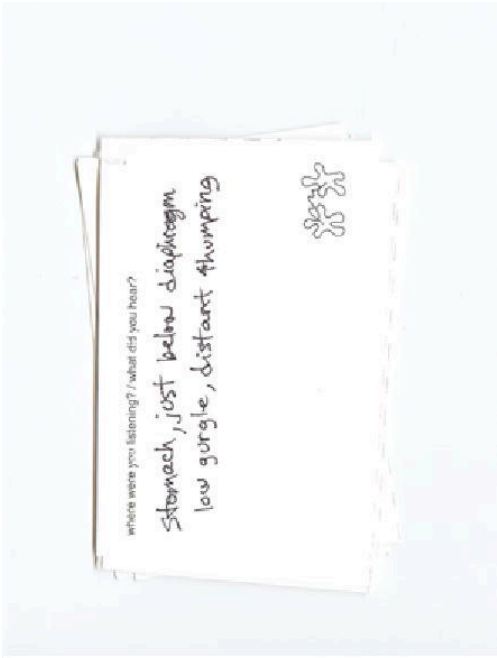
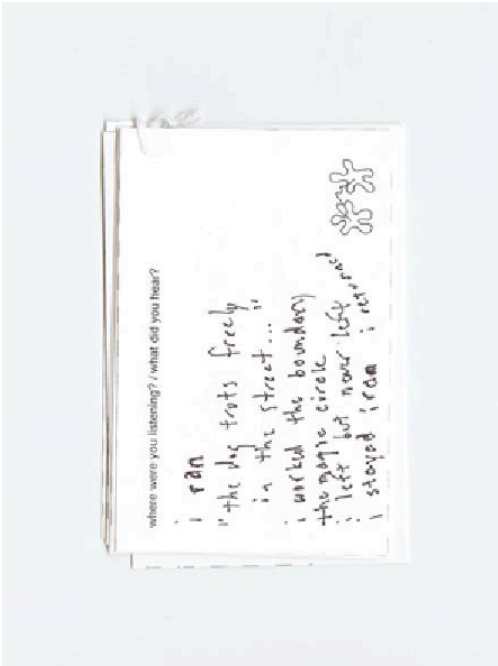
C.3.3 Workshop 'extend' Response Cards

How did you extend yourself?	How did you move?	Whisper
<p>... hid hands with someone other than my husband ... become silly ... enjoyed the unusual and unknown ... became aware of another's movement</p>	<p>awkwardly enthusiastically carefully socially</p>	<p>... whisper</p>
<p>I found myself thinking of our 'body' as a complete unit - it just had this other piece I wasn't wondering. The attached arm was felt very unusual and I got complete control back more planned. I felt like I had to coordinate where I was going in relation to my 'twin', the boundaries of my self expanded, taking up space.</p>		<p>... whisper</p>
<p>I WAS NO LONGER JUST MYSELF, I HAD TO BECOME MYSELF TO BECOME PART OF A WHOLE. AS A WHOLE WE HAD TO WORK TOGETHER. WHEN WE FALLOUT IT WAS ALMOST DISAPPOINTING BECAUSE WE WERE MEET</p>	<p>PUSHING & PULLING. EACH MOVEMENT WAS FOLLOWED BY A REACTION FROM MY PARTNER. THEREFORE, OUR MOVEMENTS HAD TO BE IN SYMBIOSIS - TO THAT, WE HAD TO COMMUNICATE.</p>	<p>... whisper</p>

Appendix C workshop 'extend'



Appendix C workshop 'extend'



Appendix C workshop 'extend'

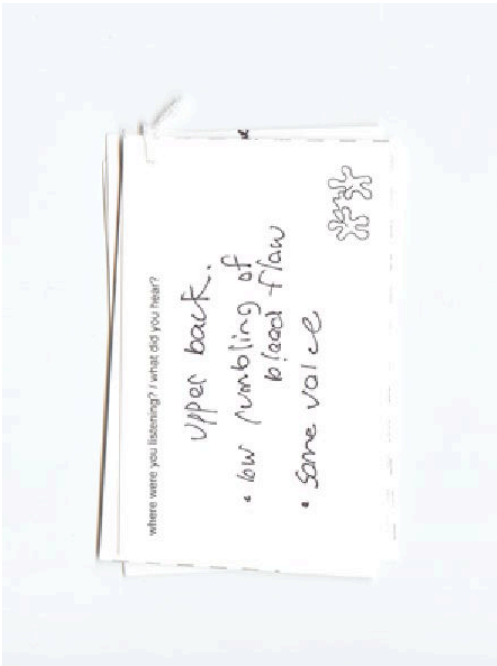
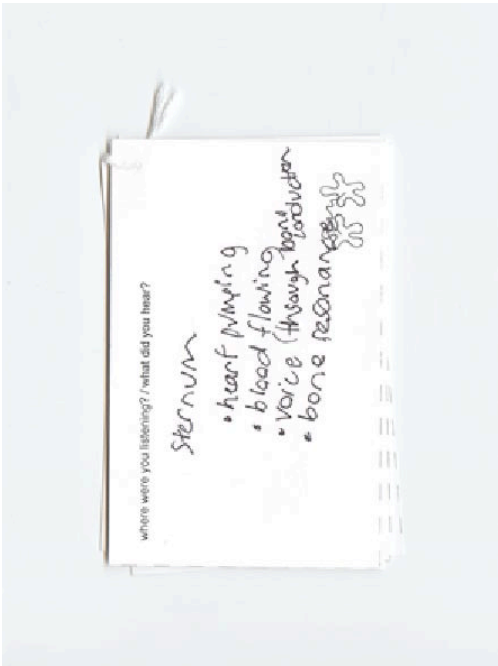
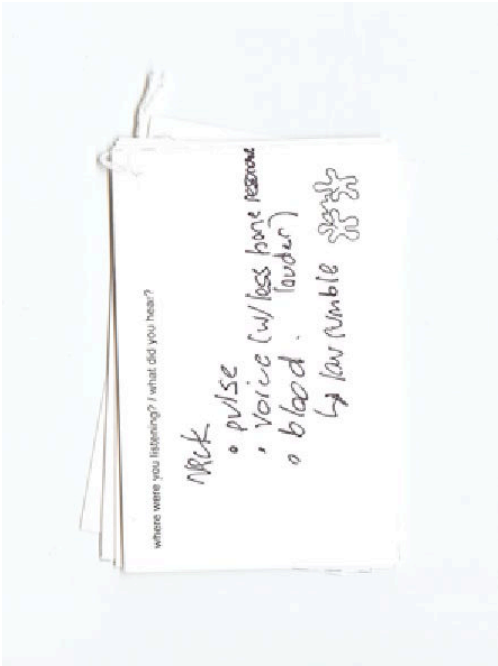


Appendix C workshop 'extend'

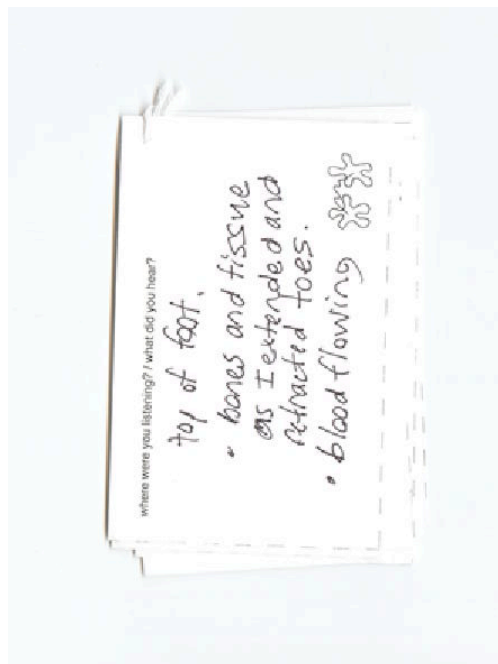
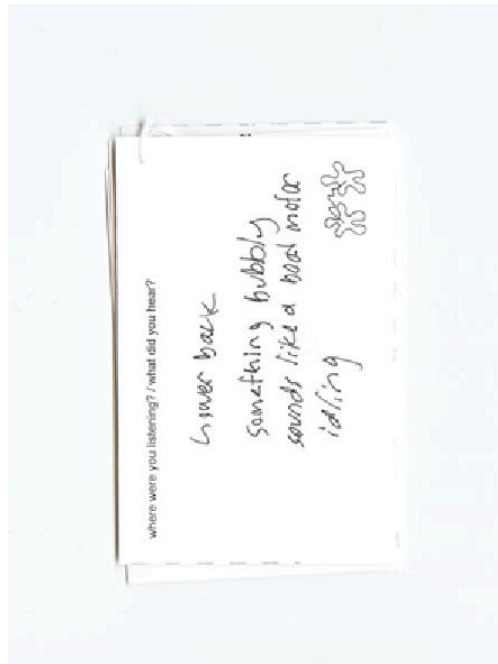


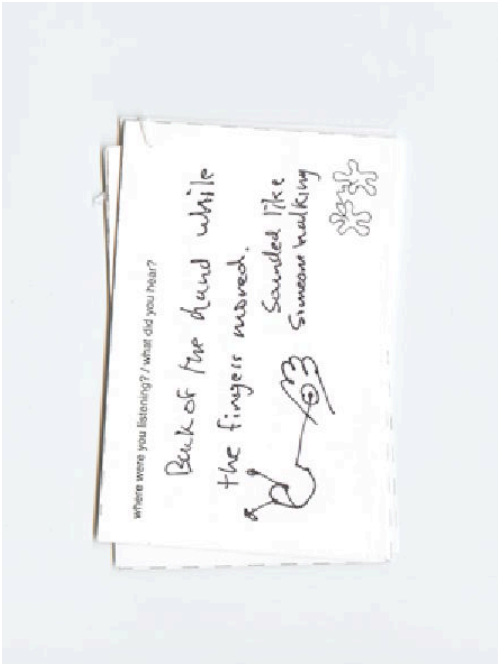
Appendix C workshop 'extend'



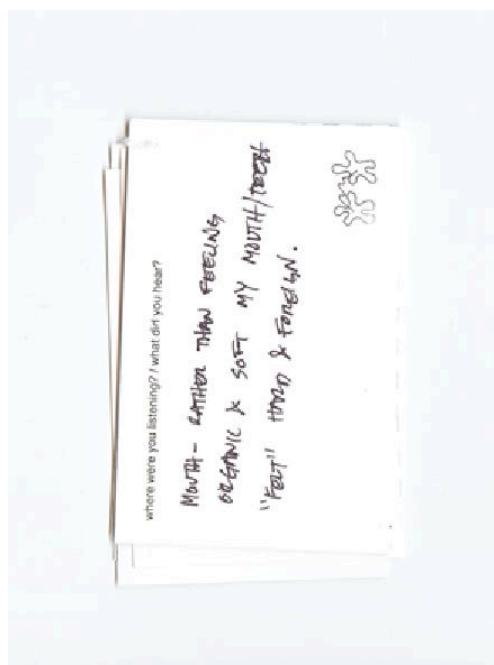
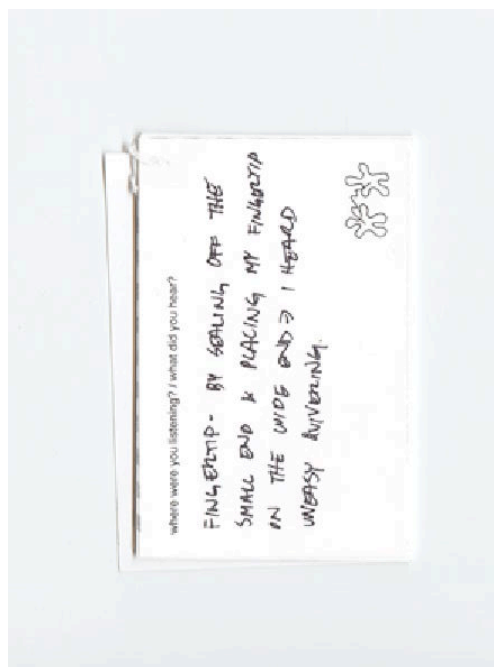


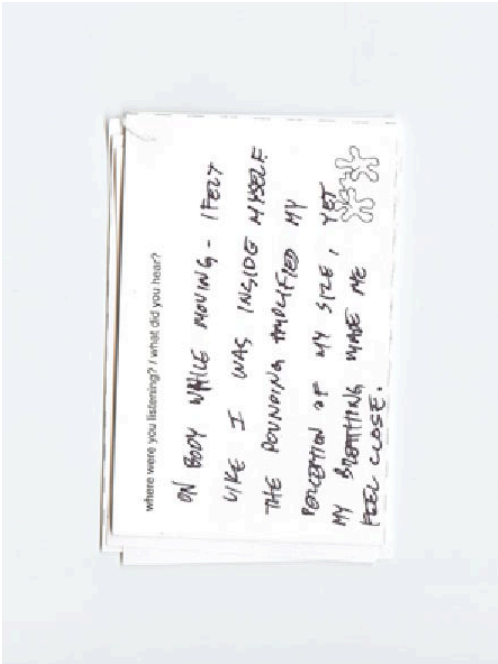
Appendix C workshop 'extend'

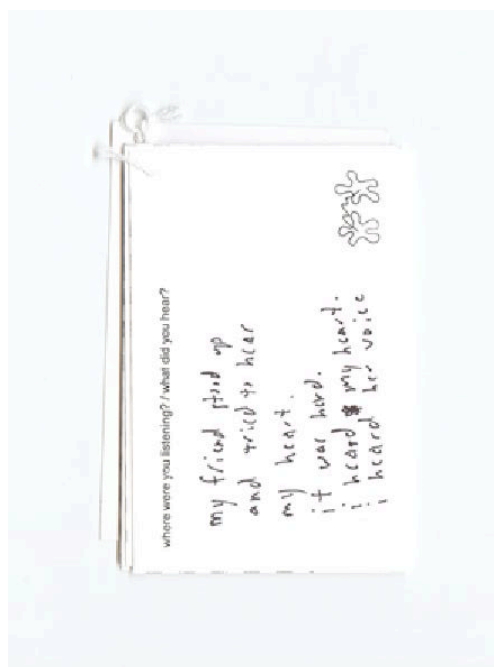
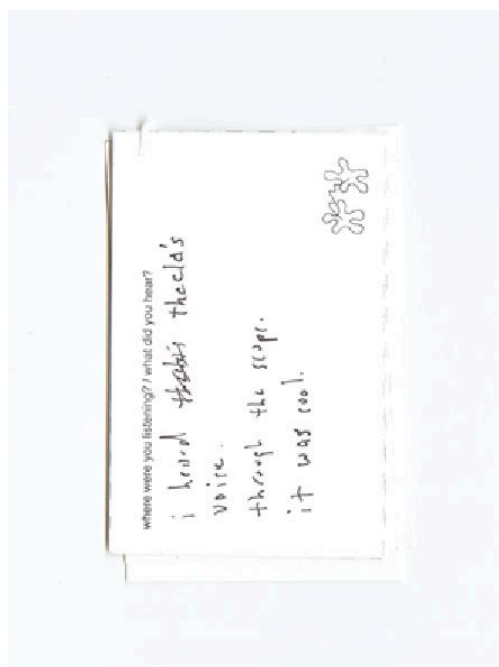


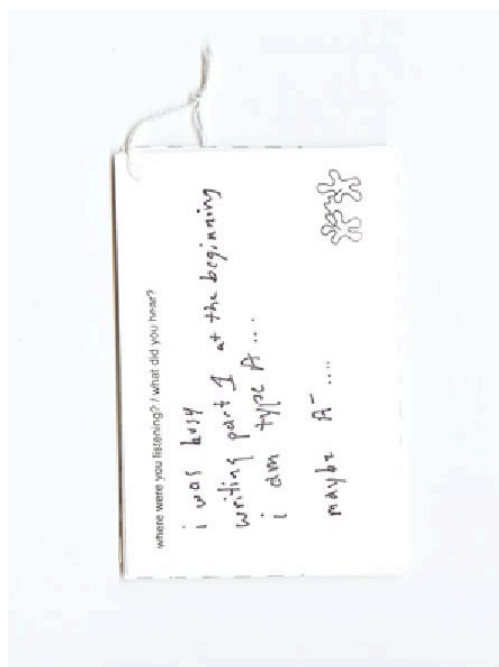


Appendix C workshop 'extend'









C.3.4 Workshop 'extend' Response Cards Transcription

Part A: 'extending outside'

[shirts sewn together]; you may speak

HOW DID YOU EXTEND YOURSELF?

° Hold hands with someone other than my husband; became silly; enjoyed the unusual and unknown; became aware of another's movement

° I was no longer just myself, I had to extend myself to become a part of a whole; as a whole we had to work together when we failed it was almost disappointing because we were apart

° I found myself thinking of out 'body' as a complete unit - it just had this other piece I wasn't controlling; the attached arm felt very unusual once I got complete control back

° I was chest first with another extender; overtime our extension eroded, and we choose to plant new seeds. The new seeds extended in a similar fashion (chest to chest) but in a operationally different approach; button to button hole.

° I didn't feel like an extension. That is I didn't feel as if the other body as an extension of mine. It felt more like a limitation & restriction

° Limp, move, laugh, play, explore, feel, experience, watch, giggle, frolic, twirl, change, sit, talk, greet, play, collide

° I broke out of my comfortable boundaries and familiar interface [lots of images | drawings here] movement

° I extended through my arms, becoming one half of a larger body. I extended out of (and into) my own body, becoming part of Eric's body as well. I extended my understanding over movement through space, allowing myself to give up some control and just to flow.

° Extension of my mid-arm, which was connected to my partner was done in unison in order that we did not turn/pull away at each other; releasing myself while "dancing" worked because as long as your moving, the entangled body kept coming undone/untangled.

HOW DID YOU MOVE?

- ° awkwardly; enthusiastically; carefully; socially
- ° pushing and pulling; each movement was followed by a reaction from my partner; therefore, our movements had to be in synchronized - to do that, we had to communicate
- ° move planned; I felt like I had to co-ordinate where I was going to relation to my 'twin'; the boundaries of my 'self' expanded; taking up some additionally space
- ° we moved like a butterfly - that is, as if we were two wings connected in the center; free yet restricted; we danced, glided, stumbled, skipped, twirled, crouched, rolled
- ° There was a negotiation that had to occur in order to move, both explicitly and implicit. Sometimes cooperation was needed, sometimes force was needed to move.
- ° Roll, ground, stretch, sit, stretch, twirl, drag foot, twirl, dance, hop, stretch, lift, be lifted, stretch, run, run fast, slow down turn, run.
- ° Poorly, we danced, clumsy, but always cooperatively, but we broke stitches, we fixed ping, we broke again we meta-morphed buttons, easier, co-operatively, we danced better [lots of images!]
- ° Movement was fun; lots of gyrations and circular motions, movement was shared, it flowed, sometimes I followed and other times I led, it was balanced, I was supporting and also supported.
- ° With awareness of a third limb, had to refocus on the oval movement of 2 arms in relationship to having tri-movements. (i.e. mid-arm that was connected needed to be coordinated with both parties); interaction of my body partner was avoided [?]

Part B: 'extending inside'

facing each other; stethoscopes; booklets

WHERE WERE YOU LISTENING? WHAT DID YOU HEAR?

- Neck over jugular: strong, deep, rhythmic pounding
- Chest, over heart: steady beating, with slight gurgling in background
- Stomach, just below diaphragm: low gurgle, distant thumping
- Base of skull: white noise
- Inside of leg, just below ankle: bubbling, boiling, w/low rumble in background
- Trachea: rush of wind
- My heart: regularity, strength, pulsing, drums
- Under my neck: waterfall, blood flowing, roaring
- Vocal cords: breathing, my voice
- Calves: tensing of muscles
- neck: my breath, raspy sounding, the best place to hear it! I'm surprised!
- Stomach: its gurgling apparently, I can't hear or feel throat
- Neck: pulse, voice (w less bone resxxx louder), blood: low rumble
- Wrist: blood moving pulse;
- Sternum: heart pumping, blood flowing, voice (through bone loud action); bone resonance
- Upper back: low rumble of blood flow; some voice
- Lower back: something bubbly, sounds like a heat motor idling
- Bicep: gurgling, increased tempo w/flex
- Top of foot: bones and tissue as I extended and retracted toes; blood flowing
- Calf muscles while fast moved [images]
- Back of the hand while finger moved [images]; sounded like someone walking

Appendix C workshop 'extend'

- Knee cap, just above the knee: pops every once in awhile, crunching too [images]
- Heartbeat: slow rumble, deep.
- Third eye: no sound [images]
- Eye lashes: brushing against drum [images]
- Throat: sounded like a distant rushing river
- Fingertip [by sealing off the small end + placing my fingertip on the wide end, I heard uneasy shivering
- Moving body, pulsing, thumping, creaking
- Mouth: rather than feeling organic and soft my mouth/touch "felt" hard and foreign
- On body while moving: I felt like I was inside myself the pounding amplified my perception of myself, yet my breathing made me feel close
- Closer to the heart, the steady beating, ta-dump ta-dump [image]
- Voice | mouth | used like a microphone [image]
- Wrist towards mid-arm: rambling ocean like noises; oncoming roar of thunder [image]
- Throat-area: roaring liquid with beating in background [image]
- I was busy writing at the beginning, I am type A, maybe A"
- My friend stood up and tried to hear my heart, it was hard, I heard my heart, I heard low voice
- I heard Thecla's voice through the scope, it was cool
- I ran, "the dog trots freely in the street ..." I worked the boundary the magic circle, I left, I stayed, I ran, I ...
- [images of running around curtains, circles]

C.4 Workshop 'mutate'

C.4.1 Workshop 'mutate' Script

first draft:

welcome to the mutate experience

this is an experience in two parts

for the first part we will ask you to put on the shirts
that we handout

you can help each other buttoning up
it is ok to ~~talk~~ and make noise
[as needed] *Speak*

please work together with your partner to explore the space

now detach yourself yourself from each other using the
Velcro tabs

We are handing out additional Velcro Tabs
Use these to find ways to attach yourself to yourself or to
others in 'mutated' ways

explore the space together
<15 min?>

please take a moment to fill out the cards
[hands out card I]
[collects card I]

we will now be handing out gsr's for the second part. GSR
means Galvanic Skin Response. We will help you fit these
on.

GSR's are good for listening to the inside, through your
skin. You can listen to your affect, your reaction your
emotional state.

Listen to yourself
listen to the other

Please take a moment to make notes in the notebook, as you
experience.
[15 min?]


C.4.2 Workshop 'mutate' Response Card

"mutate"

how did you change?

how did it feel?

... whisper



C.4.3 Workshop 'mutate' Response Cards

how did you change?

mutate

I would have gotten that close / intimate under normal circumstances

how did it feel?

kind of seeming contradiction intimacy / but disconnect people felt free when disconnected the connection constrained movement but we were free to wrt. intimacy collab. work time connection is freer in that now it's possible, but also constrained by the connection

...

how did you change?

mutate

shy, self conscious → more relaxed. having fun with it.

how did it feel?

awkward, in a relaxed way (non-threatening)

...

how did you change?

mutate

individual became part of a whole, movement affected & controlled by connected parties, became explanatory in looking for connections w/ others

how did it feel?

constrained yet inclusive, felt as part of a whole ability to connect made feeling of need

...

how did you change?

mutate

now armed, stretched thin, shes like taffy pulled, curl back into, tentacles of homelec featherarms, shellfish

how did it feel?

like that. Warm, curious, happy, fun.

...

how did you change?

... mutate

FROM INDEPENDENCE
TO LOOKING FOR POINTS OF CONNECTION
TO LOOKING FOR WAYS TO MAKE WITHIN
A NETWORK; THAT INVOLVES COMMUNICATION
THAN LOOKING FOR RECONNECTION
AFTER COMPLETELY
THEY LOOKING TO DISCONNECT.

how did it feel?

... whisper

A BIT CONSTRAINING!
THEN CONSTRUCTIVE
EMERGES WHEN MOVING.
CONNECTION WITHIN APOD
WEATHERS WITH DISCONNECTED.



how did you change?

... mutate

BECAME MORE RECEPTIVE TO OTHERS
GOING FROM A CLOSED NETWORK TO A NETWORK
CONSTANTLY IN CHANG

how did it feel?

... whisper

Feeling of stronger & weaker connections
transmitting pulse across the network influence
nodes are after the other
wanting to interact more closely with close nodes



how did you change?

... mutate

My focus in relationship to others changed. I was more
able to focus on points of connection than on
social/relationships. In other words because the
connection was available, it was like an invitation.
It became safe to touch the person at that
location.

how did it feel?

... whisper



how did you change?

... mutate

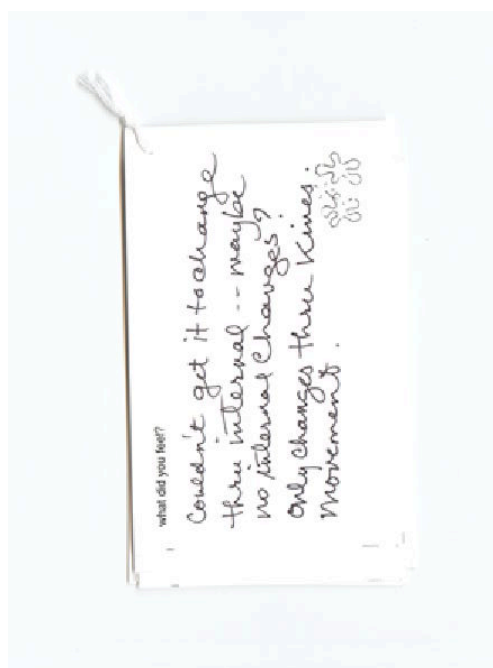
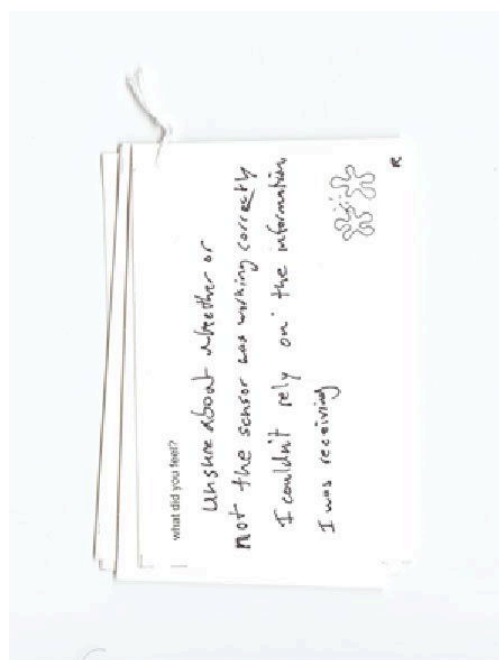
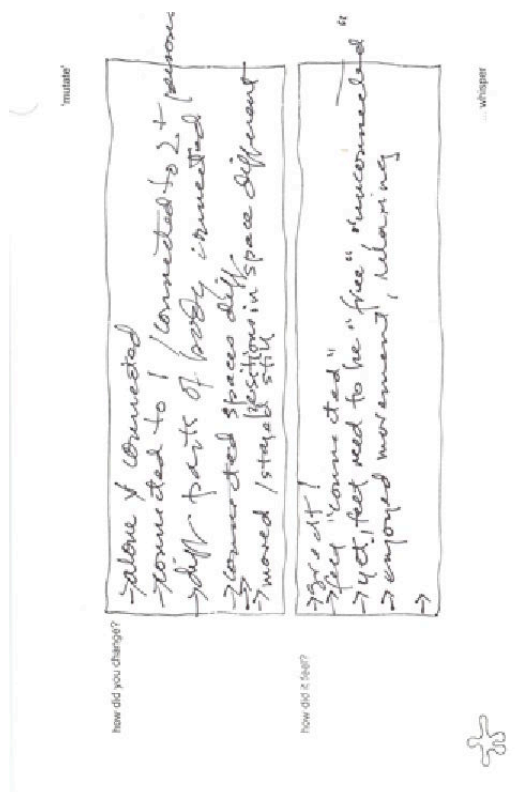
~~that~~ i left my desk
i wore a nifty white shirt
the blood recirculated to my body
i talked to people

how did it feel?

... whisper

it felt quite personal
putting on the shirts was sexy
moving in the group was boring
nobody wanted to wake shape





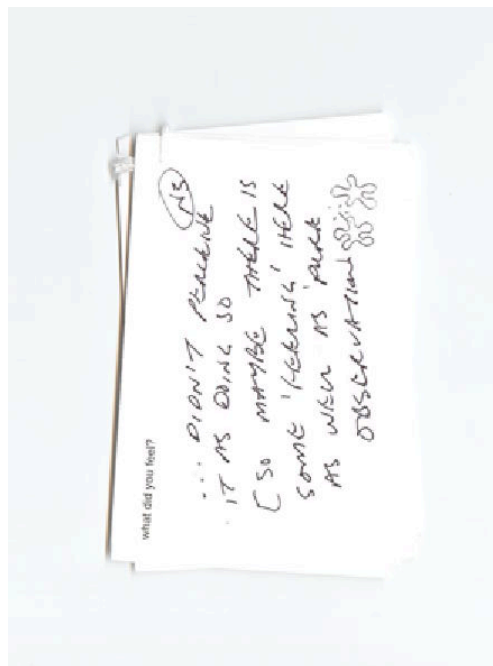
Appendix C workshop 'mutate'



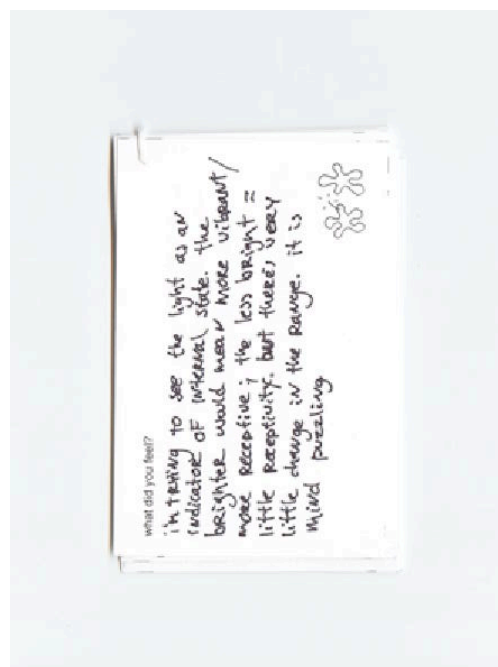
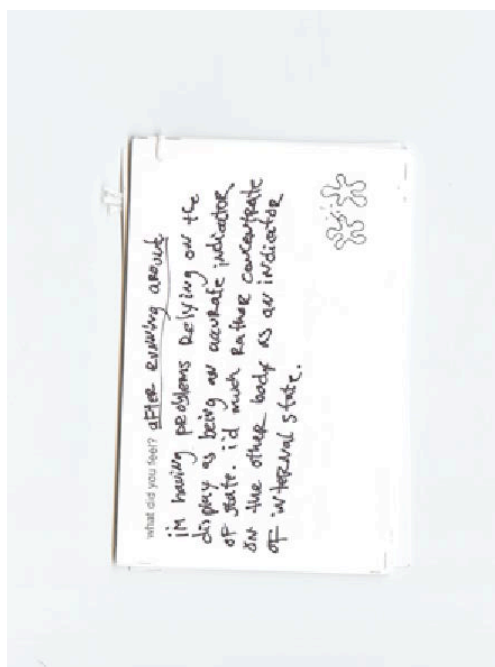
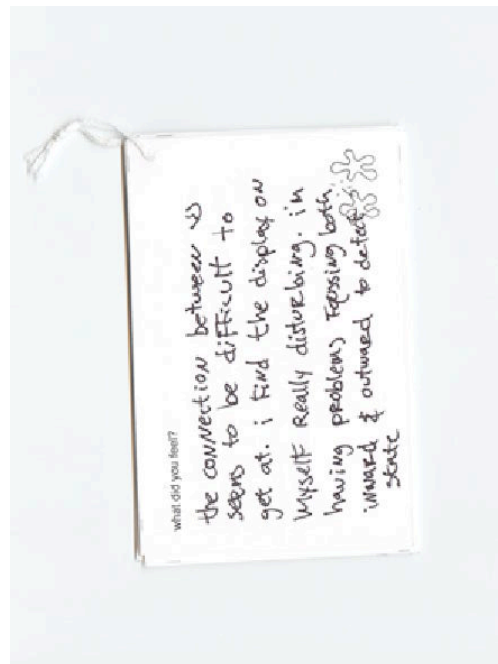
Appendix C workshop 'mutate'



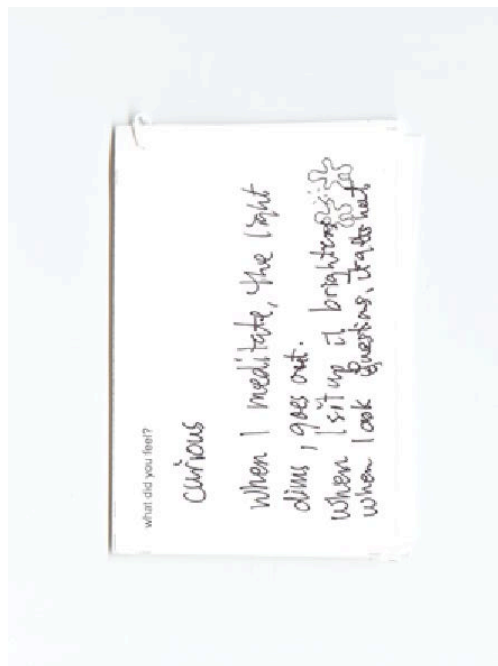
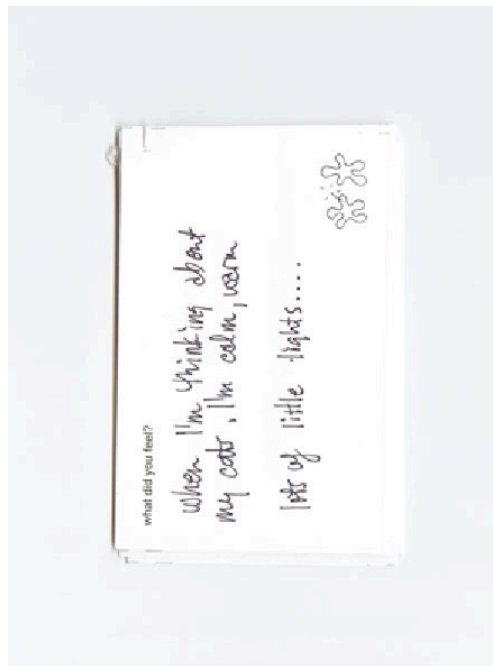


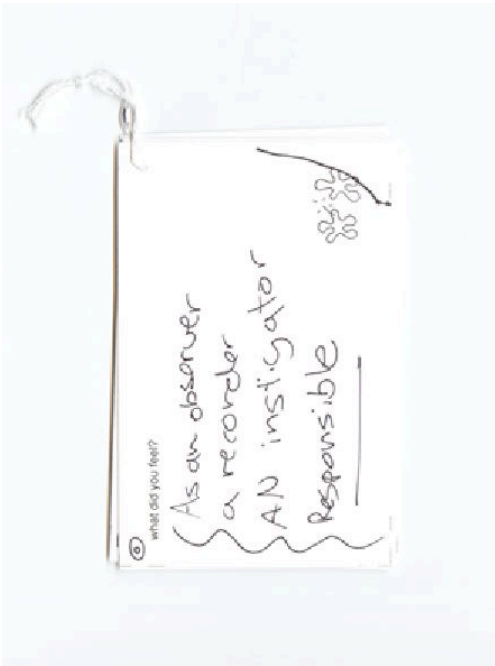
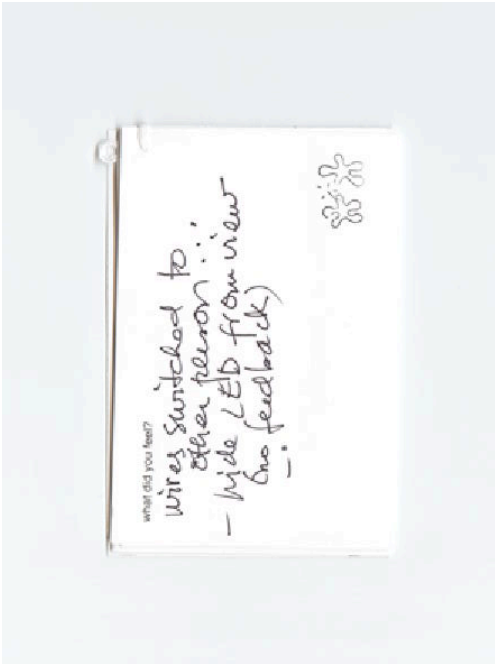


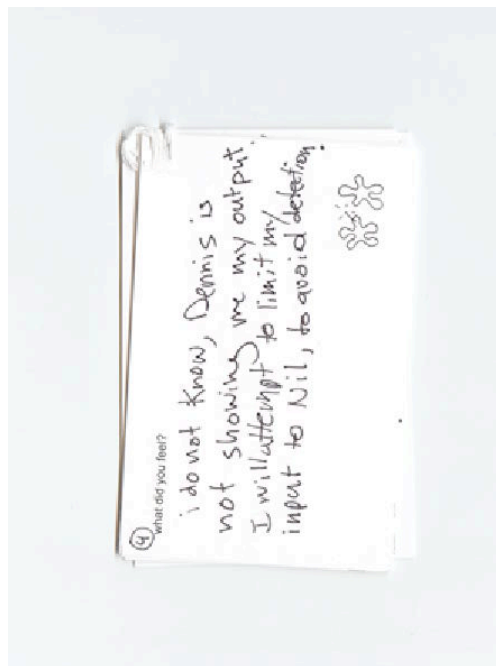
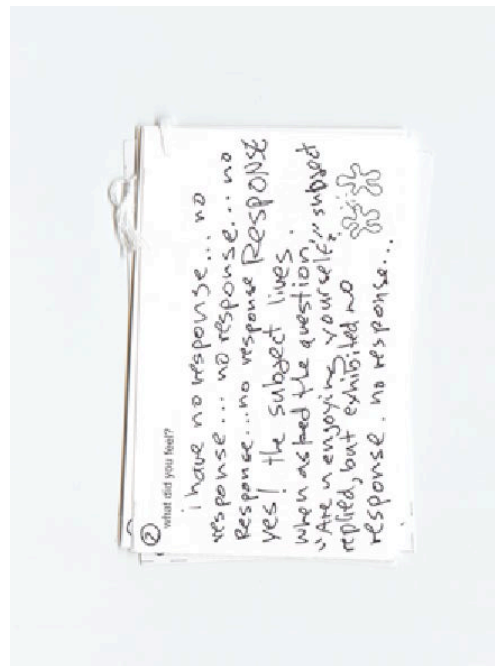
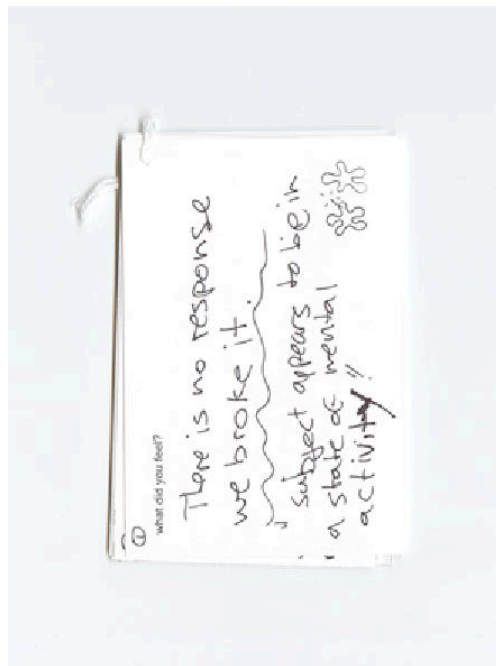
Appendix C workshop 'mutate'

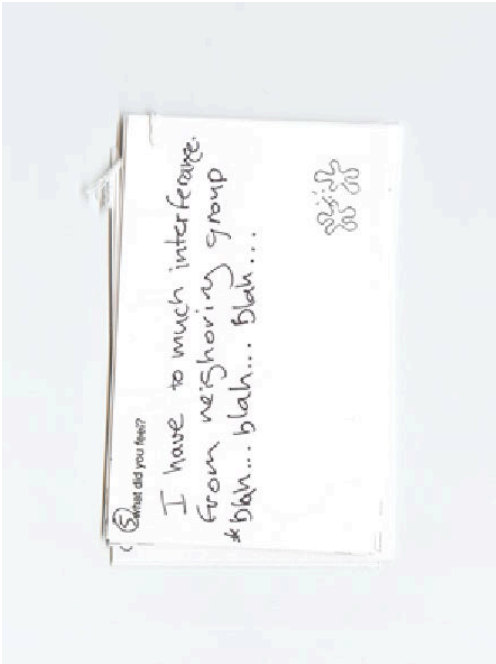


Appendix C workshop 'mutate'









C.4.4 Workshop 'mutate' Response Cards Transcription

Part A: 'mutate outside'

[shirts Velcroed together] hand out extra Velcro tabs to explore space together; you may speak

HOW DID YOU CHANGE?

- o I wouldn't have gotten that close/intimate under normal circumstances
- o Shy, self-conscious ----- > > more relaxed having fun with it
- o Individual became part of whole, movement affected and controlled by connected parties, became exploratory in looking for connections w/others
- " from independence to looking for points of connection, to looking for ways to move within a network, that involves communication, then looking for reconnection coming apart, then looking to disengage
- o became more receptive to others; going from a closed network to a network constantly in change
- o my focus in relationship to others changed. I was more able to focus on points of connection than on social/relationships. In other words because the connection was available, it was like an invitation, it became safe to touch the person at that location
- o I left my desk, I wore a nifty white shirt, the blood re-circulated through to my body; I talked to people
- o Alone vs connected; Connected to 1 | connected to 2+ persons; Different parts of body connected; connected spaced difference positions in space, different: moved/stayed still
- o May armed, stretched thin, shapes like taffy pulled, curl back into, tentacles of barnacle feathery arms, shellfish

HOW DID IT FEEL?

- o Weird seeming contradiction intimacy | but disconnected; the connection constrained movement but we were freer with intimacy; collaborative work type connection Is freeing in the more is possible, but also constrained by the connection

Appendix C workshop 'mutate'

- o Awkward, in a relaxed way (non-threatening)
- o Constrained yet inclusive, felt as part of a whole, ability to connect made feeling of need
- o A bit constraining then constructive, emergent when moving, lonely when apart, weightless when disconnected
- o Feeling of stronger + weaker connections transmitting pulse across the network influence; knocks one after the other; wanting to interact more closely with close nodes
- o it felt quite personal; putting on the shirts was sexy; moving in the group was boring [nobody wanted to make shapes]
- o great! Felt connected"; yet, felt need to be free", "unconnected"; enjoyed movement, relaxing
- o like that [many armed, stretch thin etc]; warm, curious, happy, fun

Part B: 'mutate inside'

shared gsr; booklets

WHAT DID YOU FEEL?

- Unsure about whether or not the sensor was working correctly: I couldn't rely on the information I was receiving
- Couldn't get it to change thru internal - maybe no internal changes? Only changes thru kinesthetic movement
- Making connection w partner thru discussion + being wired"
- Mention of 'techweek' brought immediate brightness
- Vocal interaction illuminates
- Lying brightens [works as a lie detector)
- Focusing on a single point; dims light: blocking out others
- Dim while waiting
- Using (focusing on) inside; voice dims light; talking brightens
- Shallow breathing dims; deep breath immediately brightens
- I didn't have a problem seeing my heart worn on someone else's sleeve (ie, see the indicator of my body activity on another's arm)
- Relatively under control when moving quickly but aware of increased sweat on skin
- After stepping (external) and at tempting to slow down (internal) heart-rate went through the roof
- Not a feeling - an observation; Dominic was accurate at picking up my focus, though there was some time ... both coming in and xxx of that state I wanted the diode to reflect this state change, but didn't perceive it doing so [so maybe there is some feeling' here as well as 'observation'
- Speeded up burning with a hard gem-like flame
- The connection between us seems to be difficult to get at. I find the display on myself really disturbing. I'm having problems focusing both inward and outward to detect state

Appendix C workshop 'mutate'

- After running around I'm having problems relying the display as begin an accurate indicator of state. I'd much rather concentrate on the other body as an indicator on internal state.
- I'm trying to see the light as an indicator of internal state. The brighter would mean more vibrant/ more receptive; the less bright = little receptivity; but there's very little change in the range, it is mind puzzling
- The light could help to distinguish a subtle shift in the internal state when there's too many noises around
- Wired!; on display; writing makes light go on ; stronger contacts? Open hand does opposite
- LED adjusted to be more secure; light does not change; feel relaxed; feel stressed -4 same reaction on LED
- Wires switched to other person; inside LED from view (no feedback)
- Can't seem to focus on inside ... light does not seem to react; lots of interest in accuracy of feedback through lights I wires; need more stable connection to fingers
- As an observer, a recorder, an instigator, responsible
- There is no response, we broke it, "subject appears to be in a state of mental activity"
- I have no response, no response, no response, no response, no response, RESPONSE YES! The subject lives. When asked the question "are you enjoying yourself?" subject replied, but exhibited no response, no response
- Subject says "cyborg", and keeps wiggling my connection. When asked "are you bored" subject replies affirmatively and begins writing in notebook. I have a response, response ... response ... response interference coming in from neighboring pair. Time to switch
- I do not know, Dennis is not showing me my output, I will attempt to limit my input to nil, to avoid detection
- I have too much interference from neighboring group; blah, blah, blah
- [images]
- responsive; I have infected the device with a virus, my cold virus which will most certainly pass to the next person to use it. The pen fumes are making me dizzy and we should turn off the other "pairs unless they give us data
- performance another is very red
- curious, when I meditate the light dims, goes out; when I sit up, it brightens, when I look interested it goes hot [out?]
- when I'm thinking about my cats, I'm calm, warm, lot of little lights
- I thought that laying down would slow it, but not always

C.5 Workshop 'phase'

C.5.1 Workshop 'phase' Response Cards

how did you move? "phase outside"

gyroscopically
propeller-driven
in pretzel patterns, ceremonially

what did you hear? ... whisper

something like the sound effects
from a Philip Marlowe novel - the
movement of fabric, in absence of
dialogue, purely sound, but
partly sight and movement
suggesting sound.

how did you move? "phase outside"

inside out, in and through sleeves, the
collar/head, the bottom, down, twisting,
flapping, windmill, with others, up &
down

what did you hear? ... whisper

rustling of clothes, my breathing, laughter,
speedy up breath, muscles and tendons,
feet on the floor, the flapping & slapping
of sleeves

how did you move? "phase outside"

It was so much fun. Thanks Jim.
At first, it took a while to figure out
what to do with this weird looking shirt.
Once crossed the line of self-consciousness
it was so fun to be like a child, indulged in
~~my own~~ fun.

what did you hear? ... whisper

my laughing, a hair inside of ~~the~~
one ear, stuck between the ear plug
and my ear. other people's movement
sounded far
?? sound of silence, vacuummed.
a bit uncomfortable

how did you move? "phase outside"

Floppy movement. Dangly. Twirly (is that a word?)
Jumpy.
There were two movement spaces, 1 internal to the
shirt space & 1 external in the room.

what did you hear? ... whisper

Misty my own breath as I moved more. at
times I heard my sleeves banging against my
body.

phase outside

how did you move?

like a duck
restrained / inhibited (at first)
aimlessly

what did you hear?

fabric of the shirt against itself
faintly laughter
the ping of the buttons hitting the ground
NOT my own breathing / heart beat

phase outside

... whisper

85 86

phase outside

how did you move?

oscillate
tight
i moved inside...

what did you hear?

i made a shade and stayed
i played, afraid
i saw clearly
i saw mist
i saw fog
i created vision from

phase outside

... whisper

87 88

phase inside

what did you receive?

sometimes snapshots,
sometimes continuous (and disorienting)
data
I liked the way the instrument gave a qualitative reading first, then moved to quantitative

how did you listen?

intuitively and instrumentally
inhibition as to what I might hear
directed what, where, when I should instrument

instrumentally means both with an instrument, and with a purpose, whisper purposefully, deploying the instrument as

89 90

Chosen points in time and space, and ranges throughout those continued

91 92

phase inside	how were you listened to?	what did you feel?	phase inside	how were you listened to?	what did you feel?
<p>periodically I would go over to someone & stand near them. I tried 3 experiments</p> <ol style="list-style-type: none"> 1. stand motionless for an extended period (76) 2. move radically around the space for a while (165-180) 3. Push ups (140) 20 pushups. 4. Move slowly (no reading) <p>When standing close to a watch I could see my heart beat & this gave me a clearer way to listen to it while away from the watch. (i.e. could feel in my bones & almost hear the sound of it)</p>	<p>how were you listened to?</p>	<p>what did you feel?</p>	<p>phase inside</p> <p>very well, especially after people got past initial shyness & (me too) & got into it.</p> <ul style="list-style-type: none"> i listened to myself the best i love my friends, but was looking for me 	<p>how were you listened to?</p>	<p>what did you feel?</p>
<p>By being in front of the transmitter. It didn't seem to work if there were any obstructions in the way.</p>	<p>how did you listen?</p>	<p>what did you feel?</p>	<p>phase inside</p> <p>i oscillated between need to connect, need to send, need to be done</p> <p>i wanted to send activity = passivity, max motion & min emotion</p> <p>i worked hard but i was freed from the imperative to interpret</p> <p>i was free, not bound & i needed that right now</p>	<p>how did you listen?</p>	<p>what did you feel?</p>

Appendix C workshop 'phase'

what did you receive?


phase inside

Numbers, throbbing beats, heat, messages
clues, states of motion, representations
of life

how did you listen?

The watch, ^{eyes, ~~to ears~~} seeing numerical changes,
sound of breathing, sound of movement
and activity, sound of feet, sound of laughter,
watching others, comparing clocks, watching
understand.

— whisper



how were you listened to?


phase inside

objects of measurement, ears, eyes
feeling

what did you feel?

examined, like an object of curiosity,
like a toy, alone, watched, prodded,
temporarily ~~was~~ wanted, then dis-
carded.

— whisper



C.5.2 Workshop Response Cards Transcription

Part A: 'phase outside'

[shirts w long sleeves + ear plugs] explore how to move; please do not speak

HOW DID YOU MOVE?

- ° I moved inside ..; oscillate `tight` free [images of path flows space]
- ° Like a duck; restrained | inhibited (at first) ; aimlessly [image of path flow w dots]
- ° Floppy movement; dangly; turny (is that a word?); jumpy; there were two movement spaces: 1 internal to the shirt space + I external in the room.
- ° Inside out, in and through sleeves, the collar (head, the bottom, down, twisting, flapping, windmill, with others, up + down
- ° Gyroscopically; propeller-driven; in pretzel patterns, ceremonially

WHAT DID YOU HEAR?

- ° I saw clearly; I saw mist; I created fog; from clear vision; I made - a shad - and stayed - and played - I'm afraid [written sideways on card]
- ° Fabric of the shirt against itself * faintly > laughter; the ping of the buttons hitting the ground NOT my own breathing | heartbeat
- ° Mostly my own breath as I moved more, at times I heard my sleeves banging against my body
- ° My laughing, a hair inside of one ear, stuck between the ear plug and my ear, other people's movement, sounded far; ?? sound of silence, vacuumed, a bit uncomfortable
- ° Rustling of clothes, my breathing, laughter, speeding up breath | muscles and tendons, feet on the floor, the flapping & slapping of sleeves
- ° Something like the sound effects from a Philip Marlowe novel - the movement - the movement of fabric, in absence of dialogue, partly sound, but partly sight and movement suggesting sound.

Part B: 'phase inside'

heart rate monitors; [chest bands and watches]

SENDERS

HOW WERE YOU LISTENED TO?

- ° My breathing
- ° I was provoked to respond scientifically; playfully; not at all
- ° Clinically sometimes, other times caressingly in a mediated way
- ° Very well, especially after people got past initial shyness (me too) + got into it; I listened to myself the best; I love my friends, but was looking for me
- ° Periodically I would go over to someone + stand near them. I tried 3-4 experiments:
1. stand motionless for an extended period [> 6] 2. move radically around the space for awhile (160 - 180) 3. push ups (140) 20 pushups. 4. move slowly (no reading)
- ° Objects of measurement, ears, eyes, feeling

WHAT DID YOU FEEL?

- ° [image heart empty ' heart full ' hear empty' heart full ' . . .]
- ° those under-wires were a little snug; fear that 'my secret' would be out; no great loss
- ° observed, but in a way that I felt was being interact with, sometimes more purposefully than others
- ° I oscillated between: need to connect; need to perform; need to be alone; I wanted to send ' activity = passivity, max motion = min emotion; I worked hard, but I was freed from the imperative to interpret; I was free, not bound + I needed that right now
- ° When standing close to a watch I could see my heartbeat + this gave me a clearer way to listen to it while away from the watch. (i.e. could feel in my bones + almost hear the sound of it)
- ° Examined, like an object of curiosity, like a toy, alone, watched, prodded, temporarily wanted, then discarded

RECEIVERS

WHAT DID YOU RECEIVE?

- ° Numbers; flickering of icons on the watch; pumping of vein at Rob's neck
- ° Numerical data of biofeedback responses; insight into 'the others' body; some great ideas; part of the experience of the others body
- ° Sometimes snapshots; sometimes continuous (and discontinuous) data; I liked the way the instruments gave a qualitative reading first, then moved to quantitative
- ° Heart beats: Jim's heart rate was irregular while doing sit-ups but steady when resting; Camille's heart rate went to 142 while I spun her around; the heart rate changed drastically during movement
- ° Numbers, throbbing beats, heat, messages, clues, states of motion, representation of life

HOW DID YOU LISTEN?

- ° Beep sound, maybe (electronic indication of the watch device)
- ° I didn't listen, I watched with an ear to hear
- ° Intuitively and instrumentally; intuition as to what I might hear directed what, where, when I would instrument; instrumentally means both with an instrument, and with a purpose, purposively, deploying the instrument at chosen points in time and space, and ranges throughout those continue
- ° By being in front of the transmitter: It didn't seem to work if there were any obstructions in the way.
- ° The watch, seeing numerical changes, eyes, ears sound of breathing, so and at movement and activity, sound of feet, sound of laughter, watching others, comparing clocks, watching "senders"

D

Appendix D: heart[h] workshop data

	prototyping spring 05
	[...] Photoshoot April 05
Experience	[...] garments 05
Design	[...] tactex-pda prototypes
Process	[...] garment-sensor prototypes
	heart[h] workshops fall 04
	[...] workshop 3 - December 7th /04
	[...] workshop 2 - November 9th /04
	[...] workshop 1 - October 12th /04
	between bodies [spring 04]
	[...] prototype garments with technology
	[...] technology components
	[...] biosensors
	[...] actuators, gadgets - reference
	[...] garment reference
	[...] garment materials
	[...] bb design notes

Figure II-5. heart[h] workshops are also online at <http://whisper.iat.sfu.ca/process.html>

Appendix D outlines the heart[h] experience workshops conducted from October to December of 2004. Workshop data and analysis of that data is presented. The heart[h] workshops continued an on-going series of explorations into the legibility of the experience of body-data. The heart[h] workshops focused on breath and movement within a network of wearable 'skirts'. This focus was intended to clarify participant impressions of sharing their physiological data, particularly breath data between one another in a public space. Three workshops were conducted. Each explored interaction and movement between a group of participants. There were two participant groups. The first group was made up of professional dancers, and the second group was made up of undergraduate students in the interactive arts and technology program at Simon Fraser University. Each workshop used a narrated script to guide participants who

Appendix D heart[h] workshop data

'played' within a networked group of skirts. Observational documentation included video and digital photography, observational sketches and hand-written notes. Participants filled out Exit Responses Cards, and Exit Interviews were conducted.

This appendix presents the following documentation:

Heart[h] workshop data

The heart[h] workshops and data analysis was utilized in the development and prototyping of *exhale: breath between bodies*, exhibited at Siggraph 2005 in the Emerging Technologies Showcase. The following data is presented here:

- Heart[h] participant profile questionnaire

Workshops

For each of the three workshops:

- **Workshop Data Analysis Grid:** Presents a content analysis of participant responses to hand-written cards, video transcriptions, observations of movement and interaction during the workshop.
- **Workshop script:** Used by the narrator to direct workshop participants to explore various aspects of their experience.
- **Workshop response card design:** The design of the workshop response card enabled workshop participants to give a hand-written account of their experience.

Appendix D heart[h] workshop data

- **Workshop Response Cards Transcription:** Transcriptions of the hand-written responses from the workshops.
- **Exit Interviews:** transcripts of the exit interviews of dancers and students.
- **Workshop Observation Drawings:** participant observation sketches made during workshop.
- **Workshop Observation Notes:** participant observation notes made during the workshop.

D.1 Workshop 'something in the skirt' / 'something between the skirts'

D.1.1 Workshop Script

Script

All participants

Tell them about project intro – Currently we are using skirts

Embedded in the garments are sensors for receiving body data which is then transmitted wirelessly into other persons skirts which then respond to the body data.

"Welcome to the first hearth workshop.

There will be 2 parts to these physical experiments. Each part has a different focus and thematic structure. The entire group will sit quietly together for 2minutes of centering with ambient music before we commence.

Once the music ends, you will all assume your individual roles and pick up your equipment/tools and begin in silence.

Please try to come to a place of stillness."

All Documenters

"You will be participating in the documentation of the kinesthetic experience of 10 participants. Try to stay outside the perimeter of the space that the participants are in.

Be respectful of not interfering of other people's flow. Try not to draw attention to yourself.

You are part of the workshop, do not interfere or obstruct. You might want to consider yourself like you are both inside with the participants, and try use a different sense of seeing, reading through your own body in order to discern and select moments to capture ... but try maintain enough outside perspective to perform your documentation.

Please have sensitivity and awareness"

All Video and Photo Documenters

"We would like you to think about how the creative framing while you are documenting the participants."

Video Documenters

"We need to have 1 person primarily doing dolly shots and pans, 1 person doing mid-wide shots and 2 doing Close Ups of

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

in the first activity:

Hands,

Feet,

eyes

Skirt Movement,

Senses, Heart, Breath, Touch, Hearing, Vision,

Interaction Between Body Parts

in the second Half:

Tying

Movement between

Interaction between bodies

Breathing"

Photo Documenters

"Try to use a different kind of seeing as an ethnographer, try take photographs with a sense of breathing. Look for lines (vectors, geometrics) in space.

Shot types

- Mid and establishing shots with people in skirts*
- Getting into the skirts*
- Getting into the garters*
- Movement shots*

Close Ups

- hands,*
- feet*
- breathing*
- get a sense of people's concentration (awareness, or state)"*

Writers & drawers

Show them 'body as home' scribbles

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

Writers – *"Consider the writing as scribbles"*

"Use the sketch pads to make your notes and drawings.

Try to make your observations quick non-analytic, do not judge what you are doing, no prejudice.

Try to capture your immediate impressions and sensations: what you see, feel, movement, shapes, colours, connections, emotional qualities, anything that comes to mind, stories, fragments

Stream of consciousness

Movement as scribbles"

Experience Participants

"You are about to participate in the workshop. You will each select a skirt, which you will put on over your clothes and place a garter on your thigh or calf.

You will participate in silence and follow a guide's voice, while they will direct you in specific tasks. Listen to your breath."

Physically honest; physically receptive; Initial questions are seeded while they are moving.

-- see activity scripts--

After Activities

"Try to hold on to your experience and allow yourself to spend a few minutes drawing your experience from a stream of consciousness approach, try not to let your analytical self take over."

(7 mins) hand out drawing cards

"Try now to describe in words your experience silently for a few minutes, again allow yourself to express your experience from a stream of consciousness approach, try not to let your analytical thought take over."

(7 mins) hand out response cards

"If you could all now stay for a few more minutes as we interview each of you on video for a few minutes."

Initial questions were seeded while they were moving.

(7 mins) start video interviews one at a time – Thecla take 3, Susan 3, Camille 3 – whoever is finished their 3 first takes the last participant.

D.1.2 Workshop Response Card

ilab the whispers research group – HEART[H] experience workshops

heart [h]
heart
+
breath



something living in the skirt

When you were wearing the skirt and there was something living in the skirt, what did you sense ?



something living in the skirt

Where in your body were you sensing? How did you respond?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

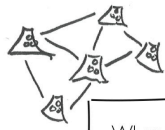
ilab the whispers research group – HEART[h] experience workshops

heart [h]

heart

+

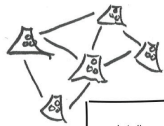
breath



something living between the skirts

When you were attached to someone else in the room and there was something living between the skirts, what did you sense?

Where in the room were you sensing?



something living between the skirts

What were you sending ?

How did you respond ?

D.1.3 Workshop Data Analysis Grid

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)				
Attributes Documented	Patterns/themes - based on type of participant			Written Observations
	Photography Observations - based on visual assessment of images	Drawing Observation - based on visual assessment of images		
movement qualities / gestural elements	some moving slowly- some erratically, looks like lying bodies are floating in space, small steps in group/rows and circles, bending forward to check out pockets and beneath lining, swinging feet, sidesteps toward others around them, shyly lifting skirts for each other, on the floor pulling, twisting	stillness, lifting skirt, crouching head in hands [very literal drawing], pairing, encircling flow, individual raising arms, others in circles with cords attached and arrows indicating movement[also fairly literal], literal sketch of people in skirts all in a train-like flow with lines of elastics attaching them, lines and triangles to indicating direction and flow, vague shapes of figures and skirts in a flow and jittery / jumpy movement	hop, stretch, tangle, ruffle, shake, fly, morph, ripple, flow, sa-shay, drag, expand, collapse, sniff, leave, twirl, lift, squish, stillness, lifting end, bunching up, twitch, beating, itching, swaying, bumping up against, keith can't keep still, starting a beat, another is crouched down, now 2 more are crouching	
	rolling to and fro, pulling of elastic between the bodies, dragging people off the floor, entangling, one jumping the elastic while others lie quietly, bodies squirming, enclosing - wrapping - mummifying, enjoining, clustering	lines of flow and gesture of arms, hands, feet and legs in skirts and head, movement lines of the upper torso and head from above, flow of the skirt, space with lines of light and lines of movement and elastics between and without the bodies, small gestures with elastics: swinging of elastic, pulling elastic, holding a body position with hand at waist, erratic spasms of the skirt and figure movement, erratic lines of activity	flare, fall, twist, escape, drape, immobile, fluff, linked, skirt lifting, jumping, skipping, contracting, centrifugal force, adaptation period to new vehicle of movement (proprioception?), the lone one is dancing on the fringes - continues moving around the outside of the group, shuffling, quickly	

Table II.3 heart[h] Workshop 1 Data Analysis: Participant Observations, 1 of 5

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)				
Attributes Documented	Patterns/themes - based on type of participant			Written Observations
	Photography Observations - based on visual assessment of images	Drawing Observation - based on visual assessment of images		
sense of breath				grunt, groan, shoo
sense of concentration	bodies lying down, figures in glowing colours perfectly still and statuesque, looking down - feeling the sensation below waist, sitting with eyes closed feeling the elastics and the sensations, listening to those around, boredom	figures show a sense of stillness and concentration, internal focus		balance, redirection of focus from skirt to elastic and from oneself to those around, still, quiet w/ eyes
sense of awareness		male[in baseball cap] and female stationary figures facing each other		balance, spread-out, curtain, change, noise, tent, mass, cage, trapped, rhythm, linked, beat, rest, away, play, patterns of emergence, discovery-looking at past actions, instigating trouble, one matches his skirt - he has recognized what is familiar, chaos within linkage, this looks dangerous, actions of one affect EVERYONE, awkward fitting, discovery, introducing experiment, the more tangled, the girls are tied in the middle, why don't the boys make horses [?]
body as home		stationary figure from behind in a shirt and seemingly a male in baseball hat [fairly literal]		new limbs, fetal position, from waist to toe

Table II.3 heart[h] Workshop 1 Data Analysis: Participant Observations, continued, 2 of 5

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)			
Attributes Documented	Patterns/themes - based on type of participant		
	Photography Observations - based on visual assessment of images	Drawing Observation - based on visual assessment of images	Written Observations
impressions / sensations	figures and bodies merging into one another, bodies tied to each other and enmeshed in ties: trapped or imprisoned	three stationary figures in skirts not all facing each other with arms slightly lifted, figures all laying down with lines connecting them	circus, doll-like, prisoner, evolution, expose, stuck, primitive, cocoon, spider, trapped, entanglement, complexity, some are irritating while others create a beat
	tension of elastic lines between the bodies on the floor		confined, web, feminine, ritualistic, insect, chain-linked creatures, short leash, liquid traffic structure, star network, ancient army
emotional qualities			calm, tension, uneasy, embarrassing, get it out! confusion, peaceful, the popular ones are together and others are isolated -why? Is she scared, they want to be together juxtapositions of joyfulness/bounciness to solemnness/discomfort, loss of control autonomy, they are comfortable with their skirts, frustration at limited movement

Table II.3 heart[h] Workshop 1 Data Analysis: Participant Observations, continued, 3 of 5

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)			
Attributes Documented	Patterns/themes - based on type of participant		
	Photography Observations - based on visual assessment of images	Drawing Observation - based on visual assessment of images	Written Observations
shapes / colours	glare of lights, pattern of bodies all in a row putting on skirts, yellows and orange heating up the space, lying on the floor in a web-like arrangement	shape pattern of people in skirts with a web-like appearance with lines indicating elastics [literal drawing], shapes and figures slightly abstracted and more shapes of body parts and patterns of movement in the space, completely abstracted lines of activity and energy, intense scribbles of frenzy - some like wave forms and soundforms or energy flow shapes and sizes of figures in skirts in a row[somewhat impressionistic], sketch of skirt shape, flow and texture, 3 triangular shapes with lines on sides and circles at bottom enclosing shape overlapping each other - 3 skirts overlapping each other no bodies, standing figures with lines between them	light, surrounded by darkness, stumpy, they feel the textures of others, the dots are together in group

Table II.3 heart[h] Workshop 1 Data Analysis: Participant Observations, continued, 4 of 5

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)			
Attributes Documented	Patterns/themes - based on type of participant		Written Observations
	Photography Observations - based on visual assessment of images	Drawing Observation - based on visual assessment of images	
stories / fragments			cloth, checking out each other, people in dresses, showing off the dresses, creature formed from many, sentenced to death peaceful once more, girls in white dresses with blue satin sashes, being chased by an army of fabric, clothes they wander, they gather together for the distribution of the connections... and then explore others, the socialite is trying to trap members that are dragged along without a say, he's so constrained - no one will help him escape, they're forcing her to stay - now there are ones helping, the lone skirt stays up to keep watch over the sleeping group...he's beautiful... the protector...the girls protected from the inside the brave girl near the edge...now he's fallen asleep and the brave one shifts and stays up
stream of consciousness			what's in the skirt, looking oddly around, from planar chaos to 3rd chaos, cat in the cradle

Table II.3 heart[h] Workshop 1 Data Analysis: Participant Observations, continued, 5 of 5

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
emotionally	living in skirts: discomfort, Invaded, unwelcoming, uneasy, friendship, alliance, a connection, lots of fun, sense of solitude	living in skirts: anxiety, excitement, anticipation, uneasiness to silliness, captivated	living in skirts: fear of the unknown	living in skirts: sense of connection and a feeling of a slight distance from the connection, less a personal experience but group, curiosity, fun	living in skirts: tension, unease, indifference, uncomfortable, space being invaded, then play, foreign, awkward, uncertain, surprised at feelings reacting to body, companionship, gradual adaptation. scared
	living between the skirts: Spontaneity, encouragement, happiness, becoming comfortable, leadership, everlasting affection.	living between the skirts: safer, dangerous emotional states were transferred between participants, confusion, humor, questioning, excitement, sadness, misunderstanding and confusion, feelings were amplified, tired, concerned, feel the others, then my body would respond to how I was feeling	living between the skirts: feeling of apprehension + caution, attached, scared, interconnectivity, emotions, happy & sleepy, curiosity	living between the skirts: [nothing]	living between the skirts: safety, protection, loss of control, reliance, connection to skirt, connection to other skirts, attachment of skirts between people, felt horrible catching connections, confinement, warmth, smothering, comfort, avoiding getting too close, compromise, curiosity
poetically	living in skirts: I send a squid or octopus attached to my waist and its tentacles hung down and flapped around against my calves. It was heavy but soft and unobtrusive.				living between the skirts: safety, like in a forest (i.e. skirts being like trees)
body state awareness	living in skirts: I was sensing through sight, touch and sound. Primarily through touch, all over my body as I moved between pp1 and was caught in the "web"- LEGS. MOVED AROUND - Around the knees - My left hip - I pretty much used whole body to sense it - I sensed mainly on my ankle & wrist (because I got tied up). I couldn't move/control my body so I let it go -my legs, my new mind within the skirt. I responded by being simple and not too loud - I felt it in my legs and more specifically mv calves	living in skirts: mind, head, and chest. I didn't move. I was captivated. ... Paralyzed - I sensed through my eyes	living in skirts: sensing through the feet, legs -whole body from fingers to toes - The body would be near the stomach down to the upper thigh -The whole body will move the attention to the skirt -The body part which touches [the skirt] will have higher temperature. Eyes watching it, nose smelling it, ears hearing it, etc.	living in skirts: The legs was sensing the most, being attached to the skirt -life seemed to be in the upper body, with the movement of arms & the upper torso. the hands moved the skirt - in the legs where there was some constraint.	living in skirts: hands -> lift up skirt to either get rid of the thing, coax it out, or acknowledge it; legs -> particularly to kick the thing out of the skirt - loss of control, reliance
	STRONGER PRESSURE WITH CERTAIN BODY PARTS.				

Table II.4 heart[h] Workshop 1 Data Analysis: Response Cards, 1 of 4

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)					
Response Cards	Participants	Videographers	Photographers	Drawers	Writers
Descriptive Qualities	<p>living in skirts: A wire dragging on the floor that was attached to the skirt. I sensed my legs ... because I felt something in my skirt & I want to get rid of it</p> <p>living between the skirts: on the stage, primarily in the middle - in front of me and to the sides - CENTRE - The centre of the room - No specific place - The entire space - the centre of the stage & especially when we had to get as far as we could (corner of the stage) - The space that was open - [it] pulled me downwards towards the floor.</p>	<p>living between the skirts: from the outside, the walls, the floor, and the middle -- From the outer edge, outside of the centre stage - To the side. I had an overview of all the participants -</p>	<p>living in skirts: The skirt became a part of the participant's body where the movement of the skirt depends on the pose & actions of the participant</p> <p>living between the skirts: near the black curtain, sitting on the ground to the side - everywhere, the rope - from different spots around the room, from different angles - Sense near the participants closer to the curtains of the stage - The downpart of the room, the skirts, the movements of participants</p>	<p>living between the skirts: In the middle of the room where most connections are gathered - Movement, action, fun - proximity was no apparent because eyes were closed - under the spotlight and from the floor</p>	<p>living between the skirts: middle of the room, particularly in between + just outside of the skirts - I was in the corner - along the outskirts</p>
literally/ details					
abstractions	<p>living in skirts: I sensed my mind embodied into the skirt. My mind was within the skirt, still a part of me but in a different area. I sensed solitude and activeness to do something - The living thing had a characteristic which made itself seem hidden but you could sense it there. I could sense it hiding and then "come out" a little bit. Discomfort and uneasy about it being there because I don't know what it wanted or what it was trying to do.</p>		<p>living in skirts: The movement, breath, live of the living thing. Is that touching, moving or talking about something? Do that have temperature? What do it want?</p>		

Table II.4 heart[h] Workshop 1 Data Analysis: Response Cards, continued, 2 of 4

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)					
Response Cards	Participants	Videographers	Photographers	Drawers	Writers
Descriptive Qualities	<p>living between the skirts: A small thing that was pulling me towards another destination - The living things were taking control and trying to pull us together - I sensed other people embodied minds. It remind me of neural networks both micro and macro - thinking of life and its connections with a whole embodied space + mind - The octopus wanted to gold on and not let go. I was afraid that its tentacle might rip off so I tried to comfort it by giving it slack - I sent messages of SOS to people by flicking the elastic -hidden sense & then reappear of the living thing. A pull between becoming comfortable w/ the living thing's actions & then the surprise of the living things "coming out" and moving -Vibes</p>	<p>living between the skirts: tension, elasticity, tied down yet somehow free, It felt like a chain of movements dominos, leaders/followers - my actors had influence on others</p>	<p>living between the skirts: the interconnectivity grew and shrank to its own will, guided by reactions from within</p>	<p>living between the skirts: Sending mixed messages according to the sense in the skirt - energy</p>	<p>living between the skirts: protection from exposure to the outside - a creature that was formed out of all the people combined - I would have felt a connection and force holding me against the other skirts. They'd be my friends, but I would lose my independence -</p>
	<p>abstractions, continued</p>	<p>living in skirts: movement controlled by the skirt rather than the wearer. The skirt seemed to move the wearer rather than vice versa</p>	<p>living in skirts: took bigger, slower steps to avoid others + whatever was living in the skirt - moving in circles -> dizziness - Respond of the arms by moving the skirt -The weight moves downward.</p>	<p>living in skirts: There are lots of movements and energy in the skirts that they transform in different shapes. There is constraint in them + to prevent from going to far away - made more effort in movement to exaggerate motion - sensed it in my hands and I want to get rid of by express it out through the pencil</p>	
<p>gestures / movement qualities</p>	<p>living in skirts: That there was counter movement. It always wanted to go in another direction. Balance was off - Some CHUNKY stuff. Things that were inside the skirt were small but has relevant amount of weight. I felt WEIGHT most of the time - Center off mass as I was moving. I tried to balance it off - I responded by jumping up and down to shake it loose - I tried to make a connection, and move the feeling to my chest and my head - I could feel the weight of the skirt standing up, sitting down, when I was jumping + walking - After letting it go I felt the flow & connection between me, other participants and the skirts as well. It was quiet for the most part so I tried to liven it up by kicking my legs out and shaking it.</p>				

Table II.4 heart[h] Workshop 1 Data Analysis: Response Cards, continued, 3 of 4

heart[h] Workshop Data Analysis - Oct 12th/2004 Workshop (1)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
gestures / movement qualities, continued	living between the skirts: I was sending my movements as a result of my thoughts - A movement not to go there - PULLING SIGNALS - pulling the ties & connections - movement, creating sounds, gestures and facial expressions - Standing my ground. To counter the force that was pulling me - forcefully, if resisted, I still moved in the direction I want - By moving slowly and peacefully to allow others to know I meant no harm		living between the skirts: it seemed like commotion; one action would trigger a whole chain of other actions	living between the skirts: body being pulled in many direction and just letting go - my movements to others but battling between control of motion	living between the skirts: skirts moving close together
awareness	living between the skirts: I received similar messages from unknown people	living in skirts: I...responded by keeping my attention focused on the action of the participants. living between the skirts: A connection but 2 ways. 1 between the skirts and two between the wearers. I feel that the skirts directly effected the wearers 1st before the wearers affected each other - from the expressions on other people's faces.	living between the skirts: noise		living in skirts: i was watching I sensed it in my brain living between the skirts: focus shift from the living thing between the skirts towards the elastic
breath			living in skirts: The movement, breath, live of the living thing.		

Table II.4 heart[h] Workshop 1 Data Analysis: Response Cards, continued, 4 of 4

D.1.4 Exit Interviews

D.1.4.1 Exit Interviews Students

Q: About, when you first, for the first part, when you were wearing the skirt and the, the activity was that there's something living in the skirts, ok. Can you guys talk about how, what did you sense – that was one of the first things that you were asked, what did you sense?

A1: So, the question was...

Q: <whisper: speak up>

A1: What did I sense?

Q: Yeah.

A1: I felt uncomfortable.

Q: Ok.

A1: About like something was invading my privacy and I wanted to get it out as soon as possible.

Q: Ok, ok. What made you feel that way?

A1: The fact of knowing there's another moving, living thing around my crotch.
<laughter>

Q: Ok, good, ok. Others?

A2: I felt the same way. I felt really uncomfortable because I just didn't know what, I didn't really know what to do... yeah, I just didn't like the feeling.

Q: Ok, how about you?

A3: Well, it felt uncomfortable at first, but then, as soon as your mind comes and thinks of what to do, or what, what you're sensing, it kind-of, the skirts embody your mind.

Q: Ok, ok great. Where were you feeling – you mentioned in your crotch area, is that the only area that you were feeling in?

A1: Yeah, I remember my thighs and my legs, yeah.

Q: Ok, anyone else?

A2: Mainly in my legs, just because there was, like, a wire under my skirt, so... yeah.

Q: Ok, ok.

A3: I think mostly at the bottom of my feet or the calves where, I guess, the, where the feet were exposed.

Q: Oh, interesting. Can you talk about that a little bit?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A3: Well, you, you, I really didn't feel any, afraid of what people saw, they saw the skirt but, they also see like your, the shoes, and what's different about the skirt.

Q: Oh, ok. And so you felt that part was exposed or...?

A3: Exposed and, kind-of bare, I guess.

Q: Interesting.

A1: I felt it around, because it's tight around the waist, right, so you knew that it wasn't there, but everywhere down below where the waist was, where it got loose, you weren't sure where the living thing was, so... it was a mystery what it was doing and what is it up to. <laughter>

Q: Right, ok, interesting. Ok, so it could've been long, or traveling, or something...

A1: It could've been, because you don't know, you have a sense of feel that it's not at the waist because it's tight there, there's no space to move around but, anywhere below that, it's all an open void for it to travel.

Q: Nice, ok, interesting. How did you respond, when you were asked, "how did you respond", how did you respond?

A2: Respond to...?

Q: To this living thing, in your skirt.

A1: Well, I jumped up and down. I tried to shake it loose and, you know, get it out of my system, or my, my skirt.

Q: Ok, ok. Anyone else?

A2: It was really hard for me to kind-of put my self in that position, where pretend that there was a living thing inside, so I felt I didn't really know what to do, so I just kind-of stood there and... I don't know, just... forget it.

Q: How did you respond?

A3: Kind-of the same thing – didn't, didn't really know how to express, I guess, the living thing, so it was more of thinking and seeing what, what could be under the skirt.

Q: Ok, ok.

A1: Well, I started to run around, too. <laughter>

Q: Ok, what made you run around?

A1: I wanted to get away from it... so I tried to run away from it, but it was attached to me so, it was like a lost cause. <laughter>

Q: Ok, great. Ok, so let's switch to when some, you're attaching the elastics and there's something living in the skirt, how did that, how did you, what did you sense, when there was something living in the skirt? Anyone?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A1: I felt that it was, like, taking control, and was trying to take over our bodies and our movements and pull us all together, which it did, eventually... when everybody got tangled up.

Q: Ok, so, was it the same thing that was in the skirts was now jumping out of the skirts, or how, how were you...?

A1: Now they were working together, because there was one in all the skirts, right? And somehow they're pulling us all together.

Q: Ok, how did you feel?

A2: I felt better, just because I, I knew that they're kind-of, there was people surrounding me, so I liked it and it wasn't as awkward as it was if it was just by myself, and yeah, I sensed that, I just liked being surrounded more with people and that everybody was doing the same thing as I was, pulling the thing and, yeah...

Q: Ok, speak about, perhaps, this pulling on the thing.

A2: Ok...

Q: What was that, what was that about? Why were people pulling?

A1: Well, we were trying to send messages... Morse code, SOS... <laughter>

Q: Morse code, SOS... what were you, so you were trying to get, help each other free yourselves, or what, how, what do you mean by SOS?

A1: Like, what I was doing, was I was flicking the, the wire to try to communicate with other people... and then other people starting doing the same thing. But, the messages weren't really communicated because we don't have this common language, of flicking strings. So, it was kind-of like a distress call. I didn't know what to make of it.

Q: Did you find that your language, language was being created, or did anything evolve?

A1: It was a bit of a struggle when I first did it, it was a bit of a struggle but, then, people started to, to do the same thing and we were almost, like, communicating together on the same level, but we just didn't know what we were communicating.

Q: Ok, what was your, what did you sense when there was something living between the skirts?

A3: Well, as, as soon as we got networked with the, with the strings, I felt that, like we, we kind-of shared this living thing, that's why most of the people were pretty close at the beginning. But, then, I started out doing my own thing and tried to bring other people to, like, other space, other parts of the space... So, it was more, like, I guess a leadership role – like, forcing them to come one way.

Q: And what made you take that role?

A3: I guess, because I was connected through my, my leg, and my waist and one is going, there's another person on one side and another person on the other. So, it's kind-of being indecisive, so I guess I finally made a decision to go one way.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

Q: Ok, ok. So, where in the room were you sensing this thing, that was living? Anyone?

A1: The centre.

Q: The centre?

A1: It just felt like everybody was gravitating towards the centre of the stage.

A2: I think it was kind-of pulling from different directions. I don't know, that's all...

Q: Ok, how about you?

A3: Yeah, I think this pulling in different directions, because I guess it just likes to, to change form, I guess.

Q: Ok, talk about that a little bit...

A3: Well, I don't know how <laughter>, but I guess, I guess because it everybody was thinking that there's this thing living under their skirt, well, I say under because a lot of people are kind-of close together like not really want to show until after when we were all networked, started, people starting going pretty wild, so once there's this kind-of common bond, I guess, kind-of, a network of movement.

Q: Right, ok, ok. When you were communicating with each other, you talked a little bit about this communication, Morse code or SOS, what other kinds of things were you sending, or what, what were you sending?

A1: Do you want me to be honest?

Q: Yeah, absolutely.

A1: I think people were sending messages just for the sake of sending them, and like, we were telling each other that this is weird. That this is a weird feeling, but we're, just, that's what we were communicating.

Q: Ok, that, that was the message...?

A1: That was an awkward situation.

Q: So, that was the message you were sending?

A1: That I received...

Q: Ok <laughter>. Ok, how about someone else? What were you sending?

A3: Well, when, when I was moving, I was kind-of sending a message that, I guess, movement, into the unexplored areas of the stage, yes, so...

Q: Ok. And you were sort-of pulling people with you?

A3: Yeah, yes, I was sort-of, and once I did that, I saw, like, most of the other people kind-of moved too, but not because they want, were following me but just because of the way they were tied up.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

Q: Ok, ok. Ok, so, so these messages were being sent – how did you folks respond? How do you feel you respond, responded?

A2: Well, when I was getting pulled, I, kind-of my first instinct was to pull back as well, so that was kind-of my reaction towards, you know, people kind-of pulling me in different directions. I felt like I had to do the same thing as though I ended up just pulling everybody or whoever was attached to me. Whatever direction I can pull them...

Q: Ok, anyone else? How were you responding?

A1: Well, when there was a web of strings in the middle and nobody was in the centre, I had the urge to run in and rip it all apart, but somebody else was doing that. I think Jessica was... or she was going in and she was, like, tugging at the centre of the web and yeah, that's what I wanted to do.

Q: So, what stopped you?

A1: She did it first. <laughter>

Q: And, and you didn't, you didn't want to do it as well?

A1: No. I wanted to be unique. <laughter>

Q: Ok, what about you? What did you feel like, or how did you respond?

A3: I, well, I guess I was kind-of, following what other people were doing, trying to come up with something different, with, with regards to their movements or, like what Andy was doing the messages. But, it was kind-of difficult or, it was kind-of easy to do something different because of the way the strings were attached to different parts of the body. So, yeah, everything was kind-of unique in that, in that way.

Q: Ok, so is there anything else you guys want to sort-of talk about, in terms of your experience?

A1: I felt a big relief at the end, when we got to lie down and just kind-of, like, go to sleep and let all that energy out, because we were standing the whole time and running around. So, that was, that was good contrast between all the activity that was happening before.

Q: Ok, anyone else? Want to add to the, this experience?

A2: It was definitely an interesting one, because I've never really experienced something like it, before. Coming into the, I don't know what to call the activity, I kind-of had a different perception of it, so I thought I could, kind-of, be more comfortable and actually just kind-of run around with the skirts but really, when it came down to it, I couldn't do it – it was just, I kind-of found it awkward but...

Q: Ok, how, what, what, why do you think you felt awkward?

A2: I don't, I guess because people watching me, knowing that people were around me, watching me and it's just, I couldn't really be just, you know, comfortable, I took a while to...

Q: To relax...

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A2: To relax and... but I enjoyed the, sort-of, lying down and just kind-of closing our eyes. That would probably be the most, <laughter> I think the best for me, anyway.

A1: The nap time. <laughter>

A2: Yeah. <laughter>

Q: And how do you feel?

A3: I felt sad, because he died at the end. <laughter>

Q: Who's this he?

A3: Or not he...

Q: It...

A3: It, the object...

Q: Ok, so you, you sort-of personified, <laughter> it was a thing, it was a he...?

A3: Yeah, I'd say so, because we're , I guess we're all trying to, to characterize this, this living thing within the skirt. So that's, I think that's why that we're doing, that we're trying. I think

D.1.4.2 Exit Interviews Dancers

Q: So, I'm going to try to do the camera at the same time as I ask the questions. So, back to the idea of something living in the skirt, when you were wearing it, what did you sense?

A1: Well the first thing I sensed was some kind of friendship or bond, like an ally. Me and this thing, whatever, against the rest of the world. But, yeah.

Q: That's nice. And, then, Shannon?

A2: It feels like it's fine for me. When I'm inside the skirt, mine especially, it's very long. It just feels like it's almost like one, almost like a whole new space; that it's living. And it doesn't even feel like my legs anymore – it just feels like a, like it's cage or something and...

Q: Did it take some time for it to feel like that or did it feel like that straight away?

A2: In the first few minutes.

Q: Great. Jack?

A3: So for a period I went through I felt weight, just weight, and then I began, because the skirt was a little big, it was a weight, it kept on going downwards...

Q: So, say a bit more about how you felt when it was falling off – it, was it like it was doing it all by itself?

A3: I suppose, yeah. It was like, something, something in, inside the skirt, was added the weight to it, was pulling it down.

Q: OK, and Hendrik?

A4: I felt like it was counterbalanced and tried to move in some other direction than I was.

Q: So, could you actually infuse some sort of intent to the skirt?

A4: No. it was just some other direction than I was going.

Q: Ok, so, I'm going to go round again. So, we'll start with Henrik. Henrik or Hendrik?

A4: Hendrik.

Q: Hendrik, when you were sensing this, this experience, did you feel anything in your body or through any particular senses, while we were calling our attention to this? Can you hold on one second, I'm going to close this door, because it's suddenly a little noisy... any way, it was somebody using the Coke machine on our audio track.

A4: It was more like, it was lowering the centre of mass so you had, like to really counter it.

Q: Oops, Ok. And so, it was lowering the mass. And what did you feel in your body, did you feel any response within any location of your body to that?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A4: More like the entire body, so you almost start swaying.

Q: Right. That's fascinating, your description is very much like, almost like forces of physics.

A4: Yeah.

Q: Lot of counterbalance, lot of full-body sense. Ok, so Jack to recapitulate, this basic question is: where in your body were you sensing, this sense of living in the skirt, and which of your senses seemed to be active?

A3: I feel that I was using my entire lung, it's like when I'm talking or <unknown [too quiet]>, I could feel maybe something, something <unknown[too quiet]> pulling down, a little disturbing.

Q: Disturbing, great. We like that. Can you say how it was disturbing?

A3: Just <unknown [too quiet]>alien<unknown>, tried shaking it, just wouldn't go off, wouldn't go away.

Q: Bit science fiction. Ok, Shannon, where in your body were you sensing whatever you were sensing?

A2: It was at different times it almost felt different, like even opposite things I had, like, with them actually one hundred eighty <unknown[too quiet]>. I think there was a point where, like when I described something in the beginning, the whole part seemed like one whole space, it was this just really warm feeling, I didn't like it. It was this <unknown> uncomfortable. I didn't like it but, then, there was a few times when I was standing still, it felt, that feeling moved out. And then, same thing, I was, my body was swaying, like back, back and forth, like rocking back and forth when I was standing up and it, it almost, like, at times too, there was a weight, because it feels like everything is concentrated from the waist down and <unknown>. And it would most common be weighted down, like all, all activity, everything I could sense is down, but then at times it feels like it would be pulled up, pulling up too, away from there. And, and the way I described it in my words was like, how something is there and it's like, hiding and I don't know what it's doing and you wait and wait there and then start do something and then something would happen, like there, it made my skirt <unknown> because it growing down and I would end up falling over. <unknown> it would stop<unknown>I would have to wait, it's uncomfortable because I don't know what's going to happen, next.

Q: Almost like it has a life of its own. I like that distinction you made between the upper body and the lower body; it's almost as if there was this sawing of the body in half that was created, by this. Somebody else has said this at one point, I think.

A2: Yeah, it really feels like that, it just feels like there's something concentrated in that area. It just, maybe it's, physically it's that your body <unknown> something <unknown>.

Q: Great. Ok, Gabriel?

A1: Yes, what was the question again?

Q: What was the question? Oh, I think we can locate the question, hold on, I'm, I'm actually sort of multitasking here. <laughter>So, as you were having this sense of

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

something living in the skirt, where in your body did you sense something, like which of your senses might have been active?

A1: Well, I can, it felt like I could feel something. It wasn't connected with vision, or hearing or smelling but, for some reason, I could, it just was on my left hip and I was, because I had this notion of personality that was there somehow to connect with, so I was a bit surprised to <unknown> thing in the pocket of the, of my skirt would be the natural place for something to live, right.

Q: Like a kangaroo.

A1: But that's not what happened. So, I guess in a way I tried to... like make a connection with whatever, whatever was there, to make as, when you have friendship is, you don't feel something physical like, you feel something in your head or... yeah, so just try to like, move it into kind of, that kind of, friendship, friendship not physical.

Q: You mentioned something about safety and protection, too, the first time you were around too...

A1: Yeah, I wasn't thinking so much about protection, but some sort of friendship, I guess, yeah.

Q: Yeah. Great. So, just quickly, when you had this sense of you being off-balance, both of you; you feeling the heat, Shannon, you feeling safety and protection, how did that make you want to respond? How did you respond to that?

A1: Well, I don't really know. I guess that, just trying to make it mutual, the relationship.

Q: So, did it make you want to run around or did it make you want to stop moving?

A1: Well, no, stop moving I think, or maybe just move, move away slowly.

Q: And, Shannon, how did you respond to this?

A2: Most of the time I'm wanted to stop move, to stop any movement at all, because I, like I said before, I really didn't know what was going on and I wanted to know what it was doing and sometimes, any <unknown> movement <unknown> and then it would stop and then so, I'm kind of calling for <unknown> and I'm like the idea of lowering <unknown> because I want to stays there and try to be as <unknown> as it is and, yeah.

Q: Ok, Jack?

A3: <unknown[too quiet]>There was this little track on the bottom of the skirt<unknown[too quiet]>.

Q: It sounded like you had a pretty fierce skirt. Which, which one were you wearing?

A3: I don't know.

Q: Were you wearing the thick yellow one?

A3: I don't know.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

Q: Ok, you were wearing the very thick yellow one. Yeah, good. There was actually one skirt that was made of steel. I don't think you were in that one, that was grey.

A3: <unknown[too quiet]>uncomfortable<unknown[too quiet]>

Q: <laughter>That's nice. Ok, Hendrik.

A4: I tried to, like, move as slow as possible so, you could actually walk.

Q: Yeah. Ok, so we're going to shift to the second. Something is living between the skirts, so similar, what did you sense?

A4: That something, like, pulled me to a direction, and just wanted to stand still. Do the opposite of what it was doing.

Q: Yeah. Ok, Jack, what did you sense, when we were doing the second bit, where something was living between the skirts, with the elastic bands, what did you sense?

A3: There was a connection between <unknown[too quiet]>a relationship between<unknown[too quiet]>sending out, sendingvibes, movements, like I could pretty much feel people were <unknown[too quiet]>

Q: Good vibes, threatening vibes?

A3: Ok vibes.

Q: Ok vibes. <laughter>Well, that's a relief. Ok, what did you sense, Shannon?

A2: With my eyes closed, it was almost like, it was something transferred back and forth between... it maybe you're not even connected directly to the person but, anyway, you can feel, like, pulling and pushing. Sometimes, you give, sometimes they give, and then you're moving – I'm, I'm rolling with what I was <unknown> and other times, make that action happen and...

Q: Yeah, great. Ok.

A1: Yeah, I felt, I felt some sort of alienation or a will to, to get away from everybody else. But there's, there's still something of course pulling you, pulling you back. And, and then I got caught up in the middle of the huge mess and was a little uncomfortable about... was just maybe not where, where I wanted to be. But that's, that's how it is. You have to accept <unknown>back and forth.

Q: Yeah. Did anyone have a sense of somewhere particularly in the room pulling them or some, some sense of a connection with the outer reaches of the room, up, down, across, any particular direction? No?

A2: When I opened <unknown[too quiet]>archives<unknown>I didn't know where exactly it was, but it was a place that I was always try to pull away to and even turn around and face a certain direction. Sometimes it would pull me out but then I'd always want to turn and face back to the direction. And now when I had a chance to open my eyes I saw that it was right against where the skirts were hanging.

Q: Right. Yeah. So, if you had a sense of sending something, did you, did you feel like you might be sending something, through the... if you think of being connected, were you sending or were you receiving? Gabriel, do you have a sense of, of your sending or receiving anything?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A1: Well, yeah, try to, tried, tried to send that was <unknown> but some kind of, ok, an encouraging message and something positive, but not more specific than that.

Q: And what did you receive?

A1: I'm not really sure. I mean it was a lot, but kind of confusing, I couldn't feel anything very specific.

Q: You did describe definitely feeling cold, so it's almost like what you were receiving was... was it mixed signals?

A1: Definitely, yeah.

Q: Ok, Shannon...

A1: <unknown>sudden, hard movements and then really slow, and just you could feel that there's not one sender but it was several different personalities, or whatever, sending all the time. It was kind of hard to differentiate between single, single sender and...

Q: That's an interesting point, that's sort of like receiving too much information from too many people all at once. Hendrik, I see you nodding...

A4: <unknown>everything, everything at once. So, I tried to slow it down. To stop.

Q: Switch it off, if there is an off switch, would you've used it?

A4: Yes.

Q: <laughter>My favourite state for my mobile phone these days is "off". So, did you have a different sense of what you might be sending, what you might be receiving?

A4: The receiving part I couldn't actually figure out because there was so many and everybody was like <unknown> or about going in different directions, so you try to stand as still as possible. Try to slow everything down.

Q: To make sense of it, do you think?

A4: No, just to... in a way, yes, because you wanted to know which way they were going. Then you just wanted to stop them going in all kinds of directions.

Q: Yeah. Jack, sending and receiving?

A3: Sometimes receiving, that is <unknown[too quiet]>

Q: Oh, you were, were you...

A3: <unknown>being pulled back<unknown>I wasn't pulling other people...

Q: That was great of you.<laughter>

A3: Yes, also I <unknown>

Q: Did you put the elastic around your neck or did somebody else tie it there?

A3: <unknown>

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

Q: You did, yeah. Oh, Shannon, I kind of swooped by you very quickly...

A2: I felt overwhelmed and I think that like, like Gabriel was saying, he had a friendship with whatever <unknown> and I feel that a lot of people might have had more positive reaction to whatever <unknown> but I didn't, so I filled out, in my sending, it was very <unknown>, I want to be away and I don't like this and I, I don't want <unknown><laughter>at all. But then, on the other hand, I feel most of the connections they are sending are opposite – like, they, they like what's going on between, they're comfortable with it and they're trying to <unknown>but I didn't want to. And I didn't see that.

Q: That's interesting. So, it's almost like you, you would've really wanted an off switch, then?

A2: Yes. Ok, any thoughts?

A1: Well, I was thinking about, I can't remember exactly when this was, but I was feeling all sort of pride and, me and this thing, yeah, I can't remember when it was, just feeling, kind of pride, proud of, for that was.

Q: It seems like you had quite a connection with your own skirt.

A1: <unknown>It felt like it was really personal...

Q: Do you have that sort of connection with your devices anywhere, like with your computer or your mobile phone?

A1: Well, yeah, I guess – not like that, of course. But, and when, if I think about it, I kind of agree with that.

Q: I'm only asking because I know I do. I really anthropomorphize things like mad... Ok, so that...

Q: So, just let me ask you some questions about your experience and you can answer honestly, anything that comes to your mind, it's all fine. So, in the first section of something, you were wearing a skirt and there was something living in the skirt, maybe you can just talk a little bit about your experience of that and what you sensed and what it felt like.

A1: To me, the skirt, it was pretty heavy around my waist, it was pretty heavy so, and then, it was quiet too, but there, I felt weight around my ankles because of the way it just collected down there, so I felt this kind of like, something with tentacles hanging off, off my body and basically just flapping around just loosely around the legs, like it wasn't restrictive at all, it was really fluid, just heavy.

Q: Cool, cool. Any, anybody else about just the...

A2: I had a hard time grasping the concept of something living in it, like I kept thinking it was me, because I wear skirts quite often, so, you know, it was bigger, it was fun, so I liked to play with it and dance around with it because it felt kind of like, I don't know, you know, back in the woods, we used to wear these big skirts. But, I don't know, I couldn't get beyond that, though, that I was the only person that the skirt, that I was wearing the skirt, controlling it, so...

Q: So that, would, that might be ok, if it what was living in the skirt was you that was living in the skirt. It's just as much a living thing as a tentacle is. So, so, it's, that's, it's

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

as good an answer, I'm just, so if that's the experience it... and there's no experience that's wrong, it's really just to kind of... just see where the play might be and also where we might bring it with sensors and stuff, so...

A3: I found that I want to get rid of the something my skirt, because, I don't know, it's just weird having something under the skirt so, that's just why want to get rid of that. I found it, like, it's not really moving, but the patch, because it's my imagination, I thought it was, like, I don't know, I just wanted to get rid of something, it's just kind of weird having something that's, like, really close to you but you can't really see it, it's like, yeah...

Q: You felt you wanted to get rid of it.

A3: Yeah.

Q: Remove it from the skirt, ok. <laughter> So, like, if you were talking about your senses – and a lot of it was imagination and movement, what was, what were the senses that were activated? Does that something that you remember in terms of senses?

A2: Touch.

A3: Touch.

A1: It was all touch. There was no time to make any noise, so quiet, so...

A2: I found some sound, mine made a bunch of noise when it rubbed back and forth. I think it was the sounds of other people when we had our eyes closed to figure where I was.

A3: Pretty much.

A2: Listening to your script as well...

A1: And mine was also pretty heavy and thick so it was kind of warm, too.

Q: Right, nice. I'm just... did any of you imagine, visually imagine seeing something in your imagination or was it more or less primarily touch and warmth, for example?

A3: I had some kind of imagination. I imagined some kind of being with beans and mushrooms under my skirt. It was colourful, it was bright, something like that. Pretty fun.

Q: What about you, did you... like, did you, your imagination give you anything either in terms of colour or warmth or...

A2: No, I took the colour from the skirt and the, the thickness of it to make the warmth and... it was a skirt I was wearing, it was really hard to get past that, to use my imagination beyond.

A3: Perhaps I was wearing the skirt with the lot of dots on it, so it looks like mushroom, you know, those ones in Mario. <laughter>

Q: Ok, so, you're saying like the look of the skirt sort of fed your imagination of what it might be. Ok. How about you?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A1: To me the look didn't really at all. Like, I was picturing some, like in my imagination took over like this octopus really end, like blue, purple, octopus. Mind you, I think the skirt was brown. So, it's just like, just like the colours kind of indicate like the feeling I was getting, like this heavy and like slow, blue and purple are kind of like, not very jumpy colours.

Q: Where, where in your body were you sensing the relationship to the skirt? Did you notice... maybe I'll just leave the question that, where in your body were you sensing what was living in the skirt, if that makes sense?

A1: When we were tied together, or?

Q: No, but at the first part.

A1: I felt the tentacles down at my calves, most of the time and, and around my waist as well, so it was like kind of two different points and one was just, one was constant, that was around my waist, that was just the constant weight, just kind of dragging me down, and then around my feet there was just, kind of, it was right around my ankles. I guess because I'm not used to wearing a skirt. <laughter>

A2: I felt like, overall, legs, waist.

A3: Overall, legs, especially my ankle bones, yes.

Q: Thanks. And then how, how did you respond to this idea or thing your imagination or the feeling? How do you remember responding? Just in terms of your behaviour, or your feeling, or what you moved, or...?

A2: I wanted to pick it up and do something with it! I found that, because I wear skirts, I found it very boring just to walk around because I do that normally. So, I like, skipped around and I tried to, like, move, sorry, like, I hit people with my skirt and do something different.

Q: So, you say like you were trying to use the skirt as almost an object?

A2: Yes. I felt that I was completely in control of the way you would, like a foam bat, going around...

A3: I felt more like, it's kind of fun to actually imagine something living under, in your skirt so, I treated it more like, kind of friendship, like I could actually play with it so, yeah, like a hop around and jump and, and I don't know, do a little swinging this. It's kind of fun. It's almost like your communicating with it.

A1: For me, I guess, it was more like, I don't know, this, oh, this thing, I couldn't escape it so, it's just, no matter what, it was annoying and it was hot, but I couldn't escape it, so there's no point in fighting it, so I just let it be. And I just treated it nice...

Q: Did you notice that, by letting it be, it changed its characteristics from annoying to something else? Was there...?

A1: Yeah, it was, it was kind of trying to be, like, I guess giving a mutual feeling back.

Q: Cool. Ok, that's cool. So then, let's go to the... is there anything else anybody wants to say, just about the first part, about the, about closing the eyes or not closing the eyes, anything about the movement or the sounds, anything that happened.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A2: It was a huge difference for me, I was less likely to bounce around and be active with the skirt when my eyes were closed, because I didn't want to hit anybody and start banging into people. I mean, you can hear their feet shuffling, but it's not, you know, being able to see. So I found that my, my movement was very much restricted.

Q: Anybody else? Did you notice that having your eyes closed helped your imagination at all, or did it really, was, it pretty well was the same either way?

A2: I found it hindered my imagination, because being able to see, then I can think why, infinite possibilities with what I can do, because I don't have any obstruction. With my eyes closed, I know I have other people and I don't want to hurt them, so I have obstruction.

A3: I agree.

Q: Interesting...

A1: That's pretty much, that's pretty much it. When I have my eyes closed, it's more or less, I mean I move slow, like slower and just make sure that I don't break anything and then, and then when I have my eyes open I was just, I was more free to move around but still treat the same, at least I still felt the same way.

Q: Ok, so let's move to the second part, about something living between the skirts. When you were attached to someone else in the room and there was something living between the skirts, what did you imagine, what did you imagine that thing, the thing between the skirts, what were it's characteristics, let's just leave it like that?

A1: For me, it was obviously, it was like a tentacle, reaching out and just held on and stuck. And just pulling. But that was one of them, that was around my waist, that was the tentacle. And the other one was – I didn't really figure out what that was, it was like that was somebody else's reaching for me, but it wasn't like, it was my own.

A2: Mine were handcuffs. I gave myself a long string so that I could have that freedom and do, you know, drag people around but I ended up getting really twisted and literally, my hands were like this <shows wrists joined together> and I was in the middle of everybody and I couldn't move and whenever I moved everyone would come with me, because I was stuck in the middle. It was kind of irritating because it didn't have that freedom I did at the very beginning. So, they were like handcuffs.

A3: I had a tie like on my ankle and it was kind of fun because I have to jump with my other leg and yeah, and I feel the connection and the tension.

Q: Did, did you notice the thing living between the skirts outside of your own connection, both to each other, because you had, were tied, but there were other people tied in different ways? Did, did you have a sense of, of that thing living in the skirts as outside of yourself?

A3: I felt it was almost like controlling me because, I guess, this whole thing should be playful, out of, into my skirt, so when I hop around and then when I kind of do the swing things, it's almost like, not like my legs are numb, but they do not belong to me any more, it's like the something is actually controlling my legs and doing those weird, well, not really weird movements.

A2: Yeah, I may have, you know, physically only been connected to two other people but, because my, hands were so tied by everybody, you know, it was, I was beyond just this direct connection.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A1: Yeah, with being attached to my belt, I didn't want my pants to fall off or anything, it was attached to somebody's foot and he's pulling down, so I didn't want my pants to fall down, so that was what I... I guess, in a way, representative of, like, me giving octopus slacks it's tentacle wouldn't... I don't know, just being nice. And, the one on my arm, that was more like just a tug-of-war, that's what it felt like, and I was getting wrapped around with other people through the arm, more and more.

Q: What, what feelings did you notice while you were in the, while you were in the whole connected group? What feelings, I mean...?

A2: Captivity. <laughter>I really couldn't move at all! I was kind-of, you know, I wanted to scream for help and for someone to untangle me.

A3: Fine. It's, it's, I don't know, I can't really explain, but it's, it's kind of fun having that kind of connection. You're being tied, but then, I don't know, but unlike Sarah, I still had my own freedom of moving around so, and actually I can control other people, not really control, because, I get tied to another guy so, I can move around and then he, he will move according to my moves. Kind of fun, yeah.

A1: Me, I was, like, I don't know, I didn't, I didn't mind, like, the whole being tied together. I think the skirt kind of felt, that she wanted to mingle with everybody, so that was kind-of, like, connected to everybody but not necessarily wanted to escape. It was just like, I just wanted to stay and just stay close, I guess.

A2: See, in the beginning for me, it was a lot of fun because it was that, it was the same way, I wanted to mingle with everyone and go in and out through the strings and that, ultimately, it was my, my own captivity. <laughter>

Q: What changes did you notice when different senses came up, like, sound or the temperature or, what it felt like, or what it tasted like – do any of those things spark imagination for you, in the group one?

A2: I found that they distracted me away from the feeling of captivity. So, when you did the sound, I could stomp my feet and so I was focusing on the skirt swishing around my ankles and stomping my feet, rather than having my, my wrists tied.

A1: My shoe, when I, oh, when I made the sounds myself, it was like the shoes squeaking and that being, it was like, I don't know, I guess the skirt kind-of like, screaming for help, it was kind-of, like, frantic, that's what I got.

A3: I didn't really feel anything.

Q: That's ok. Did you, did you notice yourself in the group like, what were you sending, what did you notice you were sending, if anything? If there's something, if you're connected, did you have a sense of something you were sending to anyone else or to everyone else or...?

A1: Connection.

Q: That's nice.

A3: Affection.

Q: Affection.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A2: Just, just like the tug-of-war theme we mentioned just, you know, the tension, I pull, you pull, that kind-of back-and-forth.

A3: I like make, I'd like to make this more interactive, so I kind of just, grab someone and do a little dance, yeah.

Q: Would you characterize that as joyful, as playful...?

A3: Yeah, playful.

Q: Yeah, that's nice. And, what about receiving, did you notice in terms of the connection that if I was going to say what were you receiving what would you... say you noticed about receiving something?

A2: Well, when someone pulled, I went with them, so I was receiving their choice of movement, against my own will at points.

A1: At times I felt, yeah, I was like a bit overpowering and then I was forced to move with them, and then at other times I felt that I had, like, from them, they're, I'd be receiving like, maybe, they're trying to do the same because I, I might have been pulling too much for them, so it's kind-of like back-and-forth.

Q: Did you notice some equilibrium coming out of that interaction?

A1: Yeah, at some points, especially when, even when, like, our eyes were closed, that's when I thought it would get really hectic, and everybody would get tied up too bad, but it wasn't that bad, because everybody was just kind-of, like, compensating, for it, for all the tension and just kind-of, trying to, trying to relieve that tension.

A2: I felt that, especially when you told us that we were sleeping, then we were dying, that's when I felt a kind-of a harmony amongst the group.

A3: Yeah, really true. Everyone just fell down, like why?

Q: Oh, that's interesting. Because that was the next question that I was going to ask – what, how, how did you respond or how did you feel, when what was living between you, began to sort-of fall asleep and then, began to die? I mean, a lot of things can happen when something dies you've been connected with, so... it's interesting that you said harmony, that's quite a beautiful, poignant kind-of thing to say about that...

A1: When the connection died, it felt like, there's no life, basically, and that was kind-of, past the point of sleeping, because you get sleepy stages and you get like, slowly, tired and then when you're dying, it's like... just because you died, it just kind-of, I don't know, everybody's just in the same position, there's no, there's no more tension anymore. Just think, still, stillness.

A2: I felt a sense of relief and the fact that my wrists were completely tied didn't really matter anymore, because there was no tension pulling on them, I could just lay them, you know, on my stomach and...

A3: <unknown>easy die, like.

A2: Yeah.

Q: So, so would, were those some feelings that were there? I mean, you said relief, is there any other kind-of, feeling state you might've associated with it?

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

A3: I actually had no feelings after, yeah.

A2: Calmness, stillness.

A1: Calmness. It wasn't, it wasn't sadness. It was just calm, peaceful.

Q: Ok, is there anything else that you want to say about that last part – those are the end of my questions – anything else you want to say about any of it, or...? I've asked you a lot of questions.

A3: That's it.

A2: I think the way that it was structured was a very good phase transition; it introduced us to it and then introduced the kind-of interconnectedness web. So, I felt it was very effective. We learned about doing an experiment I guess you'd call it.

Q: Did you, did you feel – this is just sort-of I'm thinking about now, well, ok, on this – but did you feel like the setup, in terms of just making sure people understood the process and the kind-of structure was enabled, enabled it to kind-of happen more smoothly? You know, the briefing and then the experiment...

A2: Yes.

Q: Ok, cool. Great, and what, just so you know what we're going to be doing with this, is we're using this data, we're actually using it over a period of a year to re-develop and use it to develop network technology and our software and how these things communicate with each other and so, thank you very much, it was really fun working with you. <laughter> Thanks.

D.1.5 Workshop Response Cards Transcription

heart[h] workshop 01 – October 12/04

Part A – something living in the skirt

When you were wearing the skirt and there was something living in the skirt, what did you sense?

- ° That there was counter-movement. It always wanted to go in another direction. Balance was off. It never wanted what I wanted
- ° The movement, breath, live of the living thing. Is that touching, moving or talking about something? Do that have temperature? What do it want?
- ° The skirt became a part of the participant's body where the movement of the skirt depends on the pose and actions of the participant
- ° an unfamiliar feeling of movement.
- ° More life, but movement was subdued more personal. More about individual than the group.
- ° something ruffling below me that dragged behind
- ° There are lots of movements and energy in the skirts that they transform in different shapes. There is constraint in them to prevent them going too far away
- ° a sense of discomfort; invaded; unwelcomed
- ° A wire dragging on the floor that was attached to the skirt.
- ° Friendship, an ally. Me and it against the world. Almost like a lifemate, sometimes you want different things, but you always have a connection and have to compromise.
- ° I sensed a squid or octopus attached to my waist and its tentacles hung down and flapped around against my calves. It was heavy but soft and unobtrusive.
- ° I sensed discomfort. The living thing had a characteristic which made itself seem hidden but you could sense it there. I could sense it hiding and then "come out" a little bit. Discomfort and uneasy about it being there because I don't know what it wanted or what it was trying to do.
- ° I sensed my mind embodied into the skirt. My mind was within the skirt, still a part of me but in a different area. I sensed solitude and activeness to do something
- ° I sensed myself, wearing and controlling the movement of the skirt
- ° liveness; I felt like to get rid of it at first, but then it got really friendly so I had lots of fun with it.
- ° Some CHUNKY stuff. Things that were inside the skirt were small but have relevant amount of weight. I felt WEIGHT most of the time.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- ° that something was crawling around, lurking in the skirt; sense a sort of fear of the unknown
- ° wind; water, ripples; flying, flotation; free; complexity
- ° A sense of movement controlled by the skirt rather than the wearer. The skirt seemed to move the wearer rather than vice versa
- ° anxiety, excitement; sensed anticipation – waiting for something to happen
- ° From my video vantage point I could see emotions, ranging from uneasiness to silliness, coming out through the participants.
- ° uneasiness, like my body was not only mine... I was no longer in total control of my actions, I became part of it
- ° a bit of tension, unease ... to get rid of the thing living in the skirt; a sense of welcome, trying to coax the thing in the skirt to come out; a sense of indifference – like, "hey, you're in my skirt, that's cool" – and a sense of co-existence
- ° foreign; awkward; uncertainty; gradual adaptation
- ° I noticed a sense of uncomfortableness like their space was invaded. Eventually a sense of play emerged.
- ° I would have been surprised at the feelings that reacted to my bottom half. Also as I reacted to others, I would have felt a sense of companionship.

Where in your body were you sensing? How did you respond?

- ° Center of mass as I was moving. I tried to balance it off.
- ° The body would be near the stomach down to upper thigh. Respond of the arms by moving the skirt.
- ° The whole body will move the attention to the skirt. The weight moves downward. The body part which touches it will have higher temperature. Eyes watching it, nose smelling it, ears hearing it, etc. Responds with different actions to interact with it, and see what kind of actions it replies.
- ° I sensed it in my hand and I want to get rid of by express it out through the pencil.
- ° in the legs where there was some constraint; made more effort in movement to exaggerate motion
- ° life seemed to be in the upper body, with the movement of arms and the upper torso. the hands moved the skirt
- ° The legs was sensing the most, being attached to the skirt. I responded accordingly to what I sensed in the skirt and the surrounding space as though exploring.
- ° around the knees, I responded by jumping up and down to shake it loose
- ° I felt it in my legs and more specifically my calves. It was quiet for the most part so I tried to liven it up by kicking my legs out and shaking it.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- ° I pretty much used my whole body to sense it. I could feel the weight of the skirt standing up, sitting down, when I was jumping and walking.
- ° I sensed mainly on my ankle and wrist (because I got tied up). I couldn't move / control my body so I let it go. After letting it go I felt the flow and connection between me, other participants and the skirts as well. I sensed my legs ... because I felt something in my skirt and I want to get rid of it.
- ° I was sensing through sight, touch and sound. Primarily through touch, all over my body as I moved between people and was caught in the "web" I respond by movement
- ° Legs. Moved around.
- ° My left hip. I tried to make a connection, and move the feeling to my chest and my head
- ° My legs, my new mind within the skirt. I responded by being simple and not too loud. When I did do something it had to be something different and unique.
- ° sensing through the feet, legs; took bigger, slower steps to avoid others and whatever was living in the skirt
- ° whole body from fingers to toes; movement; moving in circles – dizziness
- ° all over, depending on the movements and emotions of the thing and the others around me
- ° I could sense movement and a connection between the skirt(s) and the wearers. Since I was only an observer I could only sense this through my eyes and thoughts
- ° I sensed through my eyes and responded by keeping my attention focused on the action of the participants.
- ° mind, head and chest; I didn't move. I was captivated... paralyzed
- ° hands – lift up skirt to either get rid of the thing, coax it out, or acknowledge it; legs – particularly to kick the thing out of the skirt
- ° My legs would drive me crazy. My other parts would attempt to get the sensations out.
- ° Since I was watching I sensed it in my brain
- ° waist down; trying to push it away then learning to live with it

Part B – something living between the skirts

When you were attached to someone else in the room and there was something living between the skirts, what did you sense?

- ° A sense of connection and a feeling of a slight distance from the connection.
- ° Alienation, wanting to distance me / us
- ° attached; scared
- ° body being pulled in many directions and just letting go
- ° Curiosity and information.
- ° I sensed the tension on the string, the pulling between two or more people, wanting to go in different directions
- ° Life extended into the room, less a personal experience, now a group
- ° more anticipation. It was amplified. Felt safer and more dangerous all at once.
- ° stronger pressure with certain body parts.
- ° Tension yet some sort of comfort in the flow of what was connecting us. Comfort, in the sense of safety and support.
- ° The living things were taking control and trying to pull us together
- ° The octopus wanted to hold on and not let go. I was afraid that its tentacle might rip off so I tried to comfort it by giving it slack.
- ° A small thing that was pulling me towards another destination
- ° I felt some kind of connection between myself and others. It was a connection not only between two people, but also the entire group.
- ° I sensed other people embodied minds. It reminds me of neural networks both micro and macro – thinking of life and its connections with a whole embodied space and mind.
- ° the connection between me and other participants; couldn't control myself freely so I simply let it go.
- ° a feeling of apprehension and caution, either because of being attached to someone or because of something living between the skirts
- ° Imagining how they think and feel.
- ° it seemed like commotion; one action would trigger a whole chain of other actions; the interconnectivity grew and shrank to its own will, guided by reactions from within

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- ° The attachment of the skirts between individuals where from the viewer's perspective indicates that the actions and emotions are affected where one person changes his / her emotion from the affect of the other person.
- ° A connection but two ways – 1 between the skirts and 2 between the wearers. I feel that the skirts directly affected the wearers first before the wearers affected each other.
- ° Emotions and emotional states were transferred between participants.
- ° tension, elasticity, tied down yet somehow free, it felt like a chain of movements, dominoes, leaders / followers
- ° a creature that was formed out of all the people combined.
- ° focus shift from the living thing between the skirts towards the elastic; loss of control; reliance
- ° I would have felt a connection and force holding me against the other skirts. They'd be my friends, but I would lose my independence.
- ° safety, like in a forest (i.e. skirts being like trees); protection from exposure to the outside

Where in the room were you sensing?

- ° centre
- ° everywhere; the rope
- ° From the outer edge, outside of centre stage.
- ° from the outside, the walls, the floor, and the middle. I sensed it from the expressions on other people's faces.
- ° In the middle of the room where most connections are gathered.
- ° Movement, action, fun.
- ° No specific place
- ° on the stage, primarily in the middle
- ° proximity was not apparent because eyes were closed
- ° The centre of the room.
- ° The tentacle pulled me downwards towards the floor.
- ° under the spotlight and from the floor
- ° in front of me and to the sides
- ° The centre of the stage and especially when we had to get as far as we could (corner of the stage).

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- The entire space.
- The space that was open
- from different spots around the room, from different angles
- near the back curtain, sitting on the ground to the side
- Sense near the participants closer to the curtains of the stage
- The down part of the room, the skirts, the movements of the participants
- confusion, humor, questioning, excitement, sadness, it would consistently change
- To the side. I had an overview of all the participants
- along the outskirts
- I was in the corner
- I would feel most horrible in the centre as I got caught in the connections
- middle of the room, particularly in between and just outside of the skirts

What were you sending?

- As an artist (drawer), I did not send.
- emotions; movement; feeling
- Encouragement. Happiness.
- energy
- I sent messages of SOS to people by flicking the elastic.
- I sent my concerns, my reaction; my misunderstanding and confusion.
- I was sending everlasting affection
- I was sending my movements as a result of my thoughts, what my responses were to the script
- my movements to others but battling between control of motion
- pulling signals
- Sending mixed messages according to the sense of the skirt.
- Spontaneity – hidden sense and then reappearance of the living thing. A pull between becoming comfortable with the living thing's actions and then the surprise of the living thing's "coming out" and moving.
- A movement not to go there

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- Leadership, different, the ability to move other entities within the space. I was sending messages for movement and order
- pulling the ties and connections, sending cheerfulness that I received from something living between the skirts
- Vibes, my movements.
- footsteps, which did not seem to affect the participants at all
- sending different messages, which have a mix of confuse and noticeable emotions, e.g. happy and sleepy
- trying not to interfere with the participants
- Trying to receives messages from their movements and actions
- my actions had influence on others
- Until I read this question I never thought I was sending anything. I believe if I was sending out something then it would have been awareness.
- confinement – skirts moving closer together; warmth; smothering; spread out – cold
- I would be touching others skirts to communicate a feeling that I was feeling
- not sure what you mean?
- tension through the elastics

How did you respond?

- close together – warmth, safety, comfort; spread out – cold, lost
- my own feelings were amplified, I got tired. I became concerned and less so all at once.
- I could feel the others, my body would respond to how I was feeling
- movement; noise
- compromise
- movement, creating sounds, gestures and facial expressions
- Standing my ground. To counter the force that was pulling me
- pulling against the pressure
- I received similar messages from unknown people.
- interest
- I was just moving around.
- I would be curious to find out how the skirts react.

Appendix D Workshop 'something in the skirt' / 'something between the skirts'

- The respond is to see their reactions and absorb their feelings which generate and affect how the viewer's see
- I did not have any response to this.
- Respond with curiosity and thoughts regard to their actions
- With happy, exciting, cheerful responses such like laughters.
- through drawing with lines and mask
- Forcefully, if resisted I still moved in the direction I wanted
- By moving slowly and peacefully to allow others to know I meant no harm.
- Moved accordingly to what I sensed and the strength of the connection.
- I responded by focusing on the lines and how they interacted with people.
- avoided getting too close
- tend to let go and let things flow; movement of body would work itself out

D.2 Workshop 'resonance within' / 'resonance without'

D.2.1 Workshop Script

Script

All participants

Tell them about project intro – Currently we are using skirts

Embedded in the garments are sensors for receiving body data which is then transmitted wirelessly into other persons skirts which then respond to the body data.

"Welcome to the second heart[h] workshop.

There will be 2 parts to these physical experiments. Each part has a different focus and thematic structure. The entire group will sit quietly together for 2minutes of centering with ambient music before we commence.

Once the music ends, you will all assume your individual roles and pick up your equipment/tools and begin in silence.

Please try to come to a place of stillness."

All Documenters

"You will be participating in the documentation of the kinesthetic experience of 10 participants. Try to stay outside the perimeter of the space that the participants are in.

Be respectful of not interfering of other people's flow. Try not to draw attention to yourself.

You are part of the workshop, do not interfere or obstruct. You might want to consider yourself like you are both inside with the participants, and try use a different sense of seeing, reading through your own body in order to discern and select moments to capture ... but try maintain enough outside perspective to perform your documentation.

Please have sensitivity and awareness."

All Video and Photo Documenters

"We would like you to think about how the creative framing while you are documenting the participants."

Video Documenters

"We need to have 1 person primarily doing dolly shots and pans, 1 person doing mid-wide shots and 2 doing Close Ups of

Appendix D Workshop 'resonance within' / 'resonance without'

in the first activity:

Hands,

Feet,

eyes

Skirt Movement,

Senses, Heart, Breath, Touch, Hearing, Vision,

Interaction Between Body Parts

in the second Half:

Tying

Movement between

Interaction between bodies

Breathing"

Photo Documenters

"Try to use a different kind of seeing as an ethnographer, try take photographs with a sense of breathing. Look for lines (vectors, geometrics) in space.

Shot types

- Mid and establishing shots with people in skirts*
- Getting into the skirts*
- Getting into the garters*
- Movement shots*

Close Ups

- hands,*
- feet*
- breathing*
- get a sense of people's concentration (awareness, or state)"*

Writers & drawers

Show them 'body as home' scribbles

Appendix D Workshop 'resonance within' / 'resonance without'

Writers – *"Consider the writing as scribbles"*

"Use the sketch pads to make your notes and drawings.

Try to make your observations quick non-analytic, do not judge what you are doing, no prejudice.

Try to capture your immediate impressions and sensations: what you see, feel, movement, shapes, colours, connections, emotional qualities, anything that comes to mind, stories, fragments

Stream of consciousness

Movement as scribbles"

Experience Participants

"You are about to participate in the workshop.

You will participate in silence and follow a guide's voice, while they will direct you in specific tasks. Listen to your breath."

Physically honest; physically receptive; Initial questions are seeded while they are moving.

-- see activity scripts--

After Activities

"Try to hold on to your experience and allow yourself to spend a few minutes drawing your experience from a stream of consciousness approach, try not to let your analytical self take over."

(7 mins) hand out drawing cards

"Try now to describe in words your experience silently for a few minutes, again allow yourself to express your experience from a stream of consciousness approach, try not to let your analytical thought take over."

(7 mins) hand out response cards

"If you could all now stay for a few more minutes as we interview each of you on video for a few minutes."

Initial questions were seeded while they were moving.

(7 mins) start video interviews one at a time – Thecla take 3, Susan 3, Camille 3 – whoever is finished their 3 first takes the last participant.

D.2.2 Workshop Response Card

ilab the whispers research group – HEART[H] experience workshops

heart [h]
heart
+
breath



resonance within

When you had the blind folds on and your attention was on your body data, what did you sense ?

Where was it moving in your body?



resonance within

When you went inside the sensation, how were you able to transmit your body data?

How did it move you?

Appendix D Workshop 'resonance within' / 'resonance without'

ilab the whispers research group – HEART[h] experience workshops

heart [h]

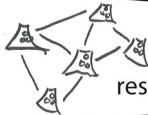
heart
+
breath



resonance without

When in the skirts with the bands on your body with your attention on your body data, what did you sense?

When you went inside the sensation, how were you able to transmit your body data? How did it move you?



resonance without

What other places in your body called your attention? How was this different, if at all?

How were you able to transmit this body data? How did it move you?

D.2.3 Workshop Data Analysis Grid

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)	
Attributes Documented	Patterns/themes - based on type of participant
movement qualities / gestural elements	Written Observations music flow, pulses, flow, touch, explore, extending, melting, feel
sense of breath	
sense of concentration	
sense of awareness	senses and body flow in one; space around - what is space? What's around me?
body as home	body communication
impressions / sensations	I don't want to be alone. Senses calming, reducing; senses merged but blurred; comfortness - relax; dumb, haha. Confusion, lost, harmony, relax, dream
emotional qualities	I don't want to be alone; Where should I go? Am I accepted? Comfort; peace, quietness
shapes / colours	
stories / fragments	questions? Where are answers? How much control do I have? Explore more and more; deep thinking, feed soul
stream of consciousness	released? Or disconnected? Reflect, reminisce; how do I feel comfortable? Where? Who are we? Meaning? Spiritual communication. What's my strongest sense? can I relay? Am I alone?

Table II.5 heart[h] Workshop 2 Data Analysis: Participant Observations

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
emotionally	<p>resonance without: I sensed reservation and curiosity; When I took the blindfold off, I still wanted to close my eyes, to stay within – I noticed a feeling of 'home' in the skirt – of having the skirt hold me in ever-loving arms – my pulse was safe inside the skirt, my movements became larger – easier – I felt at home in the space; unsure</p>	<p>resonance within: uneasiness, wanting to seeking out, because know less of the environment. at the same time, restraint, unnaturally still</p>	<p>resonance within: calmness, sense of wonder; from one side of my head to the other then to my abdomen where the sense of calm was disrupted; very smooth, far away from the real world</p> <p>resonance without: I treat if with a happier mood. Maybe it isn't that painful / bad and maybe if I transmit it to someone else I won't feel painful. I had a rhythm I tried to move as calm as possible</p>	<p>resonance within: Uncertainty and questions rose. then tolerance came and "let go" more free, care-less; senses enhanced with curiosity instead of uncertainty and questions. With curiosity came exploration.</p>	<p>resonance within: When I went inside the sensation, the intense feeling of heart beat made me walk with stronger steps just to release the intensity</p> <p>resonance without: The feeling made me want to go away from people</p>
	<p>resonance within: I feel my pulse and blood form a stream flowing directionlessly; it moved always through my heart gushing through my neck – it was circular and sometimes demanding, warm like milk and honey – full of stories, memories, truths and lies licking the sides of the veins and arteries filling the mind with warm stealth; moments of stillness, light</p> <p>resonance without: the skirts allows me to flow freely; A weird feeling of being enclosed arrived at the beginning, then I started to sense my muscles (arms) being intensified; I visualized sending breath to others – physically it made me flow to them and around them; this is when sound really wanted to come out; my third eye wanted to move directly in a line to another – to / through the space it was fast and long – it wanted to put its 'eye' on others directly on the bodies in the space</p>		<p>resonance within: emptiness. maybe I'm not alive. Was I alive? or was if a nightmare? was it just a dream and I'm just afraid of losing the data? Wasn't afraid / scared of doing anything because I don't even feel myself anymore. It's great. If felt like I was GLOWING and I push the air away. or I glow bigger and brighter and stronger when I hold on to myself. It was from within, spreading out glowing from inside me. I think people can see it</p>		
poetically					

Table II.6 heart[h] Workshop 2 Data Analysis: Response Cards, 1 of 5

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)				
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers Writers
body state awareness	<p>resonance within: breath tensions, body lines – balance (or lack of!); breath – growing and retracting in the chest belly and then back; it extended out in wave and beams then pulled back in; I sense that my other senses grow stronger and more sensitive; I sensed many things breath was first, then my blood flow pulled my attention. the blood flow was filled with heart and moved in waves of openness and thickness through my body it felt thick like the tide, and warm with viscosity – I could feel the light particles within it.</p>	<p>resonance within: heaviness in my arms spreading to joints</p>	<p>resonance within: A strong sense of heartbeat appeared, then my attention slowly shifted to breath. It was rather chaotic at the beginning, but then I started to sense the breath flow from chest to arm; movement was significant at one point then release; I felt a need to sit down before I can focus all my energy on a data spot, the standing make me more aware of my legs, but the sensations are on my arm; It seemed as if the senses increased and the participants became more in tuned with their limbs, often causing people to sway or make slight movements</p>	
	<p>resonance without: an increased sense of heaviness towards the feet and a different sense of movement from the fabric and texture of the skirt; I feel being a bit different in how I am limited in my movement. It takes a while to get used to it; The bands seemed to solidify the sense of body. The bands provided a counter balance to the flow; jumps and twitches – sharp head movements to the side – I was pulled back from the shoulders. Physical contact with others – almost giving the tension away allowed transmission</p>	<p>resonance without: covering / restraining the body. More arm movements. Feeling stationary? Tied down? I think the participants might feel there are "barriers" on their bodies.</p>	<p>resonance without: a stronger connection to the sense / body data; if focused the energy there</p>	

Table II.6 heart[h] Workshop 2 Data Analysis: Response Cards, continued, 2 of 5

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)					
Response Cards	Participants	Videographers	Photographers	Drawers	Writers
Descriptive Qualities	<p>resonance within: I sensed my breath and my heartbeat immediately. After a while I began to sense the movement in my muscles and my eyes. I became more aware of every sensation – my thoughts, the weight into the floor, my temperature, the sounds around me; it moved from my core out through my limbs and into the space</p> <p>resonance without: The band around chest/abs restricted how I exhaled, bringing more attention to data. Made me feel trapped in a sense, similar to suffocation</p>	<p>resonance within: Again, the transmission I feel between the participants are very natural, it's more like they transmit the data by their instincts</p> <p>resonance without: After touching / connecting with another, move smiles and positive reinforcement to continue and transmit to others; I think they transmitted data partly by using the bands and skirts</p>	<p>resonance within: through touch; touching vital places that would be most sensitive; touching an area that creates a stronger but same sensation (wrist pulse -> neck pulse); it moved with the person, as a child to the parent, wanting to lead but unable to do so</p>		
	<p>resonance within: ebbing movements, through the arms, and through the back; swirls, lifts and lowers, waves – it made me want to sing; once inside – the sensation took my entire body over – it moved in circular pulses from the centre outward – but always returning to the centre, always returning to stillness – then the warmth took over again needing to more – to create in a gushing; it wanted to lift me up, up, up through my neck and head up through the sky then down down down; The data flows in my body as if it is a stream, a stream that wants to explore and contact to another stream</p> <p>resonance without: Included, connected. "Emergence"; naked; Flow is obstructed by the music</p>	<p>resonance within: From my perspective I feel the "flow" for each person is different. Some of them are organized and some generate "flow" randomly</p>	<p>resonance within: my brain went empty and I could hear was the glowing sound (NOT MUSIC!) I held myself together or find my most comfortable position to help the data grow. I think if it glows enough it'll transmit to somewhere. or not even transmit, just, like a water color. It spreads like water. I move like I'm a paper with water color all over me</p> <p>resonance without: Pretty. soft. Frantic because my body data wasn't soft. It's a painful data. But the fact that I was in a soft smooth dress made the bad data not as painful. I felt like maybe something is protecting me and preventing bad feelings. Not really that painful of data</p>	<p>resonance within: I sensed that the participants' sense of space either expanded or contracted, depending on their mood and other factors. The feeling of space seemed to move towards the hands, it was an extension of what they were feeling inside.</p> <p>resonance without: Sending mixed messages according to the sense in the skirt - energy</p>	<p>resonance within: Exploration and "play" factor came in. set of "own rules" and began to play with the environment. Questions rose again but with less uncertainty</p>
literally/ details					
abstractions					

Table II.6 heart[h] Workshop 2 Data Analysis: Response Cards, continued, 3 of 5

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
gestures / movement qualities	resonance within: I transmit data into the space by exaggeration by filling my body with the movement and letting the energy flow out of my extremities; it moved me to reach out to others through the medium of touch contact, sharing weight and breath	resonance within: limbs reached out ... unsure if the others will reciprocate or accept contact. But steady exploration	resonance within: I felt a flow, a counter clockwise spinning from the base of my spine. I spiraled around and outside and inside my body. At times it felt hot, this happened when I concentrated on it; I felt the force of gravity pulling me down and the air flowing between gaps of body. I wasn't sure what it was, but my arms and my body had a space, like two electrons repelling each other; It seemed to conflict with a natural sense of movement, it caused users to think about their movements and less on an inner sense of movement. There was confusion; Concentration of space and flow. Movement was slow and very cautious. body reacted simple without too much calculation in mind	resonance within: Their body movement was projected outward, transmitting outward, it seemed to me. It compelled them to encompass the great void around them, through movement of the arms and through walking	
	resonance without: I transmitted my data by bumping into other people and flowing through the space in either a slow or quick manner; The hands and placement of feet seemed to compliment the sense and movement of the skirt. It was not very different, just complimentary	resonance without: I figured an interesting thing about how their feet moved.			

Table II.6 heart[h] Workshop 2 Data Analysis: Response Cards, continued, 4 of 5

heart[h] Workshop Data Analysis - Nov 9th/2004 Workshop (2)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
awareness	<p>resonance within: Flow of exhalation -> transmit to outside made me rock a little; caused me to move slowly and gently through the space like air</p> <p>resonance without: I felt that my attention was more focused towards the part of my body that had the band around it, and the initial impulse that started the movement</p>	<p>resonance within: through touch I saw; I focused in on hands; zoomed</p> <p>resonance without: Sight. More focus on each other's actions from clothes; They somehow transmitted the data (energy) through their feet</p>	<p>resonance within: heat; ranges of temperature – through my head, on my fingertips, in my feet; rhythm – in my chest, in my wrists, in my neck; relaxation – in my head</p> <p>resonance without: It was totally opposite place, it was more painful. It caught my attention by causing me my pain</p>	<p>resonance without: It seemed to me they were sensing the clothing that they were wearing, and they became more attuned sensually of what others around them were sensing</p>	<p>resonance without: I think the participants noticed the other people (stills, videographers.) Although I wasn't transmitting my body data, it seems they could feel our presence</p>
breath	<p>resonance within: growing and retracting in the chest belly and then back</p> <p>resonance without: Same focus – on the breath – swells – it was hard to find the place for the band</p>		<p>resonance within: Breathing in and out; lungs expanding and releasing; release of tension; calm and relaxation; chest and abdomen</p>		

Table II.6 heart[h] Workshop 2 Data Analysis: Response Cards, continued, 5 of 5

D.2.4 Exit Interviews

D.2.4.1 Exit Interviews Students

Q: First turn this on, that, I think it's just off. So, this is part of a, a wearables project and it's been going on for two years or so. Our first version of wearables had jackets that read breath and pulse. The second version has skirts and those skirts were made with garter belts, those, what you were putting on your body were variation on a, on a garter belt that would, if there were a sensor in it, it would have read muscle data. But, what we want to do now is expand our garments and also expand the range of physiological data that we're taking into account. So, we're doing these physical workshops to help us, specifically, with our design process. And, at the same time, we're also doing the software and hardware development. But we want to make sure that the, the next stage of garments is not just a set of garments that meets the software and hardware needs but that the physical expression needs are also brought into the same priority. <unknown>The same level of importance as the garments' one. So, what I'd like to do now is ask you similar questions to what we were asking you in your response cards, but to see whether we can get a different level of, of response and analysis. So, I'm curious – when you had the, actually, I'll back up a moment and just ask you to introduce yourselves.

A1: I'm Judy and I'm graduating SFU this year.

A2: I'm Loretta and I'm fourth year IR.

A3: I'm Kathy and I love those skirts.

Q: Ah, that's a good response to start with. So, when you had the blindfolds on and your attention was on your body, your body data, and what did you sense first?

A1: Well, like, I thought that my body data was air, and it was kind-of going through, like, this area <points to abdomen> and it kind-of felt like, like an astrological projection, like what happens in space with all the air and like, kind-of like, black hole and everything working around and how it's got, like, a little, a lot of sparkly lights and stuff...

Q: Oh, nice.

A1: Yeah.

Q: So, you had a physical sense and also some sort of visual sense...

A1: Well, mostly it was visual like, like, I'm a very visual person, so a lot of, like, my feelings and everything is, like, really, I like have a picture for every emotion and stuff like that, yeah.

Q: You did a kind-of a spacey project for kinesthetic space, didn't you?

A1: Yeah, I did, yeah. <laughter>

Q: It's all coming back to me. <laughter> Ok.

A2: Well, when I'm blindfolded I was focused on my lower body, because, because I can't see and then, but then there's lights shone, shone on my eyes. So, I was more focused on my lower body and, and I feel...

Appendix D Workshop 'resonance within' / 'resonance without'

Q: So, if you had to say what sort-of data or information you were getting from your lower body, was it heat, was it weight, was it pressure, was it weight?

A2: It was mostly weight.

Q: Weight? Yeah, ok. And focused more on the feet, or on the, on the knees...?

A2: On mainly the feet.

Q: Yeah, Ok. This was the blindfold bit, so you weren't in the skirts, ok. Kathy?

A3: I felt like I was dying.

Q: Oh.

A3: Because everything was suck away by the data, and like, I couldn't concentrate on anything else because I don't see anything, and I'm concentrating on data and I felt like I couldn't feel anything else anymore. So, I just sit down and slowly died away, kind-of. I wasn't dying, but it was, because it was my dad with my heart and I have a heart problem, kind-of, sometimes, and just...

Q: Thank you. So, we just had a little bit of a power glitch, but Kathy was talking about this incredible sense of tension in your heart.

A3: I felt I was, I was dying and I couldn't feel anything else and it was, my heart was growing, so it grows bigger because my aura and everything else doesn't exist anymore, like my body parts don't exist. So, like, I was just kind-of melting away. So, I sit down and if I hold myself together, my heart kind-of can grow more, so, yeah.

Q: Wow. So, then, will start with you and grow around. When it came to transmitting that, how did you transmit a sensation like that?

A3: Well, I don't, actually. But I sit down so I hold myself so it can grow more. In a sense, maybe, if it grow more, then it's strong enough it's going to somebody, not necessarily, like, give it to somebody but it's going to affect somebody or somebody else can feel it, yeah.

Q: Yeah, but the, the radiating outwards is definitely a, a form of transmission.

A3: Yeah. So, that's what I was thinking it kind of felt like that way, so...

Q: And, was there a, a life-or-death sense about it? You mentioned before that you felt like you were dying, but was it...

A3: Yeah. Because, I couldn't feel anything else, especially when I was blindfolded. Like, I couldn't know anything else other than my heart and nothing, particularly. So, it was like, yeah, I kind-of couldn't feel anything else, especially when I sit down and I actually concentrate on my heart, not much and I, everything is kind-of, not exist anymore, I couldn't feel my hand. Kind-of, you can kind-of feel it grows to your hand, another thing, so I just, kind-of, other parts, no, well, because I think that the hand is more sensitive, so I can kind-of feel a tingly feeling, yeah.

Q: Yeah, definitely. And, so, what did you... sense when you sensed it? And how did you, you told us actually what you sensed, so how did you transmit that lower body, gravity, feeling?

Appendix D Workshop 'resonance within' / 'resonance without'

A2: Well, I was standing, so it's like, every energy sucking in, sucking all the energy into my lower body so, when I sit down, it's like a release of tension. Transmitting...

Q: Yeah. And how was that transmitted to other people?

A2: Well, it, when, this is not blindfolded, right, when we transmitted to other people, it shifts to my arm, kind-of, and then, and then, it find, it slowly finds its way out, the fastest way out. And then, and then, depending on where it's going, it depends how I transmitted.

Q: Yeah, ok. That's true, with the blindfolding stage, because you were blindfolded, it was hard for you to actually get contact with people, so we were having a sense of transmitting in general, rather than necessarily transmitting to someone, which came later. So, Judy, sense of transmitting?

A1: I think, like, it's kind-of like, the way I picture it is, it's like a, like a beam of light just going from my stomach, just kind-of shooting out, I don't know if you watch, like, Buffy, but it's kind-of like, when she had to kill Angel, and she had to stab him through the heart, like, through the stomach, and then, like, the light was just, kind-of, like, coming out, like shooting out, and I didn't really, I didn't know how to kind-of like put that into physical transmitting, physical, like, motion, kind-of thing, so I just kind-of used hands, gestures, yeah. That could work...

Q: Ok, so my next question is about, is about movement, so you had this sense of transmitting, like your beam of light and you've kind-of answered it by saying that you used hand gestures, but, then how, did you have a sense of how that made you want to move in space? Like fast, slow...?

A1: Well, it was kind-of like wavy, wavy kind-of sensation so I was just kind-of, like, moving kind-of, like, vertically, but "weavy", yeah.

Q: That worked <laughter>. And what sort of movement came out of your...

A2: Well, it was usually like this arm <indicates right arm> so I was kind-of, going that way. <leans to right> So, I just moved like, with whatever it was, yeah.

Q: Yeah. Movement?

A3: I tried not to move too fast, yeah. I tried to just move very, very slowly. So, I would die, so I kind-of like I keep want to feeling myself slowly walking around feeling my heart it is like, yeah, just walk slow, because it's like a candle light, almost like, it's going to blow away.

Q: Yeah.

A3: And I didn't want it to blow away, so I had to walk really slow.

Q: That was quite an existential experience you had, there.

A3: It's weird.

Q: So, then we're talking now about the shift that we made into the skirts. So, Kathy, when you actually got up, put the skirt on and then put the band on, did that change in any way the sense of what was going on with the, the heart?

Appendix D Workshop 'resonance within' / 'resonance without'

A3: It would make me more comfortable and more secure because I had something tied around my heart and I have the skirt which is warm and I can touch my skirt it's so soft...

Q: Which one were you wearing?

A3: The black one, the blue-black one.

Q: Oh yeah.

A3: That was so soft, actually touching that like, oh, now I feel more comfortable and...

Q: If I was having an existential heart experience, I'd want to wear that skirt too.
<laughter>

A3: Yeah, I know. It was like, it felt so good and I was touching the skirt and I went, hmm, I feel so warm and like, by physically getting warm, it just like, mentally kind-of getting warmer. So, I just felt like I'm more comfortable and, yeah...

Q: So, it seems like for you, the nature of the garment really affected your physiological experience.

A3: Yeah, physical plane, yeah, like, I think it was more mental phase, you don't actually feel your heart that way so, yeah.

Q: Cool. Loretta?

A2: Well, I had a little trouble with putting the skirt on <laughter> in the beginning, yeah, I can't find a buttons and then, after I put it on, it was more like, I was like, tied to the floor, because the skirt was pretty long and I was dragging it across the floor. So, it was like...

Q: It certainly looked beautiful but, given that you were dealing with weight, did the skirt actually, and where, where did you put the band? I'm wondering about the weight of the skirt and where you put the band.

A2: Yeah, so, the weight of the skirt... actually, it makes my body feel lighter, I don't know, yeah.

A3: Because you feel pretty... <laughter>

Q: Do you think it was the contrast, the skirt was so heavy?

A3: I think it's the skirt make me more relaxed, I don't know how to tell it.

Q: It would be good if we had a boy in the skirt, too, because the girls are, obviously, really, sort-of, relating quite well to the skirts. Wonder what the men would think... <laughter> So, the transition to the skirts and the bands, what did that do for your sense of your body data?

A1: Actually, I felt that the skirt was kind-of pulling me back, like it was extra weight to the body that I didn't really like, and then, it's kind-of, like, you know, when you're running in water and it's, you're really putting all your energy, but you can only go so fast. So, it's kind-of, I felt like I'm just having like an extra piece of layer on me, is really holding me back and expressing and trying to feel the, the sensation.

Appendix D Workshop 'resonance within' / 'resonance without'

Q: Yeah.

A1: So, I didn't really like it that much.

Q: Ok, that's good, that's interesting. Just making sure that's working. So, when we made the shift to the second source of body data did, was that, was that an easy transition to make? Because you had such a powerful sense of what was going on here, with the light and the spacey feeling and the sparkles. When we asked you to pay attention to some other part of your body, what, what happened then?

A1: That was actually really fast, like when you say another part, like I immediately thought about my hands, because I think that I was really cold, so my attention just went straight to my hands and then it felt like it was really prickly. So, I think, because of the coolness, I just had another idea right away. Yeah.

Q: So, it was quick.

A1: Yeah, really quick.

Q: Did a different sort of movement come out of that?

A1: Yeah, I was really, like, kind-of like, icy, kind-of like really rigid movement, yeah.

Q: That's nice. It's good to have that contrast. So, what happened when we asked you to shift?

A2: Well, when I start thinking about the energy it keeps, it quickly sucks into my head, so it's all in my head, then, after, and then it turn, it transmitted back, onto my upper body.

Q: So, you went from feeling weightedness in your legs, it translated out your right hand and then the shift went up to your head...

A2: Yes, because I was thinking about energy, right, and it all sucks into my head.

Q: So, did it feel like, if you had to say what it was, did it feel like it was magnetic, or what sort of energy was it?

A2: It was like, was like falling water. All, like tension...

Q: Right, yeah. There's a lot going on in our bodies at all times and we don't pay attention to it and, when we do, it's like <small explosive sound>, it's a big explosion. So, what happened when you made the transition to a different body data? Did your heart sort-of give up centre stage, or did it want to stay there?

A3: Because, no, because you said that, the instruction was so free to lie down, and, like, your first instinct is to die now, I'm, like, oh, gosh, have to die now. <laughter> oh, gosh, me, it was just, like, but that actually made my heart beat, like, normally or, maybe I thought it beat normally. I thought it didn't beat normally but, then, like, so everything just calms down and then I don't even feel my heart and even because, because before I didn't even feel my other body parts, so it was really easy to find the, the other data because just the first data I got to mind, like it's my back was hurting, I'm like and there it is. Yeah, just like the first data, maybe it was pain, it was more... you know, it was more superior and then other data and so, I felt it right away.

Q: So, classifying the pain – did it feel like it was pressure, or heat, or tension?

Appendix D Workshop 'resonance within' / 'resonance without'

A3: It was typical, tension feel. It was tension, just like, it won't stop...

Q: And which, which part of your back was it?

A3: Lower back.

Q: Right. So, that must have had an effect on the way you moved.

A3: Yeah.

Q: Yeah. And this is curious. So, did you want to transmit that – like, how did that pain transmit?

A3: It didn't, oh, I didn't try to transmit it, but I was, while I was moving around, trying to transmit it to other people, I was leaning my back onto people's back.

Q: I saw you do that. It was nice, yeah.

A3: So I thought, maybe, it was a way for other people to feel the pain, but I don't think that pain can actually be transmit to other people, but the way so people to feel it, because the people...

Q: Do you think pain can transmit to other people?

A3: I don't think that it's a nice thing to do. <laughter>

Q: That, that's a very important distinction, isn't it?

A3: Yeah.

Q: It's what we feel, ethically, we can send to people, which is what people can notice. Because you can often, you can often tell when someone's in pain, can't you?

A3: Yeah, so it will just like, ok, as long as we can feel it, I don't need to transmit it. And, depends, you know how the tension hurt in your back, lower back, it kind-of like, it was the same kind-of growing motion, so it's growing like my heart beat, it's, it's a pain, so I decided, so I think, oh, if I'm leaning on somebody's back, their back will feel the same growing, and then transmit to the other people, kind-of.

Q: It's really, it's very interesting, since it seems each of you has a different, like a different vocabulary, a different way of sensing what's going on inside of you, yours is very much in terms of this, this radiation sense, and you had a sense of the light, didn't you and you have a, it's almost like boiling water so, what I'm finding really fascinating are the different metaphors that, that each of you would use to describe what was going on inside of you. So, the moment of, of giving it to somebody – Kathy, you brought up a really good point, which will relate to our project, which is, if we're sensing physiological data, do we just want to give everything, is it just one big splurge of communication, of heart and breath, and, you know, tension and pain – well, obviously not, we need to find a way to be able to regulate what it is that, that we're sending out. So, there's a sense of what, what you can send versus what you want to send. And, also, what you want to receive. So, can any of you comment on this idea of like, giving and receiving – did you have a sense, a sense of receiving anything from somebody? Did you have a sense of really effectively giving it?

A2: Well, the second part, she was lying on her back, like all, the whole way for ten minutes. <laughter> So, it was like, it was like, she...

Appendix D Workshop 'resonance within' / 'resonance without'

Q: That's a friend for you... <laughter>

A3: No, it was like we were blindfolded, really, if we wanted, I was, like, moving around, different people's back. And I was blindfolded, I might as well stay with one person.

Q: But you, actually were you blindfolded for this bit?

A3: We were blindfolded – no, at one point we had to close our eyes, yeah.

Q: Yeah, that's right.

A3: Yeah, we had to close our eyes. It was hard.

A2: She was lying on me, and then, after, like, a few minutes she, she didn't like go away, as, because I was walking around and she, and then it feels like she was attached to my body, so, I was trying to escape, <laughter> I was trying to walk her off... <laughter> and then she was still holding on...

Q: And, at the same time, were you, did you have a sense that you were giving something to Kathy? Or were you in...

A2: I was more like, receiving.

Q: You were receiving, yeah. It's a good question, isn't it, whether you can give and receive at the same time, in the same intensity. Or, rather, maybe we go through a receiving phase and then we go through a giving phase.

A1: But it's like, I think it's really hard, because, like, our actions are so vague, so, even if we intend to, kind-of, like, give this type of feeling, or idea, like, it might be received as something else, and when we see that something, like, intention might be something else, so it's like, it's really like. Because there's really, like, no common language, so you kind-of do whatever you think that other person might understand, but I think they can take it as something else. Yeah, so it's like, really wide and up to interpretation.

Q: So, when you needed some sort of movement to, to give, what, what was your, how did you travel through space and what was the, what was the point of contact? Was it hand, or arm or back or head?

A1: Well, the second, when the second body data thing, it was, like, hands and it was way easier than my first, light, thing, so I felt like, if I have to, like, touch somebody, then that would be, they would understand that the main idea is in the hand area, yeah. So, I think, if it's like, something that's common, like hand, it's really, really easy to kind-of express whatever your intentions are. Yeah.

Q: Yeah. Ok, let's see if I have any other questions. So, we've kind-of covered the differences between the first part and the second part, are there any other comments, or...?

A3: I think, for the receiving and giving part, it was really easy for me, though, because I was, like, attached to someone's back, and so other people could still touch me. It wasn't fun when people touch and I'm like, and I can just roll over to someone's back. I just attach, like, because I'm not trying to give, I'm just, it's a, you know, it's like I'm trying to affect, like affect other people...

Appendix D Workshop 'resonance within' / 'resonance without'

Q: Do you think, do you think you could've achieved the same sort of giving, but without actual physical contact? Like, could you've done that across a distance?

A3: I don't think so, no, no, not really. If it was pain, it might, if it was other stuff, I can't, yeah.

Q: How about you, do you think that the way that you were giving that it would be the same?

A2: I was trying to give, one time and then the person didn't... I was like, holding out my hand because, like, it was escaping from me and then, that person didn't look at me and then she just walked past, it was like a rejecting...

Q: Oh, oh no. <groans, laughter> But, it's curious that you said that she didn't look at you. So, it almost seemed like the eye connection was important, prior to the... I see you all nodding. Yeah, eyes are pretty powerful.

A2: It's like approval.

Q: Permission, even, yeah. Yeah.

A3: If it's permission, then, in a way, if I attack people's back and I attach to people's back, I mean people want to escape, like, in a way I'm transmitting pain, because I didn't get approval or anything, I'm just attached there, so people were feeling pain, in a way.

Q: One of the big things we're interested in this, with this project, is communicating body experience that maybe we wouldn't communicate in words or through pictures. So, like yourself, sometimes we have voice, images, what about a device that might actually communicate different levels of invisible communication, like this? Yeah, what was my question?

A1: I think that's really useful, though.

Q: What's really useful?

A1: To know, say, you break up with your boyfriend and you want him to know how much pain you're in, you can't express it in words because you're crying so loud, yeah.

A2: Oh, that's good. <laughter>

A1: Sometimes, when you're in a break-up situation, you just want the other person to know how much pain you're in and that's why, you know, people slash people's tires, or, it's kind-of like, hurtful backlash kind-of thing. Yeah.

Q: And then it's, it's somehow healing for you to, to get it...

A1: Yeah, I think, it's, it's really big for people to, like, know that the other person knows how you are feeling. I think that's a really, really big issue for a lot of people...

Q: I guess this is hard to e-mail, isn't it...

A1: Yeah! <laughter>I HATE YOU!<laughter>

Q: You write and you read the words and think, hmmm, that's not quite getting it, is it? <laughter> Well, that is joy. I guess, there's this moment of, just, wow, this is

Appendix D Workshop 'resonance within' / 'resonance without'

fantastic, like you're standing on top of a mountain and it's all sunny and it's beautiful and you just think "I'm going to tell this person about it", how can you, kind-of, like... yeah.

A1: Yeah.

Q: Yeah. But what about the receiving? This is the thing about the giving and the receiving, so it helps you to, to send it and then, I guess they, would they have a choice whether to receive or not? Do you think that's important?

A1: Yes, yeah.

Q: Or do you want to override the choice...

A1: Sometimes, probably. <laughter> Yeah.

Q: Yeah, yeah.

A1: In different circumstances, yeah.

Q: Ok, well, this was really good. Thank you.

Q: So, exit interview. See if you can just relax and breathe, and don't be nervous, you're fine. We're just going to ask some questions of your experience and, and you can answer them in any order you want between the three of you and it's really just in relationship to the things that we began to ask on the cards. So, so when you had the blindfolds on, when you first, go back to remember the beginning of the exercise, when you had the blindfolds on, and your attention was on your body data, what, what body data were you sensing and where did you sense it? <a lot of noise, of camera> So, one of you can start with your name...

A2: Adrian

A1: Marjorie.

Q: First and last name...

A2: Adrian Beloine <sp?>

A1: Marjorie Dalwindo <sp?>

A3: C. Kwo Gawa <sp?>

Q: And then, ok, so, we're going to go back to earlier in the work, so you've had a little time to think about it. So, just remember when you had the blindfolds on, the very, very beginning when we asked you to put the blindfolds on, and we asked you to direct your attention to your body data so, what I want to ask is – what body data were you sensing, was it just one, more than one, and then, how did you sense the body data that you were sensing, at that time, just at the very beginning, when you had the blindfolds on? So, anyone can start...

A1: Well, I felt more than one, and...

Q: You might want to speak up a little bit...

Appendix D Workshop 'resonance within' / 'resonance without'

A1: Ok, I felt more than one, and mostly it was, it had to do with listening to the music and also, I was a bit hungry, too, so I could feel, in my stomach area, that, I guess that was also disrupting the body data, so...

Q: Do you think that hunger is body data?

A1: Well, it's the body's way to tell person that something has to happen, so...

Q: So, like, to me, hunger would be body data. So, if you're, if you're saying, like if you're saying, I noticed my hunger as body data, then that would be, anything that's happening in your body is body data, there's no body data that's wrong. So, I'm going to ask, I'd ask you to answer that question again, with that in mind, because I need to be able to <very loud noises> It's just that I can hardly hear you. Let's, let's just do that again. So, what body data were you sensing – there's no wrong body data and there's no wrong perceptions, whatever it was, if it was a thought, thinking is body data. If you're thinking this is weird, that's not, there's nothing that you can be sensing that's not right so, given that idea that whatever you're sensing is body data, what were some of the body datas you were sensing?

A1: Well, that, the body data that I was sensing was hunger and there's also the body data of listening to the music, and that's what I felt and...

Q: How did you sense that in your body, like where in your body did you sense it?

A1: Well, the hearing, see, so, up in my head, and also in my abdomen area where my stomach was feeling hungry, because I haven't had lunch yet, so...

Q: Ok, thank you.

A2: The body data I was sensing was mostly, mainly the breathing, in and out, so, just lying there, with the eyes closed, really, I don't know, it enhanced, kind-of, it, it made me concentrate more on my breathing, so it felt like I was breathing maybe harder than I normally do and also, this, I was lying near, under the lights so, with my eyes closed I could still sense the, the light coming through, and so, that was pretty interesting.

Q: How, how would you describe the sensation of feeling the light through the blindfolds? It's a really interesting thing...

A2: Oh, I'm, I'm, when we were first lying down, sorry...

Q: That's good. Don't, don't be sorry <noise> ask these questions to get more descriptive information from you about your experience and I really like what you're saying so, I just wanted you to know it. How were you experiencing that light, which you said you were noticing through the blindfolds? It's an interesting thing to say...

A2: Well, not really through the blindfold, it was, it was before the blindfold, actually, when we were just lying down, still. Yeah, so I was directly underneath the light, I guess and so, it, because normally when we're, we're lying down with our eyes closed, it's totally dark but then, so now, there was that kind of contrast where it was a lot brighter and yeah, just, it was kind-of, hazier, I guess.

Q: So, where in your body did you sense the things?

Appendix D Workshop 'resonance within' / 'resonance without'

A2: Well, my breathing in and out was mostly around the, the, between the chest and the abdomen area, I could feel it expanding and then contracting again and the, the, the light coming through was just my eyes, mostly.

Q: So, did you experience it as a warmth, or did you experience it along your skin, for example.

A2: Yeah, yeah, yeah. Yeah, oh, so, the light, I experienced it as warmth on my face and my eyes, especially, because, I guess, being able to visually see it, made me sense it, the warmth, even more.

A3: Ok, well, there's few things. First is that I felt the heat inside my body and especially my hands, they were getting warm because, maybe it's the light or maybe it's because I was nervous. I just felt it's the heat and that's the blood, the blood circulation. Also, I felt the, the space between the arms and the body, because I wasn't standing straight when, where the hands are on my hip, there's like, space between and, somehow, it felt like there's a, it's like a magnet, two magnets, negative and negative, trying to repulse, so it's not touched, so that's what I felt. And also, like Adrian said, I felt the light, although it's blindfolded, but still you can feel the, the light. And also, the flashlight the people were taking pictures. I, I realized, even though I was being blindfolded.

Q: So, what body data did you select when <big noise> What body data did you select when you were asked to pick a body data?

A1: I chose the one on my head, like the hearing one, because that was the most dominant and then after that one my stomach started growling more <laughter>, that's, that's why I moved it down to my abdomen, yeah.

A2: I, I selected the, the breathing, so I put the band around this area <indicates lower chest> my chest, between my chest and my abdomen area and the second one I thought was because we were standing a lot and moving around a lot, that I eventually started feeling my, my shoulders so, like the tension, I guess, or just the gravity pulling down on my shoulders, so, yeah, I just, the second one I moved the band up to my shoulders.

A3: My, I think it was mind, inside my brain, and how I'm trying to figure out what's going on and you can't really tell the space, but like, you don't know where the obstacle is, but you're trying to figure out where things are and you know that there's a space around you that you can move around but yeah, it's, it's just dark, complex darkness.

Q: When you, when you're asked to transmit the body data, when you had the blindfolds on, how did you imagine that happening? When we asked you to transmit, we asked you to transmit the data or asked you how would you transmit, how would you transmit the data when you had the blindfolds on? So, what was, what was happening?

A2: For me, transmitting the data, the breathing, I just, kind-of, imagined just breathing harder and then, so inhaling more and maybe exaggerating the, the exhalation so you kind-of just feel the, the release of the, the air throughout the whole body, and...

Q: Great. Did you, did you, how did you imagine <lots of noise> How, how did you imagine that was different when you were transmitting, because, did you, transmission means transmitting it to something, did you imagine it moving through the space?

Appendix D Workshop 'resonance within' / 'resonance without'

A2: Yeah, yeah, like, I, I imagined that the air actually just flowing through the space, more than just, because before we were kind-of focusing inside of ourselves, so, when we were asked to, to imagine transmitting it, I imagined the air coming out moreso than just focusing on what's happening on the inside.

Q: And, anybody else? How did you imagine, when we asked you to transmit the data, with the blindfolds on, how did you imagine that happening?

A1: Well, similar to Adrian, except with the sound waves, I guess that's how I imagined it coming out. The sound waves would just go in the air and somehow the data would maybe transmitted that way.

Q: So did, did you imagine yourself transmitting the sound waves?

A1: Well, I tried to imagine that, as much as I could, and that's why I moved my hands up to my head and then fully moved my hand out so, to show...

Q: Can you describe that as if I wasn't there, so that you were telling somebody what you were doing?

A1: Ok, so, what I did to transmit sound waves was I moved my hands up to my head as if the sound waves were moving out of my ears and coming out in, in certain directions.

A3: Well, I was trying to just walk slowly, to find out my surrounding and see if...

Q: It, it, just remind us what, what your data was, again, just I'm thinking that every time that you say one of these things, it's a complete statement, so, sorry...

A3: Since my, I was focused on my mind, about the space and the field, the complex field, I tried to move around in the space, to figure out my surrounding and see if I can actually touch someone and, when I touch someone, then I know that, ok, this is the person, there is a person here, if I see how that person's reaction is, but there was no response, so I decide to like, walk, walk away, yeah.

Q: Ok, good. Ok, when you were asked to move, you still had the blindfolds on and you were asked to move with the data, how did you move with the data? What were, what were you doing in order to move with the data? You may've already answered it, if you have, just repeat what you said before, because you've sort-of answered it.

A2: For me, I'm, with the exhalation, the inhalation, exhalation, I kind-of moved slowly and kind-of, just-like, you know, how breathing in and out is kind-of gentle kind-of a movement, I guess, so just walking through the space like that, and walking through slowly, gently and just, kind-of, not really going any specific direction, just kind-of going wherever.

Q: Is, is that, was that because the, the thought of the air, sort-of like being everywhere?

A2: Yeah. Because I was feeling it, like the air would be like, exhaling and the air would just transmit throughout the whole space, so I just kind-of, was moving around wherever the, I imagined the air would go.

Q: Thanks, thanks.

Appendix D Workshop 'resonance within' / 'resonance without'

A1: With the hearing, I didn't really move around when I was trying to transmit the data because I thought, with sound waves, because you can hear it everywhere, it can just, you can just stand there and you'll still hear something, yeah.

Q: Good, great. So, now we're just, I'm, you talked a little bit about the skirts, I know, because we're, it's really connected with what we're doing with that, I'm just going to ask you some specific questions about the skirts, so... was there anything specific you sensed just because you put the bands on? Because you probably selected the same data as before but did the bands draw attention to it in any way, or enable you to be more connected with it in some way?

A2: Well, for me, the bands really, kind-of, because I put the band around my, my chest area, so it really restricted my breathing and, like, well, I could still breathe, but then, it just made me focus even more and so, I could kind-of feel, like, it was like limited, I guess and kind-of tight, so it's kind-of harder to, to breathe in a way.

Q: You said it focused your breathing more. Did that change your attention to your breath in a certain way? Did you...?

A2: Well, yeah, before I was thinking more about the inhaling and exhaling, but then, with the, with the band around me, it was more towards the exhaling part, because that's... sorry, not exhaling, but the inhaling part because that's where I would really feel it, kind-of, tightening.

Q: Good, ok. And, <unknown> do you want me to say the question again? It's like, when you asked to put the bands on, the same thing, sort-of the same thing you were imagining before, with the blindfolds, so, if you took the blindfolds off, the sensation of both not having the blindfolds but also having a band in the place, how did that change, did it change the sense of the data, did it give you a different sense of it, were you able to imagine it better, or... anything different that happened just because you had the band on?

A1: I think it was a little distracting, to have the band on, so I couldn't really focus on the data as much. But, when I, when I initially had the band on my head, that's when I found it distracting but, when I moved it down to my abdomen area, it was a little better because I had more of an idea of focusing the data on my, because my hunger was way more important than the band at that time. <laughter>

Q: Good, good. How is it different that the blindfold was on your head and the other band was on your head, yet the blindfold wasn't distracting, what was the difference?

A1: I think, when people have their eyes closed, they tend to sense more information than when they don't have a blindfold on, so... I think that made a difference.

Q: Interesting.

A3: Well, first time I put the band on my wrist and that didn't, I didn't feel like not much, not much of a change but, the second time, when I put it around my neck, then I feel there's difference, because it's, oh, maybe it's because my brain is over here <points to head> and the band goes around, it feels like I am inside, and it's actually close to me, instead of just, oh, wearing it on the wrist.

Q: So, what you're saying is your head, are you saying your head feels, like, closer to you than your wrist feels to you? Something like that, because it's on the periphery of your body? Is that the kind of feeling it was?

Appendix D Workshop 'resonance within' / 'resonance without'

A3: Yeah, I guess so, yeah, just because, I, also I can see the band on the wrist, I can see the band and I forgot about it, until I realized, oh, it was time to take it off, but when it's on, around my neck, then I can't see it, and I can feel it, because it's on the shoulder I can feel the weight. So, I feel it... oh, it's not a distraction, but it makes me feel more concentrated because that just pulls everything together into the circle, yeah.

Q: Ok, you were asked to transmit the data, again, with the band on, how did you transmit the data, did it change when you transmitted the data, with the band on, then before that? Like, were you able to do something, did it enable you to move differently, or think differently about it?

A2: Transmitting the data with the band on, because I was feeling the, the restriction, kind-of, feeling so, I was able to, maybe, more physically, tangibly, transmit it, like, because I, I know I grabbed on to other people and kind-of gripped their, their arm, to try to, I guess, replicate the, the feeling of the, the tightness when I was inhaling.

Q: That's interesting. So you, so can you just, like, describe what you did with your body when you transmitted, because it's interesting what you just said, you said you used your hands to transmit your breath.

A2: Yeah, well it, it didn't change my, my actual movement, because I was still moving in the same way, it's just that, I guess it was more of a, the, the restriction was more of a distraction so that was what I was focused on, so that, like, led me to transmit that feeling more so than actual breathing in and out.

Q: Good, how were you moving? I mean, because you were asked to move, were you moving, how...?

A2: I was, I was still moving I guess, slowly, because, just because that's how I was breathing, in and out, so, the speed at which I was moving and, like, direction and stuff was still the same.

A1: With the hearing thing, I guess with the band on my head and moving around, I tried to move around as much as I could but, because I was distracted, I wasn't really sure how I should be moving, so I thought, maybe because of the way sound travels, I decided to bump into people <laughter> because sometimes sound just, bumps into you. Yes, so that was one way of transmitting the data and then, when I moved the band to my abdomen, because grumbling noises in your stomach tend to be rushed, I moved faster throughout the space and, when I transmitted data I was moving my hands up and down, back and forth, sort-of like what would happen in your stomach, yeah.

Q: Good.

A3: Since mine was more focused on mind, of being lost and in the complexity, the band around my neck gave me protection, a sense of protection and through that I felt self-confidence and when I moved through the people, I tend to be happy and just encouraged to go around to communicate then that, hey, you're, I'm confident.

Q: That, that's interesting. I think that most of you already have answered this in a different way, but this, this question is what other places in your body called your attention? Most of you have already mentioned the second one... I mean, you went from the wrist to the... maybe, maybe just summarize that part, so, in the last part of when you had the skirts on, we, we asked you to see if there was another part of the body that called your attention, so maybe talk about just that other part of the body

Appendix D Workshop 'resonance within' / 'resonance without'

that called your attention and how that was different... I think that you've mentioned it in different ways before, but it's, but if you have something else to say about it...

A2: Well, for me, the shoulders, the downward kind-of pull of the shoulders, was the second sense I was feeling, at the time and, putting the band on didn't really, because I put a band on around my shoulders and it didn't really change that, but, for that I would say both transmitted, like, I guess more forcefully to, like, other people, I would bring down their shoulders to, to convey the, the same sense of feeling that I was feeling.

A3: Mine, it was mind but also feeling heart because that, the self-confidence, although it's you think mentally, but you feel it in your heart, yeah.

Q: How did you, did you transmit, how did you transmit that when you were moving? How did that make you move? Was it the same thing that you were talking about before?

A3: Yeah, just confident and going around, being happy and when I see someone I know, I give a punch. <laughter>

Q: And was that, did you think of that as heart data or did you just think of the whole thing as a unit?

A3: I think everything is linked, it's not just separated, like mind and heart, well, I think mind is more thinking logical and heart actually feels, although they're both in the mind, but, yeah, I just felt it's being linked together...

Q: Great. I know that you were talking about the ears and the stomach, so is there anything else you want to say about how that was different, moving to the stomach?

A1: Coming to the stomach, that, well, it just took more, it was just a more dominant feeling, because it just suddenly appeared – well, I'd been feeling hungry to the day, but it's just that, later on in the day, when you've got nothing in your stomach, that's how I was feeling.

Q: Ok, some I'm going to ask you just a little more general questions, it's not on my list here but, like, if there was kind-of, a single impression or feeling, or something that you didn't expect to come out of this that happened to you somehow, that really surprised you in a way? It could be anything, what would it be? Or, if it was more than one thing, or...? Just the thing that, if you leave, the thing that you, sort-of, remember the most, or...?

A2: Well, for me, the thing that I remembered the most was just, I guess, the tension I was feeling, because, even when we were, when we first lied down and we were asked to feel like our feet melting onto the ground, I could actually feel that, where everything is just kind-of dropping down, but it was interesting because, like, it was easier for, for my upper body to feel like it's going down more so than my legs or my, my feet.

Q: Interesting. Interesting, good observation.

A3: Well, just the wearing the skirts, because I usually careful the appearance, <laughter> I need to look, I mean I'm not trying to dress with clothes, and when I noticed that people were taking pictures, drawing them, I don't want to wear anything that I have lack of confidence, so, the, I think wearing the skirt, just totally lost my fashion style, and put myself into, like, different position instead of, like, every day,

Appendix D Workshop 'resonance within' / 'resonance without'

every day, just go outside, when you go on public, that's not what you wear, and, yeah. That's, that's just an extra thing that I felt like.

Q: Did it feel like a costume, or did it feel like you, like sometimes costumes make you go into another place, or did it feel like...?

A3: It's...

Q: Did it make you feel like an alien? Or, what would the word be, if you thought of a word that would describe...?

A3: Limitation. Yeah, limitation of self-expression. So, you're not expressing by your clothes, you're, just focusing inside, not just, not the outside, yeah.

A1: I think it seemed like, because we're in a theatre, I feel like some, like a performance so, putting on the skirt kind-of added to that performance feel, especially in the space.

Q: Yeah, maybe I'll just sort-of ask this, probably this is the last question – because we've mentioned the skirts and I didn't really ask questions about the skirts, so is there anything about the skirts that either, you've kind of talked about something that limitation, I would say, if I said added or detracted or changed your experience so maybe I just ask that question more generally to everybody, you sort-of have already answered it, but, is there anything about the skirts that, that you can say about the experience that gave you more or less or something or maybe just think what did it give you more of and what did it give you less of, everything always has two sides, so maybe we'll think about it that way...

A2: I think, for me, the skirt, it made me feel more self-conscious of, my surroundings and how other people view, view me and like, how I'm being seen and just photographed <laughter> and drawn. It, less, I wouldn't say it really took anything away, though. It just gave me more of that enhanced sense of other people looking, at me.

A1: I guess that I'd have to agree with Adrian, in that sense, because I did feel self-conscious putting the skirt on and putting the band on, especially on my head, yeah. And, also, I guess...

Q: Did you feel that way when you were doing the blindfold?

A1: When I was doing the... not so much. But, I guess, this skirt, like, in other terms, it also helped me move, because it flowed with my movements, so...

Q: Cool. Do you have anything, you mentioned the thing about the fashion, any other aspect of it...?

A3: I think wearing the skirt, gets us to, gets me to forget about the bottom half of my body. Because, with the band, you can wear anywhere, but no-one will on the leg. So, I think it's because the skirts that you don't see your legs anymore, yeah, that's just something I realized.

Q: Interesting. So, that's really great, you guys, I mean, anything else, or... thank you very much, thank you.

D.2.4.2 Exit Interviews Dancers

Q: When you had the blindfolds on, and your attention was on your body data, what did you sense? Did you sense something, did you sense something at first and then, did it shift? What?

A1: I think the first thing that I sensed was breath and heart beat and, then, after I'd had the blindfold on for a while, I started to notice more subtle things, like, like what I was thinking or the weight into the floor, into, through my feet or which muscles I was using to hold myself up, sort-of, if, I, I was like, oh, I'm really tensing my shoulder for no reason. You can start to notice, like, I have my eyes closed what I'm seeing on the back of my eyelids or, just little stuff like that.

A2: Same, also, just the balance, finding that I felt like my feet were never quite even and I kept wanting to adjust things so that was taking a lot of my concentration. <laughter> It was interesting, and then when you cued us or said, you know, think of one thing, the first thing that happened was breath so that was what I'd go with.

A1: Yeah, me too.

A2: It took, it took me right out, out of that.

Q: Right out of the balance part?

A2: Right out of the balance part. And of, there's my breath I thought I wonder if that's really obvious – too late now – maybe.

Q: Did you sense a particular form of movement that was happening with the, the data that you were sensing?

A1: Well, when you asked us to choose one, I went with breath, just the first thing that came, I guess, and just with that sort-of feeling of expanding and contracting it sort-of just transmitted that rhythm and it sort-of came from here <presses abdomen> and spread out through my extremities, I think. Just that, almost like, like the ocean sort-of that feeling of back and forth and back and forth.

A2: Similar images of water, hugging and extending out in beams or waves somehow, which was...

Q: Did that make you want to move through the space?

A2: That way, or extend limbs through the space that way or just project the breath that way and then at one point when we were – again, this might be the next question – giving, I really wanted to start making sound, like, a lot of sound. That's why I started humming and I just wanted to start going "Woah, maybe I'm not supposed to do that..." <laughter> so it was really my brain kicked in, thinking, oh yeah, maybe it's not about noise, but...

Q: Let's talk about sound...

A2: That really would've... I wanted to sing at one point, it was like, I just wanted to start singing and just like, yelling and making random pitches and things, so...

T: But when we were in...

Appendix D Workshop 'resonance within' / 'resonance without'

A1: I think that sound is sort-of a natural extension of breath, as well, like we breath hard, breath hard enough you're going to make a sound and then if you add voice to it, it becomes singing, basically. So, for me it felt really natural to vocalize, that rhythm.

Q: What was quite distinctive about the way the giving mechanism came, it was just like you all went 'shook' right next to each other...

A2: Had I not received instant contact, not that I was advancing or running away from it but that it wouldn't have been the first thing that I did, I think I was really interested in extending the energy out towards, you know, not <unknown> right to someone, but all of a sudden, oh, there's people next to me, ok <laughter> you know, there's no, there was no impulse to pull away from it, but I remember thinking, well, ok...

T: That's right, because you were actually, we were next to each other in the space, and...

A2: Yeah, right away. And I was outside, just sending that out to someone, because that's what I felt like, waves, that whole feeling...

Q: So, then when we made the shift to the skirts and the bands, can you describe what sort of transition that was for you? Did that feel like that was quite a different thing, or did it feel like it was kind-of the same thing but with skirts and bands?

A2: That's pretty much what I felt like, although, I had trouble figuring out where to put that band. <laughter> Like, I wanted a big one, right across the whole chest, a really wide one, because it was here and here and here and here and I'm thinking, these bands are really little... <laughter>

Q: <unknown> feed that comment back to our designers...

A2: I felt, literally, a whole...

Q: A corset?

A2: Corset would've been perfect for that breath, because the whole chest, yeah.

Q: Interesting detail. Those were originally designed to be garter belts, which is why they had the tail, you were looking at the end of the design...

A1: Oh, where's this supposed to go? <laughter>

Q: But, you sort-of found a place for it to go...

A1: Well, I just sort-of let it hang. <laughter>

Q: You wrapped yours around.

A2: I wrapped around the top. I thought, oh well, this, I'll have two sort-of bands here.

A1: I felt like it really drew my attention and really focused my attention to that area, especially because with the breath I could feel the band sort-of holding in where I was expanding, so it really focused my attention to that sensation and sort-of really brought me back to the initial impulse, from the beginning of the exercise.

Q: Good.

Appendix D Workshop 'resonance within' / 'resonance without'

A1: The weight of it, I felt that the weight made my movements more grounded, and I just had, I just, I found myself looking at it, and I was looking down, probably, the whole time I was wearing it because I found it, like, oh, it's so beautiful. <laughter> But, yeah, I didn't notice as a different sensation other than the just weight of wearing it, the extra material.

A2: A little, a little bit of license to move as, as a costume. The other thing I thought, after I put it on, I thought, wonder if I put it on up here. <laughter> I really thought, oh, oh, ok, it was very interesting, the alternate ways of wearing it, other than around the waist, which would've been really interesting...

Q: Well, we'll definitely get you involved in the alternate garment construction workshop. <laughter>

A2: That'd be fine, I just, I just suddenly thought, you know, you do the normal thing and I thought, oh, I wonder if I have time to take... well, that's ok... <laughter> You could put it up here and whether it's still...

Q: And so, the shift from one source of body data to another source, how, how was that transition?

A2: It came instantly. It was really interesting, really completely different, just all of a sudden very much up here. <touches shoulder blades> Again, I had trouble figuring out a band configuration, would be this section of the body, figure eights, or... I ended up putting it on my neck, but, you know, because of the connection, but it was really fast.

Q: And did, was it, was it sort-of just like waving at you once you gave it the opportunity to?

A2: Somehow, it wasn't like I was aware of it before, and you said, you know, what other data are you getting, and I thought, oh, woah, <laughter> Right there, right there, that's data... that was fun.

A1: I sort-of had the same experience, just as soon as you said to switch, I felt my foot moving, my toes and just pushing into and away from the floor and, but it felt really external – like breath, breath is so internal and is so involved with your core and your foot is pretty much as far away from that as you can get, without leaving your body. So, it was a really different experience, trying to work with that and play with that and concentrate on that sensation. But...

Q: And so, I'm curious, in terms of the, the data sense, were you aware of the sense of pressure?

A1: Yeah, that was mostly what I was going with, just the pressure into the floor and the weight of my foot...

Q: Pressure point?

A1: Yeah, pressure and weight.

Q: And, getting back to you, quickly, before <unknown> shifting to the neck and shoulders, if you had to give that some sense of what, what that data was, data is such a horrible word...

Appendix D Workshop 'resonance within' / 'resonance without'

A2: Again, like the, like the beauty of the second time, in a way, was I wasn't thinking of categories, like, breath, or electricity, or anything, but when I was asked to analyze it, later, it seemed either tension or electricity.

Q: That's very interesting.

A2: And I, I was thinking, the same thing obviously happened to you, you were just aware of, boom, my foot, but not thinking, oh, is that muscular data, is it electric data, is it breath, is it blood flow, no, it's just my foot.

A1: Yeah.

A2: And later, oh, it's about pressure... whatever.

Q: So, did the moment of giving appear different for either of you two, from the previous giving moment?

A2: Yeah, oh, very much. I felt it was almost like every, all of us were in some sort of pain, I know that's kind of weird, not in, not in an agonizing way, but it's like here <touches head>, I, you know, I take my energy in my head and the energy in my foot and take the energy in my shoulders and that's what it felt like and all of a sudden there was this healing moment where I like "ok..."<laughter> That, that's just the image that I got from that. Not sure, really fascinating.

A1: I, at first I had, I had to think, I'm like, ok, how can I give this energy to someone else, through my foot, so I ended up stepping on the feet. <laughter> Because I, I couldn't, it was the only thing that made sense to me, so I just went with it. But, yeah, it really did feel different than the first time, the first time we sort-of came together.

Q: Well, thank you very much.

D.2.5 Workshop Response Cards Transcription

heart[h] workshop 02 – November 9/04

Part A – resonance within

When you had the blindfolds on and your attention was on your body data, what did you sense? Where was it moving in your body?

° breath tensions, body lines – balance (or lack of!); breath – growing and retracting in the chest belly and then back; it extended out in wave and beams then pulled back in

° I sense that my other senses grow stronger and more sensitive. I feel my pulse and blood form a stream flowing directionlessly.

° I sensed many things breath was first, then my blood flow pulled my attention. the blood flow was filled with heart and moved in waves of openness and thickness through my body it felt thick like the tide, and warm with viscosity – I could feel the light particles within it. It moved always through my heart gushing through my neck – it was circular and sometimes demanding, warm like milk and honey – full of stories, memories, truths and lies licking the sides of the veins and arteries filling the mind with warm stealth; moments of stillness, light

° I sensed my breath and my heartbeat immediately. After a while I began to sense the movement in my muscles and my eyes. I became more aware of every sensation – my thoughts, the weight into the floor, my temperature, the sounds around me; it moved from my core out through my limbs and into the space

° I sensed that the participants' sense of space either expanded or contracted, depending on their mood and other factors. The feeling of space seemed to move towards the hands, it was an extension of what they were feeling inside.

° Uncertainty and questions rose. then tolerance came and "let go" more free, care-less; senses enhanced with curiosity instead of uncertainty and questions. With curiosity came exploration.

° A strong sense of heartbeat appeared, then my attention slowly shifted to breath. It was rather chaotic at the beginning, but then I started to sense the breath flow from chest to arm.

° Breathing in and out; lungs expanding and releasing; release of tension; calm and relaxation; chest and abdomen

° calmness, sense of wonder; from one side of my head to the other then to my abdomen where the sense of calm was disrupted.

° emptiness. maybe I'm not alive. Was I alive? or was it a nightmare? was it just a dream and I'm just afraid of losing the data? Wasn't afraid / scared of doing anything because I don't even feel myself anymore. It's great. It felt like I was GLOWING and I push the air away. or I glow bigger and brighter and stronger when I hold on to myself. It was from within, spreading out glowing from inside me. I think people can see it.

Appendix D Workshop 'resonance within' / 'resonance without'

- ° heat, ranges of temperature – through my head, on my fingertips, in my feet; rhythm – in my chest, in my wrists, in my neck; relaxation – in my head.
- ° I felt a flow, a counter clockwise spinning from the base of my spine. I spiraled around and outside and inside my body. At times if felt hot, this happened when I concentrated on it
- ° I felt the force of gravity pulling me down and the air flowing between gaps of body. I wasn't sure what it was, but my arms and my body had a space, like two electrons repelling each other.
- ° movement was significant at one point then release; I felt a need to sit down before I can focus all my energy on a data spot, the standing make me more aware of my legs, but the sensations are on my arm.
- ° hand movement with sound; my muscle
- ° It seemed as if the senses increased and the participants became more in tuned with their limbs, often causing people to sway or make slight movements.
- ° The sense of motion and body was extended through the movements of the skirt. The skirts denoted sense of self, movement and intimacy. Flow and mixture of body data was translated by the skirt.
- ° very smooth, far far away from the real world.
- ° From my perspective I feel the "flow" for each person is different. Some of them are organized and some generate "flow" randomly.
- ° heaviness in my arms spreading to joints
- ° uneasiness, wanting to seeking out, because know less of the environment. at the same time, restraint, unnaturally still

When you went inside the sensation, how were you able to transmit your body data? How did it move you?

- ° ebbing movements, through the arms, and through the back; swirls, lifts and lowers, waves – it made me want to sing
- ° I transmit data into the space by exaggeration by filling my body with the movement and letting the energy flow out of my extremities; it moved me to reach out to others through the medium of touch contact, sharing weight and breath.
- ° once inside – the sensation took my entire body over – it moved in circular pulses from the centre outward – but always returning to the centre, always returning to stillness – then the warmth took over again needing to more – to create in a gushing; it wanted to lift me up, up, up through my neck and head up through the sky then down down down
- ° The data flows in my body as if it is a stream, a stream that wants to explore and contact to another stream
- ° Their body movement was projected outward, transmitting outward, it seemed to me. It compelled them to encompass the great void around them, through movement of the arms and through walking

Appendix D Workshop 'resonance within' / 'resonance without'

- ° Exploration and "play" factor came in. set of "own rules" and began to play with the environment. Questions rose again but with less uncertainty.
- ° By helping it flow out of the body with assistance of the hands; slowly, calmly, carefully, with ease
- ° Concentration of space and flow. Movement was slow and very cautious. body reacted simple without too much calculation in mind
- ° Flow of exhalation -> transmit to outside made me rock a little; caused me to move slowly and gently through the space like air
- ° Focusing on the body data I felt the urge to spin with the flow. I would turn counter clockwise as I walked.
- ° it focuses all the attention onto one point and found the fastest route out the body
- ° my brain went empty and I could hear was the glowing sound (NOT MUSIC!) I held myself together or find my most comfortable position to help the data grow. I think if it glows enough it'll transmit to somewhere. or not even transmit, just, like a water color. It spreads like water. I move like I'm a paper with water color all over me.
- ° through touch; touching vital places that would be most sensitive; touching an area that creates a stronger but same sensation (wrist pulse -> neck pulse); it moved with the person, as a child to the parent, wanting to lead but unable to do so.
- ° When I went inside the sensation, the intense feeling of heart beat made me walk with stronger steps just to release the intensity
- ° It flows like a river.
- ° It seemed to conflict with a natural sense of movement, it caused users to think about their movements and less on an inner sense of movement. There was confusion.
- ° The body data transmitted through internally and caused the participants to focus their attention to each limb.
- ° through sense mostly visual
- ° Again, the transmission I feel between the participants are very natural, it's more like they transmit the data by their instincts.
- ° limbs reached out ... unsure if the others will reciprocate or accept contact. But steady exploration.
- ° through touch I saw; I focused in on hands; zoomed

Part B – resonance without

When in the skirts with the bands on your body with your attention on your body data, what did you sense?

- ° A weird feeling of being enclosed arrived at the beginning, then I started to sense my muscles (arms) being intensified.
- ° an increased sense of heaviness towards the feet and a different sense of movement from the fabric and texture of the skirt
- ° I feel being a bit different in how I am limited in my movement. It takes a while to get used to it
- ° I felt that my attention was more focused towards the part of my body that had the band around it, and the initial impulse that started the movement
- ° I lost my sense of fashion. The skirt is totally not my style. The band made me wonder what it is for.
- ° I noticed the body data less even if the band was focusing the area. It dulled the overall sensation.
- ° I sensed reservation and curiosity
- ° Included, connected. "Emergence"
- ° It seemed to me they were sensing the clothing that they were wearing, and they became more attuned sensually of what others around them were sensing
- ° It was a bit distracting and I could not sense as much, especially with the band on
- ° naked
- ° Same focus – on the breath – swells – it was hard to find the place for the band.
- ° The band around chest/abs restricted how I exhaled, bringing more attention to data. Made me feel trapped in a sense, similar to suffocation.
- ° The bands seemed to solidify the sense of body. The bands provided a counter balance to the flow
- ° the skirts allows me to flow freely
- ° weird
- ° When I took the blindfold off, I still wanted to close my eyes, to stay within – I noticed a feeling of 'home' in the skirt – of having the skirt hold me in ever-loving arms – my pulse was safe inside the skirt, my movements became larger – easier – I felt at home in the space
- ° a stronger connection to the sense / body data; if focused the energy there.
- ° Pretty. soft. Frantic because my body data wasn't soft. It's a painful data. But the fact that I was in a soft smooth dress made the bad data not as painful. I felt like

Appendix D Workshop 'resonance within' / 'resonance without'

maybe something is protecting me and preventing bad feelings. Not really that painful of data.

° covering / restraining the body. More arm movements. Feeling stationary? Tied down?

° I think the participants might feel there are "barriers" on their bodies.

When you went inside the sensation, how were you able to transmit your body data? How did it move you?

° Able to grip on to others to transmit the tightness and restriction I felt. moved me even slower, like being held back

° Feeling the movement of the skirt while I walked.

° Flow is obstructed by the music.

° I transmitted my data by bumping into other people and flowing through the space in either a slow or quick manner

° I visualized sending breath to others – physically it made me flow to them and around them; this is when sound really wanted to come out

° No

° sometimes sensation are significant and is rushing out from my hand. It also lead where I should walk to.

° The best way to transmit breath to others is through the rhythm of the body while breathing

° The body data it transmit through the touch and move when I collide to others. My feeling gets expand because of the large size of skirts

° the body data was transmitted

° transmitting became or moved from inside the skirt to inside the space; the space became the skirt

° Unsure.

° When I was inside the sensation, I transmit the data by grabbing others' arms

° With my sight returned, I regained some balance. I could walk and spin more freely.

° I treat it with a happier mood. Maybe it isn't that painful / bad and maybe if I transmit it to someone else I won't feel painful. I had a rhythm I tried to move as calm as possible.

° It gave a primary focus, not a body connection like what happened without the bands.

° After touching / connecting with another, move smiles and positive reinforcement to continue and transmit to others

Appendix D Workshop 'resonance within' / 'resonance without'

° I think they transmitted data partly by using the bands and skirts.

What other places in your body called your attention? How was this different, if at all?

° Desire, mental state, and spiritual feelings.

° Head. Inside the head; maybe the background sounds started to affect my mind at the end of the experiment.

° Head. Trying to figure out what I should do.

° I haven't had lunch so I'm hungry. This is probably external to the body data I was initially supposed to feel so this may have altered some responses

° It seemed that their heartbeat and their breathing became more noticeable to them. Also, their appendages like their arms and legs seemed to attract more focus.

° Moving around the space I noticed a drop in my hearing sensitivity with out the blindfolds.

° My foot and the pressure into the floor, how that affected the rest of my body's organization; less internal and organic

° my head calls in a lot of attention; it's like sucking in all my thoughts

° My leg, need to move around

° My mind is out of sync. Time became irrelevant

° my third eye began to call me – it was very 'attentive' in a quirky – faster – the speed of the connections sped up – my movement became quick –staccato, I could sense lights impressions from many directions at once

° My torso, it seems to have been tighted to something

° Shoulders – totally different – muscle tension and electricity – sharp jumpy moves. very hard to place a band on the shoulder girdle

° shoulders; force of gravity bringing shoulders down; tension bringing body to ground.

° the feet, when the participants closed their eyes they had reservations about moving around the space

° The hands and placement of feet seemed to compliment the sense and movement of the skirt. It was not very different, just complimentary.

° the mind, the heart and other organs

° It was totally opposite place, it was more painful. It caught my attention by causing me my pain.

° My head; it got hotter, wanting release rather than cooling.

° I figured an interesting thing about how their feet moved.

Appendix D Workshop 'resonance within' / 'resonance without'

° Legs. Wearing clothes that are uncommon. Covers a significant portion of body height.

How were you able to transmit your body data? How did it move you?

° As my hearing dulled I sensed on my shoulders. I walked sideways got a breeze on it.

° By pressing their feet into the floor with my foot; experimenting with different ways of pushing into and off of the floor.

° By touch others torsos. It might increase also others sensations on their torsos. That is when I transmit my data

° I think the participants noticed the other people (stills, videographers.) Although I wasn't transmitting my body data, it seems they could feel our presence.

° jumps and twitches – sharp head movements to the side – I was pulled back from the shoulders. Physical contact with others – almost giving the tension away allowed transmission

° look at everyone else's action and mimic their movement.

° my third eye wanted to move directly in a line to another – to / through the space it was fast and long – it wanted to put its 'eye' on others directly on the bodies in the space

° N/A

° Physically with passion and urge.

° stoned.

° The bands seemed to give a point of reference. Something to observe.

° The feeling made me want to go away from people.

° The hunger in my stomach disrupted other body data so it made me want to move quicker in the space

° then it transmits to other places and out my body

° Through muscle

° Transmit by bringing others down at shoulders, pushing downward slowly

° It wanted a release, so it chased to find a vessel.

° It was like my back had its own mind. it leads me

° Sight. More focus on each other's actions from clothes.

° They somehow transmitted the data (energy) through their feet.

D.3 Workshop `self to self' / `self to other' / `self to group'

D.3.1 Workshop Response Card

ilab the whispers research group – HEART[H] experience workshops



part one: *self to self*

When you had the blindfolds on and you were listening to your breath, what did you sense ?

When you went inside with your breath, what did you experience?



part one: *self to other*

When you had the blindfolds on and you were sensing your partner's breath, what did you experience ?

What was the sound and rhythm of their breath? Were you able to pass information to your partner through this sound or rhythm?

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

ilab the whispers research group – HEART[H] experience workshops



spacious breath: *self to other*

heart [h]

heart
+
breath

When the blindfolds were removed and you could see the visualization of your breath and your partner's breath, what did you sense?

When you were able to connect the visualization of your breath and that of your partner's to the sound, what was your response?



spacious breath: *group self*

When you were asked to sense the breath other the other members of the group, what did you sense?

Were you able to communicate your breath data or receive the breath data of other group members through the sound and visualization? What was your experience?

D.3.2 Workshop Data Analysis Grid

heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)	
Attributes Documented	Patterns/themes - based on type of participant Written Observations
movement qualities / gestural elements	rock, tilt, sway, fluid yet tactile; try to loosen up, swish, sway, sashay around, it moves on its own! Swing it around, move, move, move faster, jog; sloth, ministry of silly walks, stuck in clay, freeze, flapping, swing the arms, move the breath, give it away; push air, target, direct it, chase it, hop, push, force; aerodynamic, compression and controlled explosion; drop to the floor, squat, lay down; flap, flap
sense of breath	I can breathe; sense of breath, shared; exhale; slow, slow, slow synchronized breathing; a flow of air through the nasal cavities in the throat, negative pressure created by flexing diaphragm sucking air; I breathe, huff and puff
sense of concentration	control the wave, watch the output, control through breathing; sit like Buddha. Ohhmm.
sense of awareness	intenal movement, lungs inflate and create rhythms; stillness; a weight on the waist, this thing is heavy; it's too small, my butt is too big; take up space
body as home	
impressions / sensations	butt to butt. His ass is touching mine! Hisssss; noises, waves, soothing rolling waves; I am the receiver
emotional qualities	calm, relax; waiting, anticipation, fear? Nerves, blind, deaf, all eyes on me; slow, cold; hunger; closeness; nearly frightening; I feel pretty, oh so pretty

Table II.7 heart[h] Workshop 3 Data Analysis: Participant Observations, 1 of 2

heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)		
Patterns/themes - based on type of participant		
Attributes Documented	Written Observations	
shapes / colours	they're so colourful; clear skies; which one brings out the colour of my eyes; does this match my shoes	
stories / fragments	closed bodies in preparation of the unknown. Unspoken and still, solving the issue of comfort vs. function and operation; sink into the surf and fade away; wheat stalks blowing in a field; this is a prom dress! Give your breath away (love theme from Top Gun); I'm a cyborg, I'm on live support; the once chaotic mess in the space attempts to grow as one object wanting to collaborate their different needs together; parallel lines of thought begin to form unifying the many tangents running wildly in my mind extending into the space; deciphering the rush of raw data, I wander the sensory boundaries that drive us daily back and forth under the umbrella of life	
stream of consciousness	pay attention. breathing, breathing, breathing, a group of connected, tethered users limited by space, a leash, a lifeline, a plug that restricts freedom, some are better breathers than others, mirror, mirror on the wall, life boat gone; change, arhythmic. new. sync. in/out in/out in/out in/out; soap suds that could be carved in shape and shaped noise; which one am I? Oh, there I am. We breathe as one - can we all breathe? slow, cold, sensor exploration, stylish scarves with velcro accessories, guys on leashes; surf, gentle white noise; there is a hole in my sock; still, loud wave; where's the duct tape; fashion show; the darkness consumes the space again	

Table II.7 heart[h] Workshop 3 Data Analysis: Participant Observations, continued, 2 of 2

Heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)					
Response Cards	Participants	Videographers	Photographers	Drawers	Writers
Descriptive Qualities	<p>resonance within: felt like I was observing an experience rather than having one myself; Loneliness, only not lonely because of the connection to the other person behind you; a moment of peace, just for a moment; Struggle, detached; careful, funny; Connection through touch and breath; sameness; Inside sound, feel the other person in a more personal way than just visual, and hearing their breathing</p>	<p>resonance within: relaxing; centered</p>	<p>resonance within: isolation, one, alone; a sense of calmness, relaxed yet aware; Calmness, unification; sense of calmness from participants; some bodies seemed to be trying to adjust and gain a sense of self-awareness; Tranquility; a sense of distrust, each breath did not want to release its autonomy. a power struggle</p>	<p>resonance within: comfort, isolation, withdraw, rhythmic order ; chaotic comfort; self-awareness, my sense of being; calm and insight towards myself; Concentration and the slow release of self-consciousness; open space within a safe zone; warmth through acoustic feeling / sense (similar to perhaps a child in the mothers womb); unity; Calm, senses seemed sharper; exclusion; familiarity, support, repetition, comfort, dependency; sense of sharing</p>	<p>resonance within: A sense of relaxation tingling traveling up my spine an eerie experience; completeness, sense of being full. Expanded; Slightly eerie a stalker, sense of taboo attempting to normalize myself to my partner's experience; sharing</p>
	<p>emotionally</p> <p>resonance without: competition, trying to make yourself breathe the same, or trying to create the more movement; I felt more limited to my thoughts and movements; more harmony / unity; happiness; control; confusion, unknowing; Felt more connected to the group than just partner; community yet some apprehension; easier with partners; I didn't feel like I connected with anyone. Lonely; I felt relieved and assured that I could sync with so many people. I felt happy and excited</p>	<p>resonance without: like a robot; like a cyborg</p>	<p>resonance without: control, safe, alone; injection back into the raw, real world; thirst, awkward, emptiness; I sensed chaos as it was hard to try to match up to the people who are trying to do the same. I sensed a need for leadership and I tried to take control</p>	<p>resonance without: Commonality, relationships; validation; Excitement; Sense of control, although limited; a familiar feeling triggering previous experiences</p>	
poetically	<p>resonance without: There was a sense of unity and rhythm. There was a consistency between ourselves and the visual</p>	<p>resonance within: A sense of suspension, of the illusion of singularity in a group of people. A unification of breathing temp</p>	<p>resonance within: euphoric. I could sense the exchange of air down to the cell. It's rhythmic movement throughout my body; It's communicative properties through interior exterior space. My body was an artifact; the breath was the life; sailboats or what I would imagine as a pirate ship; dizzy but not nauseous</p>	<p>resonance within: I found a pattern, a rhythm. It's a type of pattern that seem to last forever. A sense of being alive</p> <p>resonance without: Data was passed. It was like many voices whispering at once</p>	<p>resonance within: Flowing, swirling. Pressure and inflation. Coolness and nourishment</p>

Table II.8 heart[h] Workshop 3 Data Analysis: Response Cards, 1 of 5

Heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
body state awareness	<p>resonance within: a feeling of resistance and occasional acceptance and lapsing in and out of relaxation; self-awareness</p>	<p>resonance within: I was focusing on my breath. It was playful because people could control the sound and they played with it; my heart; body movement; You were able to sense your body a lot more. also, the air felt more real, it had more mass than it really did</p>	<p>resonance within: A sense of the rocking motion and the flow of air in my body. The air went from center, to feet, to arms, to head; the air flows within my body and its directions and rhythms; my back felt hot; The body making constant corrections as it tried to accommodate the extra air in it. I could sense it in the nose / mouth and in the chest cavity, but not in between; the fat in my arteries in certain places as I felt my blood circulate; I felt my ribs locking up and need to keep relaxing them; I was more worried about my balance as I felt like I was going to fall</p> <p>resonance without: I could feel their breathing. Even if I couldn't hear it or see it, I knew its rhythm</p>		<p>resonance within: Silence, a light sigh my body catching up on the level of air intake the awkwardness of having to tune to that feeling was new; The air in my nose. The observant silence of others</p>
	<p>resonance without: a sense of unity, being able to experience the other's breath through your own; Again a sense that the room was more in flux as it was connected more to everyone. I felt warmer and immediately breathed faster; While originally fragmented, the group eventually started to all breathe at the same rate</p>	<p>resonance within: the sound was a representation of what they were doing, they could communicate through the sound, passing information</p>	<p>resonance within: Could feel my heart beating, felt my breathing rate changing rapidly; feeling the weight of my body</p> <p>resonance without: I pictured the visualization as a sound wave and it matched up pretty well with the air going in and out of his chest; Trying to see how changes would take effect on the sound; I was not thinking about connections - I captured them occurring for others</p>		<p>resonance within: Huffing. By exaggeration you can make audible</p>
literally/ details	<p>resonance within: not sensing the other person so much as sensing the sensors that were sensing him</p> <p>resonance without: Up until then, the wavelength did not give an immediate sense of tangibility, but after hearing the sounds, there was an easier connection made; It was easy to communicate the data through the visualization; Sound was very helpful in sharing breathing rate, but the visuals seemed to abstract from our shared breathing</p>				

Table II.8 heart[h] Workshop 3 Data Analysis: Response Cards, continued, 2 of 5

Heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)				
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers
	Writers			
abstractions	resonance within: Singularity inside a group. The ability to retreat and reflect; concentration; spreading of senses	resonance within: inner and outer presence of energy. It was a loss of time and place. My body was heavy yet soft; I felt as though I was in an endless space. There was nothing on my mind aside from the occasional itch that I would feel; I thought that experience was highly ritualized; reminded me of a high school theatre warm-up or a Masonic ritual; Complete blueness. I felt blue, I could see blue, I was blue; I developed an experience of form and shape that my breath defined; Again, just a sense of a boundary-less space. I just felt more light physically; the energy flows within the body; a sense of awareness outside of the body; one participant's body seemed to adapt and sense and anticipate the kinesthetic qualities of the other; seemed like an extended sense of self-awareness; more so than just listening to the breath	resonance within: Sense of communicative space, individual is gone; stillness, togetherness, uncertainty; Inside brings out the individual and the private. Your own individualism swayed the masses; Experience conflict and acceptance. negotiation of space, navigating individualism; group, collaboration, harmony; I was able to communicate using a different language, a different sense; it seems like we became one	resonance within: peace, sense of being, existing, peace, life throughout my body. awareness of Being

Table II.8 heart[h] Workshop 3 Data Analysis: Response Cards, continued, 3 of 5

Heart[h] Workshop Data Analysis - Dec 7th/2004. Workshop (3)					
Response Cards Descriptive Qualities	Participants	Videographers	Photographers	Drawers	Writers
	resonance without: recognizable pattern and a sense of network; parallel sense of being in the space; It seemed like a challenge, but the network of breath slowly emerged; sense of being in a network		resonance without: My being did not want to see. it only wish to rely on sensorial data that was less defined. Through the sensorial interface our breaths could negotiate with a higher fidelity; A private function made public; a normal act made different; Unification. The group had come together as one entity; further distance from the big grid we experience every day – and the reintroduction to closer, more intimate connections; The effort in trying to be unified, operating as one breathing physical entity; The experience became a lot more abstract as if we were something else, something on a larger scale	resonance within: loss of balance, it was hard to stand up. other times I didn't even notice anything except rocking; It was hard to stay still as it felt as if the air going in and out was causing me to sway	resonance without: Applied order to complexity of experience. Visual justification
abstractions, continued					
gestures / movement qualities				resonance without: Movement almost like a static field the ebbs and flows	

Table II.8 heart[h] Workshop 3 Data Analysis: Response Cards, continued, 4 of 5

Heart[h] Workshop Data Analysis - Dec 7th/2004 Workshop (3)				
Response Cards	Participants	Videographers	Photographers	Drawers
Descriptive Qualities	<p>resonance within: watching this, me listening to myself think about them watching me instead of listening to my breath; distracted on purpose?</p> <p>resonance without: Community again. Sense of being. telepathy / control of other bodies</p>	<p>resonance within: people started to move and breath together. they didn't need to see each other to communicate</p>	<p>resonance within: pattern of body movement; : the moment and people in it. I couldn't feel them but I knew they were there; they all look surface calm yet with some inner tension; from the readout on the screen, it seemed as if the participants were able to send signals and adapt successfully</p> <p>resonance without: it seemed like they were focusing more on the screen visualization more than their breath</p>	<p>resonance within: Others around me, the movements of air within the space. Focus of thought; I sensed connection, I sensed the significance of my partner's presence</p> <p>resonance without: it looked like they were having fun. their body was the controller and the sound responded to them, it was a game</p>
awareness	<p>resonance without: A collaboration of breathing. Almost a group effort.</p>	<p>resonance within: A more direct unification in breathing, two nodes acting as one; The swaying and act of breathing was able to send directorial messages</p>	<p>resonance within: My breath wasn't natural, I was controlling it. It was nearly impossible to breathe at a natural pace; I felt textures of a soft roughness like chalk that my breath was passing over. I kept focusing too hard on my breath rhythm rather than letting it happen naturally; the movement of the ribs, the frequency of the expansion of the body when breathing in and out; I thought we were breathing in sync, we were rocking slightly and that made me think that we were in sync but opposite, he breathed out, when I breathed in, vice versa</p> <p>resonance without: Slight, momentary disbelief. Not sure if it was actually our breath, wanting to verify it by making a sudden change</p>	<p>resonance within: Slow pulsing. A slight sensation between the breathing of one and the other; The sharing of one organ</p>
breath		<p>resonance without: probing breaths, looking for one another</p>		<p>resonance within: unison of a rhythm and breath, two beings wanting to join and become one by the sensation of breathing automatic emulation and seeking harmony and balance with the other body</p>

Table II.8 heart[h] Workshop 3 Data Analysis: Response Cards, continued, 5 of 5

D.3.3 Exit Interviews

D.3.3.1 Exit Interviews Dancers

Q: When you were, you were with blindfolds on at the beginning, when you were just listening to yourself and your own body, and, mostly you were listening to your breath, what did you sense? And either one of you can start...

A1: I would probably say that I sensed at the beginning kind-of feeling of definitely just starting, not, not having done much breathing or being, coming into the space and finding myself not in touch with my breath, and feeling that kind-of just trickle through my body, I guess, over time.

A2: Well, for me, I entered into the ritual of "this is the exercise of checking in with my breath" and this is something that I've done with many different groups to which I belong, so my experience was "alright, we're at this point again" and so I got in quickly, even from the exercise beforehand, which was simply, probably, basically getting us into a space, ready to go on with the blindfold thing, so at that point, yeah, I was checking my channels of, you know, of air and things like that.

Q: Ok, so, the second part is sort of the same. When you were inside, what did you experience? Is there anything different that you want to add to that experience of taking in after maybe with the blindfolds on and then with the breath sensors on, perhaps, the difference in the experience?

A1: I felt a bit constricted by the, by the breath sensor and a bit, like, hyper-aware of, that it was there. And maybe even sending, not sending my breath there but, like, that's where my breath was going, as opposed to deeper in my body or lower in my body.

A2: When I breathed, I often think about how air enters into my lower back. When I made a specific exercise of doing so, I can see the, it was actually opposite, it was interesting, to breathe in, I felt, basically, the energy lines going in opposite direction to, to where the inhalation goes and, breathing out, I felt a pushing down of air to push it effectively out, but... that was interesting. But, yeah, with the, with the constriction of something around my chest, as soon as I wasn't considering the fact that my breath is something which is deep, that goes away and it becomes a matter of breathing to my chest, so it was consistently a negotiation between, between, yeah, which type of breathing I'm, I'm feeling.

Q: Really cool, interesting. Ok, so when you had the blindfolds on and you were sensing your partner's breath, what did you experience?

A1: <laughter>

A2: Ok, for myself, my partners breath was something very, it was a small push, it was, there was hardly... I didn't hear her breath, first of all, and the, the sensation of her breathing was very small. What I did notice a lot was the rocking and that was exaggerated, particularly when both of us should inhale at the same time or both of us should exhale that, woah, we create quite the rock. Otherwise, we're filling each other's spaces.

A1: Yeah, I found it difficult to stand because of the lack of visual information and then sharing weight a bit – I was, like, am I not giving enough weight here, is the, because it was very dynamic and I felt Shawn's breath and I felt the moments that we breathed

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

together. When we were – and this might be the next question – but we were asked to be responsive or to be, to communicate, the one communicating and I think I felt more calm when I was the responsive one, my breath felt more natural. And then, when... but then I got Shawn's headache. <laughter>

Q: So, you felt it, you felt it, empathy, empathy for him?

A1: Yeah. <laughter>

Q: What would the word be? Not really empathically, more like...

A2: Sympathetically.

A1: Yeah, I felt increased heat and yeah, increased, like, heat and awareness of both shoulders, they were very... a lot of feeling and, but it was enjoyable to be the one communicating, because I felt like, when I was just my breath had some, was being felt it was going somewhere.

Q: Nice. And, do you want to add to that, I guess?

A2: It was, I believe it was around this point that I started getting into, like, woah, woah, woah, and collapsing.

Q: Do you know, do you know what that might have been from? Was it too much oxygen, or?

A2: I don't think it was necessarily related to oxygen. Again, this is something which I'm comfortable doing, the breath and all of this stuff. I'm, I don't even think it was the lack of visual data as, as Lori said, that, that led to this.

Q: Although your equilibrium could've been off.

A2: It could be off...

Q: I mean during that time.

A2: I'm not, I'm not exactly clear what's led to it.

Q: Ok, that's not what this is about, so I was just curious. So, I don't know if, if because you have a headache, this is going to be, maybe you'll be, have enough time to think about this experience – was the sound, did you have an experience with the sound, with the rhythm of your partner's breath and, well, you kind of talked about this, were you able to pass information through the sound or the rhythm and, and that also being through the, the sound in the room? The visualization, you couldn't see the visualization at that point, but the data the program was transmitting from the data, were you able to sense the rhythm or, or, or get a sense of the differentiation in the sounds from, from what you were hearing, in terms of breath?

A1: Yeah, I think so, that was the moment that the three of us were also together so I think that it was more, maybe, even my head at that point where I was, like: Ok, so the noise comes when I breathe in, I think, not, not breathing out, and then, sort-of, being like, more curious about that.

A2: Similarly, I would, I would basically breathe and wait until the sound reflected what I was breathing and I would test it by, by taking a longer inhalation and saying "ah that, that would have to be mine" and then also hearing... and it would be limits of

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

the technology, I suppose, but like the skip between one person and the next, was an indication where I became aware of "ok, this cannot be the same person" so, you know, we have a, yeah...

Q: Cool, you might let us squeeze in here... pulled out as I can be here...

A1: I can come over here.

Q: Just have to... there we go. Maybe I'll come through the side like this, you might... maybe put it on the couch or just sort of... oh there, it blends right into the material. So, we're on to the second side, we're talking about now the group breath and I think after the blindfold came off. So, when the blindfolds were removed and you could see the visualization of your partner's breath, what did you sense?

A3: Chaos.

Q: Chaos?

A3: That was, yeah, that was the first sense that I had during that. It seemed very chaotic. It took me a moment to find my own breath again.

Q: Even though you were seeing something...

A3: Yeah. And I'm not quite sure whether that was the visual stimulation of seeing it and just the processing time, or just being lost for a moment in the breath.

Q: Sometimes also the visual will sort of wash over the other senses.

A3: Yeah.

A1: I think I felt some sort of sense of... not relief, but ease in seeing other people moving in the space and then seeing the colours of the skirts; I thought I felt more comfortable.

A2: After the blindfolds were off I thought... I felt in the still breath, in the standing there, that it was the same energy as had been navigating the space. The visualizations – again they were a kind of visual indicator which person am I, relative to the other people in the room. I was able to pick Lori's pattern, based on having had my back to Lori's, and so I saw "ah, that would have to be, have to be hers" and then, by a process of elimination for the group one, because in the, in the triangle base, in the group I didn't gain a particular push-and-pull feel of whose breath was whose. Yeah, it was, that one was auditory.

Q: And when, so once the blindfolds were off and you also got a sense, you'd had a chance to listen to the audio, prior to taking the blindfolds off, once you got to see the visualization, were you able to pick out the sound again, and what was your experience like?

A3: Have to think about that for a minute...

A2: I've, I've got one. As far as, yeah, understanding the visualization. Oh, the first I guess, the sound as mine, I said, well, I have a longer, slower, breath, so I go than the other two participants. From that, that understanding then, said to me, if I'm looking at one of these graphs, mine will likely be the longest, perhaps with the greatest variability. And then, yeah. But it wasn't something which I immediately connected to sound to visual.

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

A1: And I didn't even, I couldn't even figure out which one was mine. I didn't look at the thing and I was thinking... yeah, I didn't know.

A3: It was easy for me to pick it out audibly, the visual didn't connect at first.

Q: Were you, were any of you able to, I guess the question was more <unknown> did you ever lose the sound once you took the visual out, were you still able identify your sound <unknown>?

A3: Yes.

Q: Ok, so that didn't change. I guess that I have to hurry up and join them, but I'll ask you a couple more questions. We asked you to sense the other members of the group, but were you able to communicate with the visualization and the rest of the group once the blindfolds were off and you were asked to move and <unknown>. Did you find that you were able to communicate through the sound and movement through the graphs and the...

A1: It felt to me like she asked more like how would, how would we communicate, and so I felt like I was able to be in a communicative mode and a, a responsive mode.

A3: Yeah.

A1: And I sense a difference.

Q: How did you communicate then?

A1: I would say that I amplified the sensations that I was having when they were just personal. It was sort of like an expansiveness. I think was because of the skirt as well but...

Q: It added to the effect, or?

A1: It, yeah, it – I'd say that it grounded me and allowed me to let that breath travel more into my legs.

Q: I think that you had the heavy one we made, too...

A1: Oh, did I? Yeah, and it opened up my lower back area as a receiving, or sending out area and it felt to soften my, like, front of my pelvis, as a receiving area.

A3: Pretty well, just to add on to that was, it was more of a sense of the breath outside of the body. It was still the internal breath but it was getting further and it had to do with the skirt – I'm not quite why or what it was but I had this real sense of just that whole breath around me.

Q: So, it sort of encased you or encircled you?

A3: Yeah.

Q: Like a glove or a blanket or something like that?

A3: Yes, yeah.

Q: A <unknown> maybe?

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

A3: No, more of the sense of the blanket, the thing surrounding me.

Q: Nice, nice. Something to add over here?

A2: Yeah, I felt that because the question was posed in the kind of theoretical, rhetorical, sense of "how would you communicate, if you were asked to" kind-of thing, I ended up working with the idea of a pulse, with the, yeah, with the, basically using vibration as something which I could use to communicate, but what ended up... because the questions were constructed like, specifically, "you are now wearing a skirt and how would you use the skirt to communicate", I, I felt that as far as inspiration goes, almost in the literal sense, that I was taking air up to fill the bottom of the skirt as if it were half, like in a hot air balloon, for instance, and then, in order to, to communicate out from that, that I needed to shake the I <??>, in order to, yeah, in order to get that energy going out.

Q: Nice, nice. Ok, that's sort of the last questions. Are there any other comments or feedback or experiences you want to share about this activity?

A1: Not really.

Q: No? Ok, thank you.

D.3.4 Workshop Response Cards Transcription

heart[h] workshop 03 – December 7/04

Part A/1 – resonance within / self to self

When you had the blindfolds on and you were listening to your breath, what did you sense?

- ° felt like I was observing an experience rather than having one myself.
- ° Loneliness, only not lonely because of the connection to the other person behind you
- ° My legs were twitching a lot the whole time; there's like twenty people watching this, me listening to myself think about them watching me instead of listening to my breath; distracted on purpose?
- ° Struggle, detached
- ° warmth, moisture
- ° comfort, isolation, withdraw, rhythmic order ; chaotic comfort.
- ° Concentration and the slow release of self-consciousness.
- ° Others around me, the movements of air within the space. Focus of thought
- ° self-awareness, my sense of being; calm and insight towards myself.
- ° Sense of communicative space, individual is gone.
- ° stillness, togetherness, uncertainty
- ° A sense of the rocking motion and the flow of air in my body. The air went from center, to feet, to arms, to head.
- ° euphoric. I could sense the exchange of air down to the cell. It's rhythmic movement throughout my body.
- ° I sensed uncomfortness, my breathing became a lot bigger as opposed to not having the blindfold.
- ° I was more worried about my balance as I felt like I was going to fall
- ° inner and outer presence of energy. It was a loss of time and place. My body was heavy yet soft
- ° loss of balance, it was hard to stand up. other times I didn't even notice anything except rocking.
- ° Loss of balance. It was hard to stay still as it felt as if the air going in and out was causing me to sway.
- ° My breath wasn't natural, I was controlling it. It was nearly impossible to breathe at a natural pace.

- pattern of body movement
- the moment and people in it. I couldn't feel them but I knew they were there.
- Awareness
- Calmness, unification.
- I felt as though I was in an endless space. There was nothing on my mind aside from the occasional itch that I would feel.
- I thought that experience was highly ritualized; reminded me of a high school theatre warm-up or a Masonic ritual
- isolation, one, alone; a sense of calmness, relaxed yet aware
- sense of calmness from participants, some bodies seemed to be trying to adjust and gain a sense of self-awareness
- the air flows within my body and its directions and rhythms
- A sense of suspension, of the illusion of singularity in a group of people. A unification of breathing temp.
- I was focusing on my breath. It was playful because people could control the sound and they played with it.
- my heart; body movement
- breath; light
- peace, sense of being, existing, peace, life throughout my body. awareness of Being.
- Silence, a light sigh my body catching up on the level of air intake the awkwardness of having to tune to that feeling was new.
- The air in my nose. The observant silence of others

When you went inside with your breath, what did you experience?

- a feeling of resistance and occasional acceptance and lapsing in and out of relaxation; self-awareness
- a moment of peace, just for a moment
- sound, air friction
- Thoughts not related to the present, mind wandering
- warmth

- Calm, senses seemed sharper.
- exclusion
- I found a pattern, a rhythm. It's a type of pattern that seem to last forever. A sense of being alive.
- Inside brings out the individual and the private. Your own individualism swayed the masses.
- open space within a safe zone; warmth through acoustic feeling / sense (similar to perhaps a child in the mothers womb); unity
- Something I've never experienced before.
- Complete blueness. I felt blue, I could see blue, I was blue.
- Could feel my heart beating, felt my breathing rate changing rapidly.
- feeling the weight of my body.
- I developed an experience of form and shape that my breath defined.
- I felt textures of a soft roughness like chalk that my breath was passing over. I kept focusing too hard on my breath rhythm rather than letting it happen naturally
- It's communicative properties through interior exterior space. My body was an artifact, the breath was the life.
- my back felt hot
- The body making constant corrections as it tried to accommodate the extra air in it. I could sense it in the nose / mouth and in the chest cavity, but not in between.
- the fat in my arteries in certain places as I felt my blood circulate
- Again, just a sense of a boundary-less space. I just felt more light physically
- black, cold; the movement of the ribs, the frequency of the expansion of the body when breathing in and out.
- Concentration, oneness
- seemed like an extended sense of self-awareness; moreso than just listening to the breath
- the energy flows within the body
- they all look surface calm yet with some inner tension

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- ° Tranquility.
- ° relaxing; centered
- ° Singularity inside a group. The ability to retreat and reflect.
- ° You were able to sense your body a lot more. Also, the air felt more real, it had more mass than it really did
- ° A sense of relaxation tingling traveling up my spine an eerie experience
- ° completeness, sense of being full. Expanded
- ° Flowing, swirling. Pressure and inflation. Coolness and nourishment.
- ° warmth

Part A/2 – resonance within / self to other

When you had the blindfolds on and you were sensing your partner's breath, what did you experience?

- ° careful, funny
- ° Connection through touch and breath; sameness
- ° n/a
- ° not sensing the other person so much as sensing the sensors that were sensing him.
- ° volume, warmth
- ° Experience conflict and acceptance. negotiation of space, navigating individualism.
- ° familiarity, support, repetition, comfort, dependency
- ° I sensed connection, I sensed the significance of my partner's presence.
- ° sense of sharing
- ° Slow pulsing. A slight sensation between the breathing of one and the other
- ° The sharing of one organ.
- ° A rocking sense and synergy occurred between us.
- ° a sense of distrust, each breath did not want to release its autonomy. a power struggle
- ° before we were instructed my partner and I had our breaths match up but afterwards when we were asked to we had a hard time to.
- ° Could feel his back move but I couldn't feel his breath. I would pause my breathing to feel but couldn't feel his breath
- ° I could experience the body movement, which in turn resulted a rhythm
- ° I experienced rhythm and balance at points but most of the time it was abnormal breathing rates.
- ° I felt my ribs locking up and need to keep relaxing them
- ° I thought we were breathing in sync, we were rocking slightly and that made me think that we were in sync but opposite, he breathed out, when I breathed in, vice versa.
- ° more unbalancedness. Now I had an extra source causing me to sway. As our breathing slightly differed my body was expecting to be braced by his but was instead touching nothing

- sailboats or what I would imagine as a pirate ship; dizzy but not nauseous
- a sense of awareness outside of the body; one participant's body seemed to adapt and sense and anticipate the kinesthetic qualities of the other
- concentration, contemplation; clarity of being, purpose
- Listening through one's body, not through the ears. By using other senses
- my partner's energy-flows within himself
- rhythm, moving as one; a sense of unity between the two people's movements
- Team effort, two bodies to one body
- There was a sense of a limit as opposed to the endless space which I encountered on my own.
- A more direct unification in breathing, two nodes acting as one.
- concentration; spreading of senses
- people started to move and breath together. they didn't need to see each other to communicate
- Listening. Feeling for movement but disconnected.
- movement, sensations of out of body receptors of their movement being as one.
- sharing
- Slightly eerie a stalker, sense of taboo attempting to normalize myself to my partner's experience

What was the sound and rhythm of their breath? Were you able to pass information to your partner through this sound or rhythm?

- erratic and difficult to define. very little information. 0.3% chance of telepathy.
- Inside sound, feel the other person in a more personal way than just visual, and hearing their breathing
- momentum, no
- n/a
- their own, yes was able to pass but not sure about whether they received it
- Dull and distant information was passed but it was faint like shouting into the wind.
- group, collaboration, harmony

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- I was able to communicate using a different language, a different sense; it seems like we became one
- Influence through rhythm in breath patterns passed between myself and my partner.
- irritating but constant repetition causes structure pattern comfort
- Slow in, fast out. The state of the other person's thoughts.
- Couldn't feel their breath, nothing was passed between us.
- It was hard to pass sound and rhythm with the blindfolds on, as we were too close to other breathers, but when we could see each other and the visual is was much easier.
- mostly a lagged rhythm, not really
- sound, not so much rhythm, yes; tried too consciously to synch up
- The information exchange was being interfered with. The interface was sufficient but it was like some entity between us did not want the exchange to occur.
- the rhythm was back and forth, we kept up through most of it
- The sound and rhythm seemed to comedianly sound. I could sense laughter. I couldn't pass information clearly, I'm not sure if he sensed me.
- They were transmitting the hard energy, and then it switched to something else, but I was unable to tell the second one. I sent a cat purring sound as that is what the experience reminded me of.
- We generated a rocking rhythm that was translated through our spine
- we were both trying it was difficult
- from the readout on the screen, it seemed as if the participants were able to send signals and adapt successfully.
- Grew heavier
- Hard to say as an observer; seemed slow, even with an occasional but regular change of temp / volume / length
- It was in sync with mine after some time. There seemed to be some communication to act alike.
- Slow, relaxed. Communication was possible
- the rhythm was almost the same between the partners, they seem to have started to breath under the same rhythm by the movements they feel from the other
- Yes. It passes the emotions or the energy flows within me

- ° I think they were able to.
- ° the sound was a representation of what they were doing, they could communicate through the sound, passing information
- ° The swaying and act of breathing was able to send directorial messages.
- ° Huffing. By exaggeration you can make audible.
- ° Not sure
- ° smooth even different
- ° unison of a rhythm and breath. two beings wanting to join and become one by the sensation of breathing automatic emulation and seeking harmony and balance with the other body.

Part B/1 – resonance without / spacious breath / self to other

When the blindfolds were removed and you could see the visualization of your breath and your partner's breath, what did you sense?

- ° a variety of outside information
- ° competition, trying to make yourself breathe the same, or trying to create the more movement
- ° connectedness, technology, omnipresence
- ° equilibrium; unless someone was messing with the sensor through unnatural fast pace breathing or they held their breath, it was a steady rhythm
- ° everyone else watching
- ° Felt like the breathing rate we had been sharing through sound disappeared as soon as we could see the graphs.
- ° I felt in tune with a machine and immediately felt connected to the other participants in a stronger way. I could suddenly hear the other's breath more clearly and noticed that everyone's partners were trying to somehow affect their people with the sensor in some way by breathing louder or looking differently
- ° I felt more limited to my thoughts and movements
- ° I felt the deep and very direct extension
- ° Isolated from breath like it was something separate
- ° it seemed like they were focusing more on the screen visualization more than their breath
- ° lightness, sense of being exposed
- ° like I was famous
- ° more harmony / unity
- ° Not so alone, people around; comfort
- ° put an image to something you normally cannot see. it made you focus on how you were breathing , for example, deep shallow, fast, slow
- ° recognizable pattern and a sense of network; parallel sense of being in the space
- ° seemed artificial; curiosity of whose graph is whose
- ° sense how we moved
- ° The lights blinded a bit but my breath became easier

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- ° The patterns had merged and that the messages were sent and received. Without seemingly direct communication, two people were on the same wavelength.
- ° There was a sense of unity and rhythm. There was a consistency between ourselves and the visual.
- ° Commonality, relationships
- ° validation
- ° I sensed a connection with the rest of the participants as I could now receive information about their patterns and not just my partners and mine.
- ° I sensed like we were trying to be one but one person was doing the breathing and the other was trying to follow.
- ° My being did not want to see. it only wish to rely on sensorial data that was less defined. Through the sensorial interface our breaths could negotiate with a higher fidelity
- ° Pattern, size conflict, weight
- ° A private function made public; a normal act made different.
- ° injection back into the raw, real world
- ° Slight, momentary disbelief. Not sure if it was actually our breath, wanting to verify it by making a sudden change.
- ° Unification. The group had come together as one entity.
- ° like a robot

When you were able to connect the visualization of your breath and that of your partners to the sound, what was your response?

- ° a sense of unity, being able to experience the other's breath through your own.
- ° Again a sense that the room was more in flux as it was connected more to everyone. I felt warmer and immediately breathed faster
- ° curiosity ; interest
- ° enhancing smell – big grid larger than life
- ° Felt more connected to the group than just partner
- ° happiness; control
- ° I traced it but wasn't completely in sync. Made sure to do as he did. Even made me yawn when he did somehow.
- ° It feels like we can communicate to each other internally.
- ° it looked like they were having fun. their body was the controller and the sound responded to them, it was a game.

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- It was enlightening to see the parallel between the sight and sense of breath.
- Just surprise. It was strange after the rest of the experience
- not changed
- nothing
- revelation, curiosity
- Slight disorientation
- they seemed to have a bit of trouble
- Tried to match breathing rates.
- Up until then, the wavelength did not give an immediate sense of tangibility, but after hearing the sounds, there was an easier connection made.
- want to play with my breathing to affect the viz
- wasn't able to connect people to visuals
- yes, the breathing rhythm was fast and unnatural, irritated to have to conform to it.
- Applied order to complexity of experience. Visual justification.
- Excitement
- control, safe, alone
- I pictured the visualization as a sound wave and it matched up pretty well with the air going in and out of his chest.
- It was a quick phase transition. There was no "awareness moment". It just happened and it was natural
- The connection became more vivid as if now we could think and see the other person's sense.
- A sense of achievement perhaps, of connecting ones self to another
- I was not thinking about connections – I captured them occurring for others
- The sound and the visualization matched up.
- Trying to see how changes would take effect on the sound.
- like a cyborg

Part B/2 – resonance without / spacious breath / group self

When you were asked to sense the breath of the other members of the group, what did you sense?

- ° A collaboration of breathing. Almost a group effort.
- ° Community again. Sense of being. telepathy / control of other bodies
- ° community yet some apprehension; easier with partners
- ° concentration; focus
- ° confusion, unknowing
- ° connections failing, being made
- ° everyone started to breath together. the group became one.
- ° first it was an instinctual correctness where I immediately believed that everyone was reaching the same rhythm. This gradually went away for some reason and I was finding myself trying harder to change my breathing
- ° It just felt as though the space had a lot more entities than earlier thought
- ° It seemed like a challenge, but the network of breath slowly emerged; sense of being in a network.
- ° my own breathing, the sense of space, the sense of being over observed.
- ° nothing
- ° Nothing unless there was some auditory clue.
- ° only my partner
- ° The room expand and contract. Pulls an d pushes from different places.
- ° their rib, back movements
- ° There was a transference. Breath was moved through everyone without actual visual signal; it was sense.
- ° Togetherness, all as one lung
- ° Tried to stay connected to my partner and together find the group
- ° wave, intensity of energy that was quiet but loud at the same time
- ° While originally fragmented, the group eventually started to all breathe at the same rate.
- ° a familiar feeling triggering previous experiences.

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- Movement almost like a static field the ebbs and flows
- even without the aid of narration or sound I felt the breath dominate the space and negotiate then presumes. They were autonomous over my desires or more accurately influenced them
- I sensed chaos as it was hard to try to match up to people who are trying to do the same. I sensed a need for leadership and I tried to take control.
- It felt as if I could sense their breathing but it wasn't as strong as my partners.
- thirst, awkward, emptiness.
- Connection to the group through attentiveness to their personal functions of breathing.
- further distance from the big grid we experience every day – and the reintroduction to closer, more intimate connections.
- I could feel their breathing. Even if I couldn't hear it or see it, I knew its rhythm.
- The effort in trying to be unified, operating as one breathing physical entity.
- probing breaths, looking for one another

Were you able to communicate your breath data or receive the breath data of other group members through the sound and visualization? What was your experience?

- A bit. Experimental.
- Communication through sixth "sense". unconventional communication techniques; felt fresh and new
- Felt life, very basics of life breathing a natural function, everyone needs
- had a hard time trying to connect of the group, but I was behind instead of in close.
- I didn't feel like I connected with anyone. Lonely
- I felt relieved and assured that I could sync with so many people. I felt happy and excited.
- I think they did well.
- I tried to synch to the audio. Seemed to work until Thecla started talking.
- It was easy to communicate the data through the visualization.
- not really applicable
- seems like my contribution was small and didn't make much difference but this small difference by everyone created a whole / one living / breathing thing
- Sound was very helpful in sharing breathing rate, but the visuals seemed to abstract from our shared breathing.

Appendix D Workshop 'self to self' / 'self to other' / 'self to group'

- The breathing rate was similar, a sense of grouping and communication without direct contact.
- very little data, except obviously you can hear it but not much in terms of sensing it otherly.
- Yes, I saw that people were communicating through the sound and images.
- Yes, I tried to sync my breathing with everyone else.
- Yes, it was easy just needs focus
- Yes, resulted in increased self and outside awareness
- Yes, the sound we generated was much like that of a beach, and we and our motions became the waves.
- Yes; group play
- Data was passed. It was like many voices whispering at once.
- Sense of control, although limited.
- no.
- The experience became a lot more abstract as if we were something else, something on a larger scale.
- The sound was more confusing than helpful. The visual helped a lot as I could get an overall view of how people are breathing
- there was an innate connection holistically. It was no longer single senses but one large sense and the breath was an entity of us all
- found the audio distracting – the timbre was too harsh.
- It was easier to see a connection between the visualization and sound than from observing the group alone.
- Sound helped to sync up the breath between one person and the rest of the group.
- Yes. It was surprisingly easy to sync breath with each other
- yes, but only by exaggerating, acting out willfully

E

Appendix E: Design of a Tactile Semantics

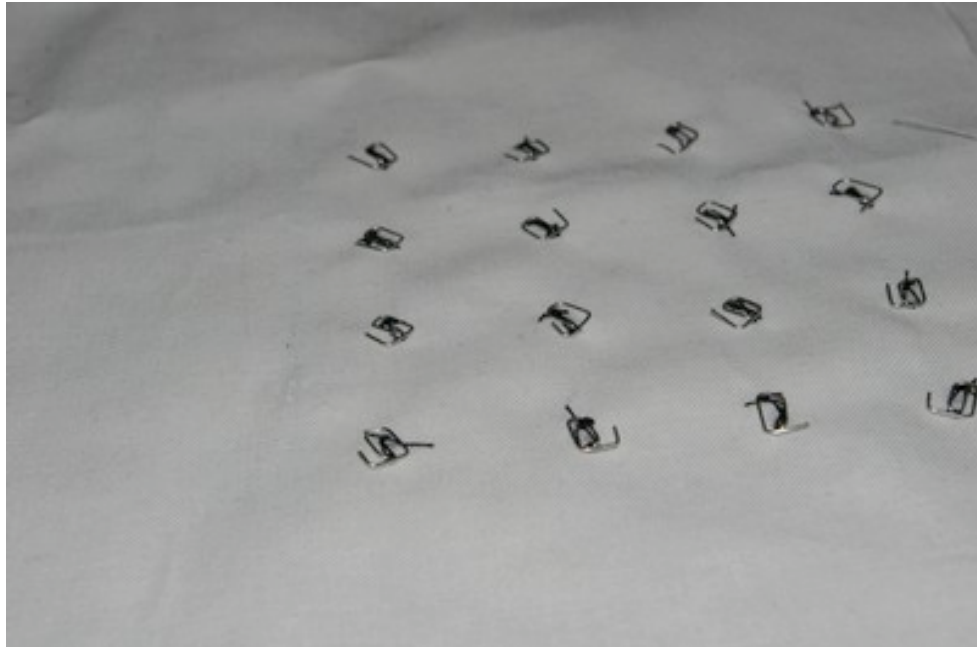


Figure II-6. *soft(n)* design process can be found at www.sfu.ca/~tschiphoh/html/artDesign.html

Appendix E outlines design development for tactile interaction as it was developed in *soft(n)*. This research was developed with the V2_Lab in Rotterdam from 2005 – 2007.

- ***soft(n) interaction model:*** illustrates the interaction model used within the *soft(n)* networked installation.
- ***Use of Laban Effort/Shape in Data Recognition:*** The use of Laban's Effort Shape analysis in tactile gesture recognition of a multi-touch surface.
- ***move.me Interaction Model:*** describes the behaviours and interactions of the *soft(n)* installation.
- ***The Journey of a Token:*** The token ring is a network comprised of a complete logical 'circle'. A unique 'message' (light, sound, vibration) called the 'token' is passed through the ring from node (object) to node (object). The token identifies where the data is 'expressed' and who can modify the data at any

particular time. It is just ONE of a number of networked communication architectures that can be used in the system to support emergent participant behaviour.

- ***The Journey of a Thrown Object:*** This is an example of self-2-others implemented using a "broadcast" network communication mode. We could also call this "broadcast empathy" for the "thrown" path of another "soft-object".
- ***Data Flow:*** design sketch of data flow process.
- ***Self to Self Touch Response:*** state transition diagram for initial touch interaction between participant and soft object.
- ***Self to Self Sleep Call Touch Response:*** state transition diagram for sleep state.
- ***Token Ring Response State:*** state transition diagram for token ring response.
- ***Thrown Object:*** state transition diagram for object movement with accelerometer data.
- ***Resonance States:*** state transition diagram for group membership.
- ***Interaction Modes and States:*** design process discussion of modes and states.
- ***move.me Sensor Evaluation and Laban Analysis:*** a description of some of the Python structures and functions used for gesture recognition.
- ***soft(n) workshop response card:*** the design of the workshop response card enabled workshop participants to give a hand-written account of their experience.
- ***soft(n) workshop response cards:*** the hand-written response of the participants for the workshop.
- ***soft(n) workshop transcription February 1 2007:*** participant observation.

soft(n) interaction model

This technical document contains the functional specification for the software development team. It describes the interaction model for a group of networked soft-objects, and includes definitions for the software data-model (object and object hierarchy, definition for the object interaction states (active, inactive, and interactive), and definition of the interaction modes that can elicit these interaction states (self-to-self, self-to-group, and group-to-self). It shows examples of the Life-Cycle of the Object as it moves from inactive, to active or interactive.

Object Hierarchy

In order to implement a simple and effective Multi-Object Interaction Scheme, we define a hierarchy of objects, starting with the Soft-Object itself, and a set of interactions between these objects on various levels of the hierarchy. The hierarchy is a simple tree-hierarchy of **nodes** and **parents**.

Objects

The starting point for our Object Hierarchy is, of course, the physical soft object itself. Formally we'll refer to the interactive object as a **Soft Object**.

Soft Object

A soft object to which input can occur, and from which output can occur. The Soft Objects are **nodes** in a Group.

Group

A Group is two or more **Soft Objects**. A Group is the **parent** of its Soft Object nodes. The Groups are **nodes** of the Room.

Room

A room contains one or more **Groups**, a central visual display and a central sound system. The Room is the **parent** of its Group nodes.

Object States

Each of these Objects defined above can be in one of three states:

inactive

An **inactive** Object is neither receiving any input, nor producing any output.

active

An **active** Object is not receiving any input, but is producing output.

interactive

An **interactive** Object is receiving input and producing output.

A **Group** becomes active as soon as one of its nodes becomes active, and becomes interactive as soon as one of its nodes becomes interactive. The **Room** becomes active as soon as one of the Groups becomes active, and becomes interactive as soon as one of the Groups becomes interactive.

Interactions

Each of the Objects may interact with itself or the containing (i.e. higher-level) Object. Given the three levels of objects, we can distinguish the following interactions:

self-to-self

Interaction within the Object itself. This 'mode' only exists at the bottom level, for the Soft Objects. In essence it is a mapping from the received inputs to the objects outputs.

self-to-group

The *interactive* members of a Group communicate their received input to the Group. The Group derives its internal input-state from the total of inputs of its *interactive* members. This is the 'node-to-parent' interaction.

group-to-self

The Group's output is distributed across its *active* members. Some portion of the Group's output is also distributed to its *interactive* members. The percentage of the Group's output distributed to the *interactive* members is inversely proportional to the number of members (*active* or *interactive*) in the Group. This is the 'parent-to-node' interaction.

active Soft Object output	= Group output
interactive Soft Object output	= Own output + (Group output / number of members)

group-to-room

The *interactive* Groups in the Room communicate their internal input-state to the Room. The Room derives its internal input-state from the total of inputs of its *interactive* Groups. This is again the 'node-to-parent' interaction.

room-to-group

The Room's output is distributed across its *active* Groups. Some portion of the Room's output is also distributed to its *interactive* Groups. The percentage of the Room's output distributed to the *interactive* members is inversely proportional with the number of Groups (*active* or *interactive*) in the Room. This is again the 'parent-to-node' interaction.

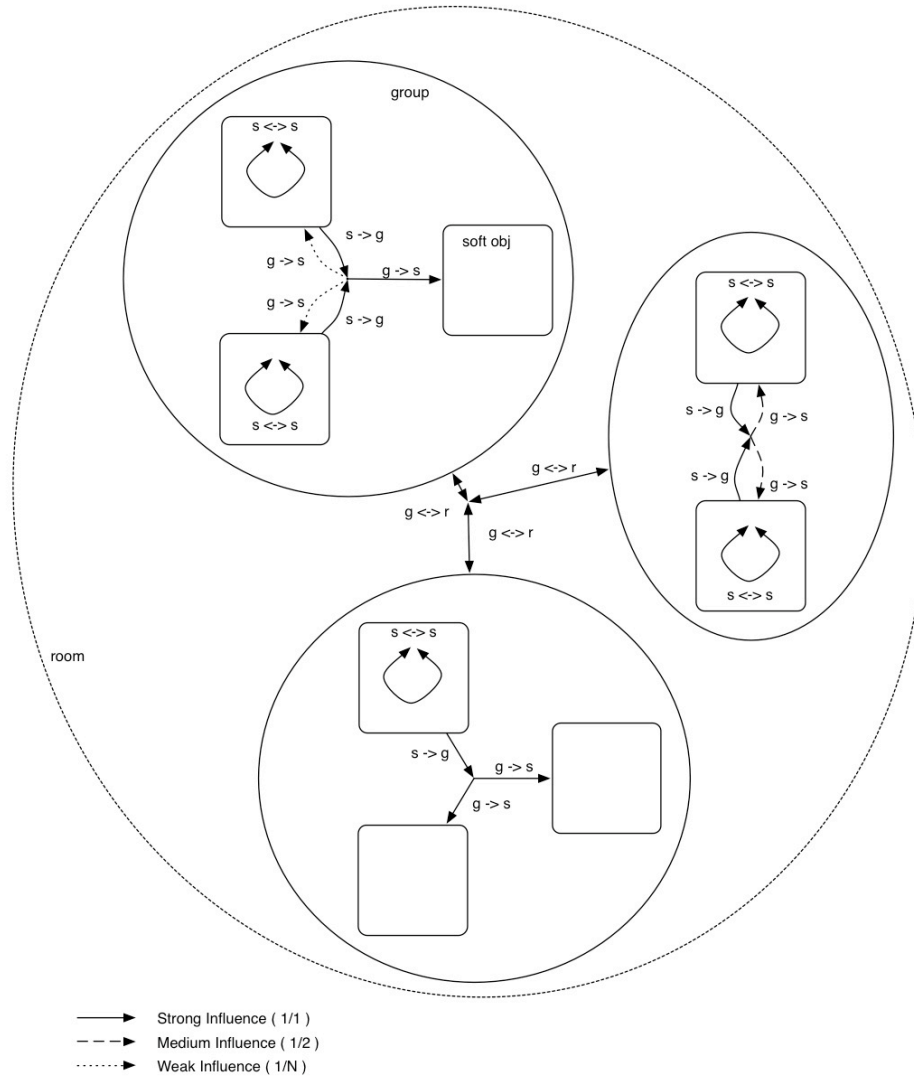
active Group output	= Room output
interactive Group output	= Own output + (Room output / number of Groups)

NOTE

The 'self-to-other' and 'other-to-self' interactions are special cases of the 'self-to-group' and 'group-to-self' interactions respectively, when the Group has only two Soft Objects.

Interaction Diagram

This is a diagram showing an example situation where there are eight Soft Objects in three Groups in a Room.



One Group contains three Soft Objects; one active and two interactive. The second Group has two interactive members, and the third Group has one interactive and two active members.

Group Formation

Groups are used as an abstraction to simplify the interaction possibilities of several elements. [The relevance of groups is still not very clear.]

A **group** is a collection of elements that share one or more proprieties and/or interact with one another. There are two main kinds of group formation: **static** and **dynamic**.

The elements of a **static group** are defined *a priori* and remained unchanged.

Appendix E soft(n) interaction model

The inclusion (or exclusion) of an element in a **dynamic group** is defined based on the element properties, following *a priori* rules. Since such properties are bound to change, the group formation will change accordingly.

The formation of a group is, so far, based on *a priori* top-down rules. Top-down rules are not in conformance with emergence or self-organization theories.

Question: Should we allow the creation of Groups with only one Soft Object?

In Group Theory context, a group must contain at least one element, with the unique (up to isomorphism) single-element group known as the trivial group. In the installation context, a trivial group represents one soft object that does not interact with other soft objects.

Dynamic group formation

One obvious and simple criterion for forming Groups is proximity. This could be proximity in space or proximity in time.

Proximity in Space

This means that Soft Objects that are 'close together' in space will form Groups. There are many ways to divide a collection of points in space into groups or sets, like the Voronoi Division, for example. An additional consideration for the spatial formation of Groups is that non-interactive Groups (i.e. Groups with no interactive members) are 'boring' (from an interaction perspective) because such Groups only function as grouped output-devices for the Room. Therefore it is desirable to distribute the available *interactive* Soft Objects into as many Groups as possible. The Group-distribution of the Soft Objects should be recalculated every time a Soft Object moves in space, or changes state from *active* to *interactive* or back.

Proximity in Time

This could also be called 'Synchronicity'. When multiple Soft Objects receive similar inputs within the same timeframe, they form a Group. This scheme has two serious drawbacks compared to the Spatial Proximity scheme:

- The Groups will be short-lived, because as soon as one Soft Object goes out of sync with the others in its Group, it leaves the Group.
- Only *interactive* Soft Objects will be Grouped, because a Soft Object without input cannot be classified.

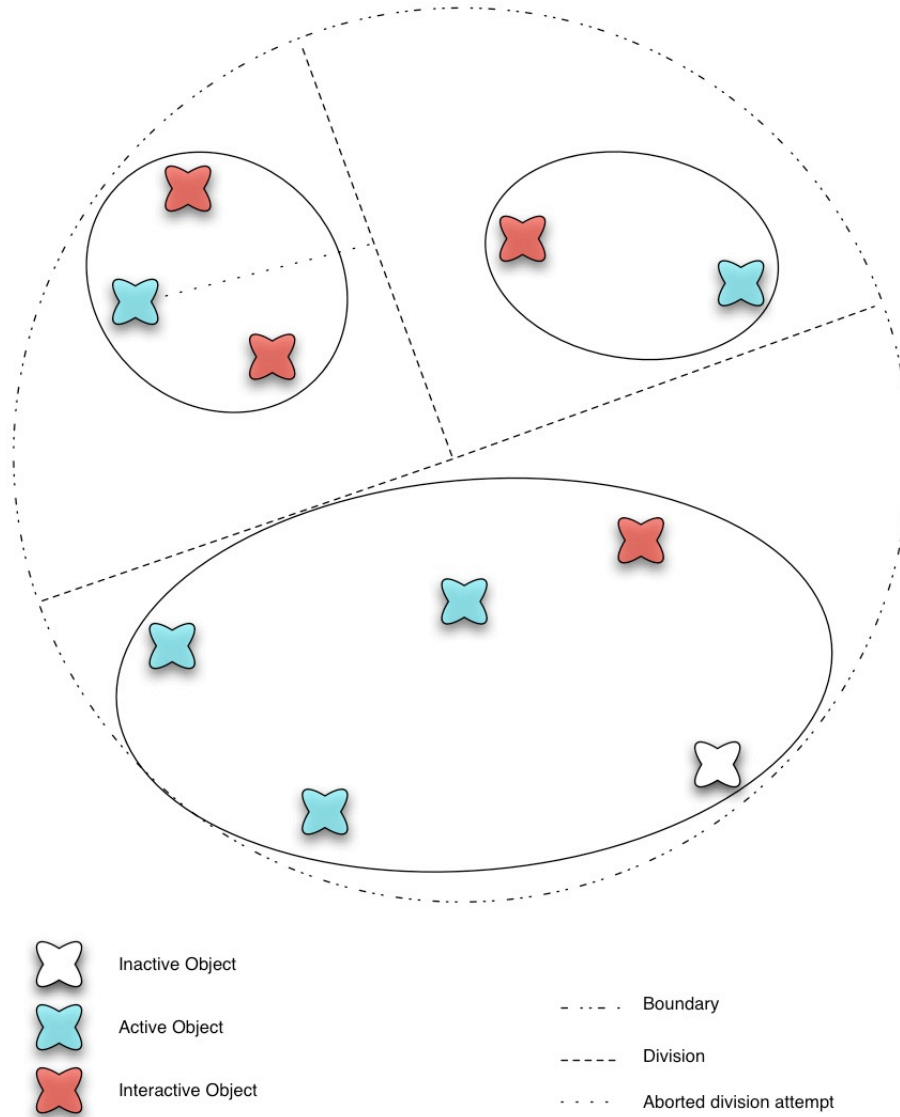
It is certainly simpler, and probably more 'obvious' (from an interaction perspective) to implement Grouping in Space. For this we would have to implement a location-tracking system that can determine the position of the Soft Objects with respect to each other. Since we are only interested in the relative cartographic (i.e. 2D) positions of the Soft Objects, this system would **not** have to be very accurate, nor very fast.

Position Tracking

We propose to implement simple a camera-based tracking-system using one IR-sensitive web cam looking straight down from above, and IR-LEDs in the Soft Objects. The Tracking-server synchronizes clocks with the Soft Objects and allocates time-slots. Each Soft Object will only light up its IR-LEDs during its appointed time-slot. This should allow localization of each Soft Object in a 2D coordinate system (i.e. the web cam's coordinates), and a new Grouping can be calculated after each full cycle of time-slots.

Group Formation Example

An example algorithm for collecting Soft Objects into groups could work like this:



1. Find the center-of-gravity (COG) of all *interactive* Soft Objects
2. Draw a circle at COG with a radius that encompasses *all* Soft Objects. This is the **Boundary**.
3. Divide this circle in two with a line through the COG such that:
 - The line does not cross any Soft Object
 - A **minimum number** of *interactive* Soft Objects lies to one side of the line
4. Calculate the COG of the remaining *interactive* Soft Objects on the **maximum number** side of the line.
5. Draw a new line from the previous COG, through the new COG to the Boundary.
6. Repeat from step 4 as long as:
 - The new line does not cross any Soft Object
 - More than one (or at least one?) Soft Object lies on either side of the new line.

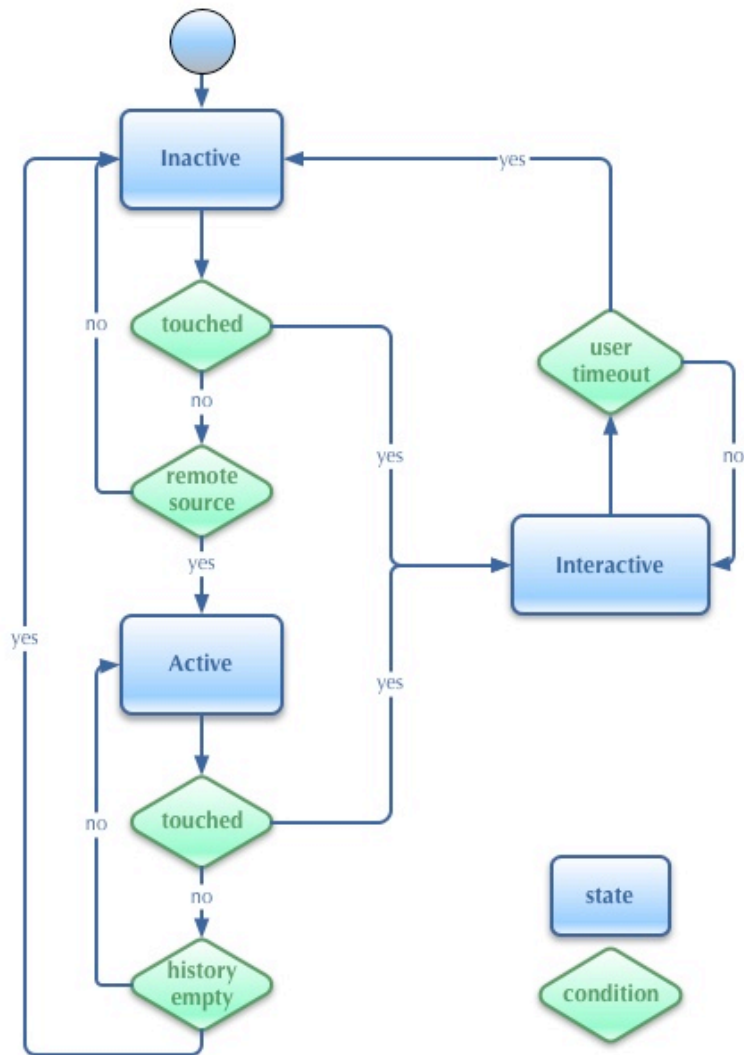
The clusters of Soft Objects divided by the lines (except the last, aborted, division-line) are the Groups.

Soft-Object life cycle

Master/Slave soft-object relation

Master soft-objects broadcast information and slave soft-objects listen to broadcast information.

- An **interactive** soft-object becomes immediately a potential master soft-object.
- An **inactive** soft-object looks for a potential master soft-object. An inactive soft-object receives a list with potential masters; if the list is not empty the inactive soft-object randomly chooses one master and becomes an active soft-object.
- An **active** soft-object listens to the information broadcasted by its master and becomes available as a master soft-object.



Use of Laban Effort / Shape in Data Recognition

“For a [phenomenon](#) to be termed emergent it should generally [unpredictable](#) from a lower level description” wikipedia

The following table makes an attempt at connecting the “Original Laban Effort Qualities” to the ways that they can be used with both the accelerometer sensors, and the way that they have been used with the touch-effort heuristics implemented in our previous systems.

- Column A lists the original 8 basic Laban Efforts: Float, Glide, Wring, Flick, Punch, Slash, Dab, Press. When there are pairs listed, this is simply because we were able to distinguish additional data from touch, and so created some refinements of qualities.
- Column B lists Efforts that would be relatively easy to implement with accelerometer data.
- Column C lists the touch-efforts that we implemented

Note the following:

1. With the Touch-Efforts we had 2 “unassigned” Laban Efforts: float and slash. These are listed in the table first.
 - a. It is not possible/easy to represent “FLOAT” in touch data, but it should be fairly easy to represent “FLOAT” with accelerometer data.
 - b. We did not represent Slash in touch data.
2. The Descriptions in C describe how the touch qualities operated. Please note, any mention of the ‘hand’ is simply historical. Originally we were working with a Tactex MTC Express, a hard graphics tablet. Most people used their hand with it. There is –no- reason that touch cannot be implemented with any body part, including sitting on, standing on, etc, or with another soft object that comes into physical contact with the touch pad.

A	B	C	
Laban Effort	Accelerometer Effort	Touch-Effort Description (these have been implemented using touch heuristics)	
Float	Float		An Object “floating” in space (approaching zero acceleration)
Slash	Slash		
Dab	Dab	Tap	A soft, short, small touch usually rendered with a single finger
Dab		Pat	A bigger version of ‘tap’, and a soft version of ‘slap. Usually rendered with open hand or palm, or with larger area of other body part
Dab + Press		Hold	A lingering, soft, big, touch. ‘hold’ has an encompassing feel.
Dab + Press		Touch	‘touch’ is a small version of hold. It is an indication of comfort and is rendered with the fingers, hand or palm.
Glide+ Press		Stroke	A traveling touch, soft but directional, rendered with fingers, hand or palm.
Glide	Glide	Glide	A traveling meandering touch. Soft and directionless, rendered with the fingers, hand or palm
Flick	Flick	Jab/Poke/ Flick	A hard, short, small, touch. A hard poke by a finger of blunted object. Also known as a ‘poke’.
Punch		Knock	A medium size, fist against, rapping hard, In our scheme it is different than “jab” and “slap” in size only.
Punch	Punch (landing from fall for eg.)	Slap/ punch	An open-handed, hard, short, touch. In our scheme, a large version of “jab” and “knock”
Press	Press	Press	This is a long, hard, touch.
Press		Rub	This is a moving, hard, touch.
Wring	Wring	Knead	Kneading involves many fingers moving in a slightly wandering fashion.

Appendix E Use of Laban Effort / Shape in Data Recognition

The following table shows how the touch efforts in the previous table were recognized from data parameters/attributes.

touch-effort	Parameter				Modifier		
	pressure intensity	time duration	size area	number	space (speed)	path (direction)	disposition (pressure)
tap	soft	short	small	ø	stationary	n/a	n/a
pat	soft	short	big	one	stationary	n/a	n/a
touch	soft	long	small	one	stationary	n/a	n/a
stroke	soft	long	ø	ø	traveling	straight	ø
glide	soft	long	ø	ø	traveling	wandering	ø
hold	soft	long	big	one	stationary	n/a	constant
poke/jab/flick	hard	short	small	one	stationary	n/a	n/a
knock	hard	short	medium	one	stationary	n/a	n/a
slap/punch	hard	short	big	one	stationary	n/a	n/a
press	hard	long	ø	ø	stationary	n/a	constant
knead	hard	long	ø	many	ø	ø	varying

The next table shows the original Laban Efforts on which the heuristics are based.

ORIGINAL LABAN EFFORTS: Divided into two main categories:

INDULGING (synonyms are passive or receptive)	FIGHTING (synonyms are active or emissive)
FLOAT – all indulgent elements: Indirect Space Light Weight Sustained Time	PUNCH – all ‘fighting’ elements Direct Space Strong Weight Sudden Time
*modifications	
GLIDE – Direct Space (Fighting)* Light Weight Sustained Time	SLASH – Indirect Space (Indulging)* Strong Weight Sudden Time
WRING – Indirect Space Strong Weight (Fighting)* Sustained Time	DAB – Direct Space Light Weight (Indulging)* Sudden Time
FLICK – Indirect Space Light Weight Sudden Time (Fighting)*	PRESS – Direct Space Strong Weight Sustained Time (Indulging)*

move.me Interaction Model

A pillow is a networked tangible object that 'channels' the human/body behaviour of the participants in the space. The system expresses emergent 'pillow behavior' only, but pillow behaviour requires input from bodies in the space.

Goal of Interaction Model

- Emergent behaviour of the system (which is the pillows + the participants)
- The pillows act as a conduit and it also transforms the system
- We need to allow for behaviours that are unexpected
- People explore what system does and adjust their physical behaviour to accentuate or explore/play with what they enjoy within it

System parts:

- Pillow (actuates output from input data)
- Participant (provides input and responds to output)
- Definitions of groups (defined by pillow states or proximity)
 - The pillows + participants are defined as a group by 'having' similar states. A state is the result of a set of inputs that determines a movement 'quality'. There may be other ways to define groups such as proximity etc.
- Behaviours of system
 - Isolated pillow behaviors (define the pillow state)
 - group pillow behaviors (define the group state)
 - participant behaviors (trigger state transitions)

What data is shared?

- Output data pattern is a 'representation' of effort qualities
 - Light
 - Sound
 - Vibration

Communication I/O Modes –:: Local or Remote

Input can be received:

- Locally (hand/body on or moving the pillow)
- Remotely (data pattern is passed from another pillow)

Output can be actuated:

- locally (on the same pillow where input is received)
- remotely (on a different pillow that receives input)

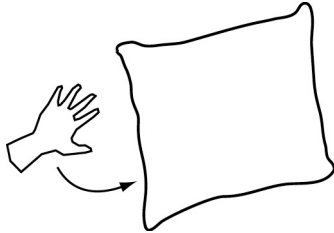
Computation can:

- occur locally (on the same pillow where input is received or actuation is performed)
- be distributed remotely (for example: in order to ask group questions, or make group decisions, or perform group actions e.g., all group members turn all the red LEDs on)
- occur locally as well remotely (vote) asking for consensus on something?

Interaction Modes

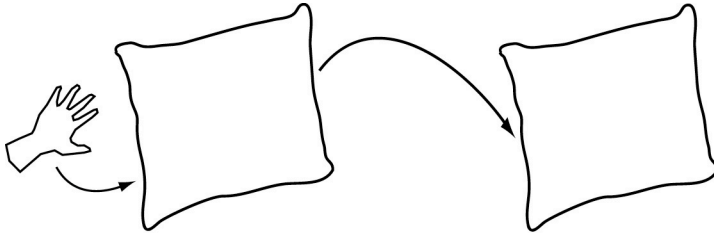
There are four primary interaction modes:

1. self to self



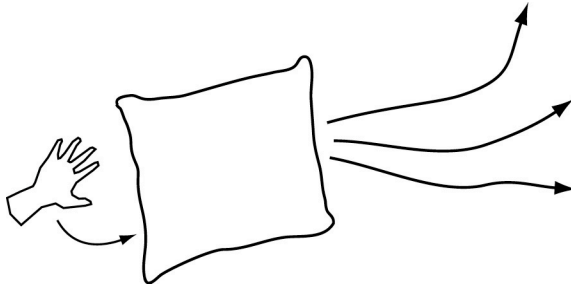
- self(hand) to self(pillow)
- local input; local output
- Interaction Metaphors include < secret; covert; mute; alone; private; journal entry; inner; nobody's business >

2. self to other



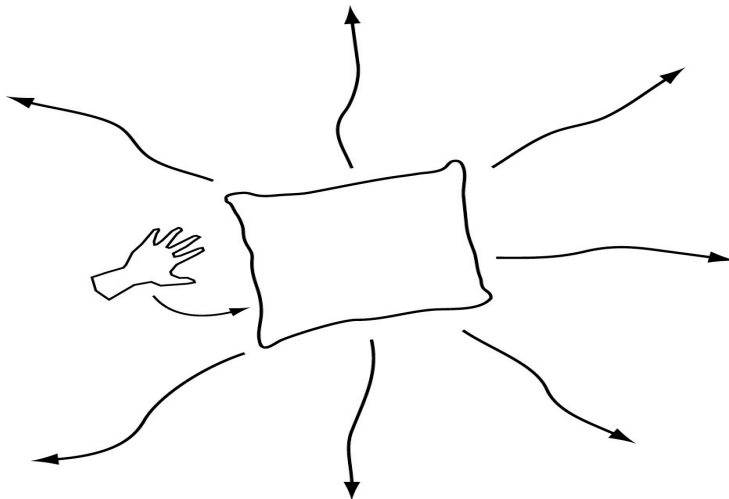
- self(hand) to other(pillow)
- local input; remote output
- Interaction Metaphors include <whisper; proximal; couple; pair; friend; buddy; need proximity or identity to pair pillows/bodies; half or full duplex connection>

3. self to group



- self(hand) to group(pillows)
- local input; remote output
- Interaction Metaphors include <speaking out loud; share; friend; circle; club; send to list; need to identify recipient's group membership, a group could be defined by similar pattern or by physical proximity>

4. self to all



- self(hand) to all(system: all pillows)
- local input; remote output
- Interaction Metaphors include <broadcasting; singing; spam; performing (playing); yelling>

Summary of Interaction Modes

Interaction Mode	i-mode expanded	I/O Mode	Some Possible Interaction Metaphors*
1. self to self	self(hand) to self(pillow)	local input: local output	secret; covert; mute; alone; private; journal entry; inner; nobody's business
2. self to other	self(hand) to other(pillow)	local input; remote output	whisper; proximal; couple; pair; friend; buddy; need proximity or identity to pair pillows/bodies; half or full duplex connection
3. self to group	self(hand) to group(of pillows)	local input; remote output	Speak out loud; share; friend; circle; club; send to list; need to identify recipient's group membership, a group could be defined by similar pattern or by physical proximity
4. self to all(system)	self(hand) to all(pillows)	local input; remote output	broadcasting; singing; spam; performing (playing); yelling;

- these interaction metaphors are listed to illustrate **some** ways that behaviors may be interpreted by participants and by the system. The advantages of identifying some of these metaphors are to illustrate possible relationships that may occur within the system. Disadvantages are that behaviors need to emerge from the system itself, not in a top-down definitional way.

Mirror Interaction Modes

This is state dependent, how a pillow receives a message from another depends on its state

- other(pillow[s]) to self: (this is based on group definition)
 - requested (expected: when you have a 1 to1 communication)
 - solicited (you are part of a group, waiting for something)
 - unsolicited (you are not expecting it)

How to define a Group? (some ways)

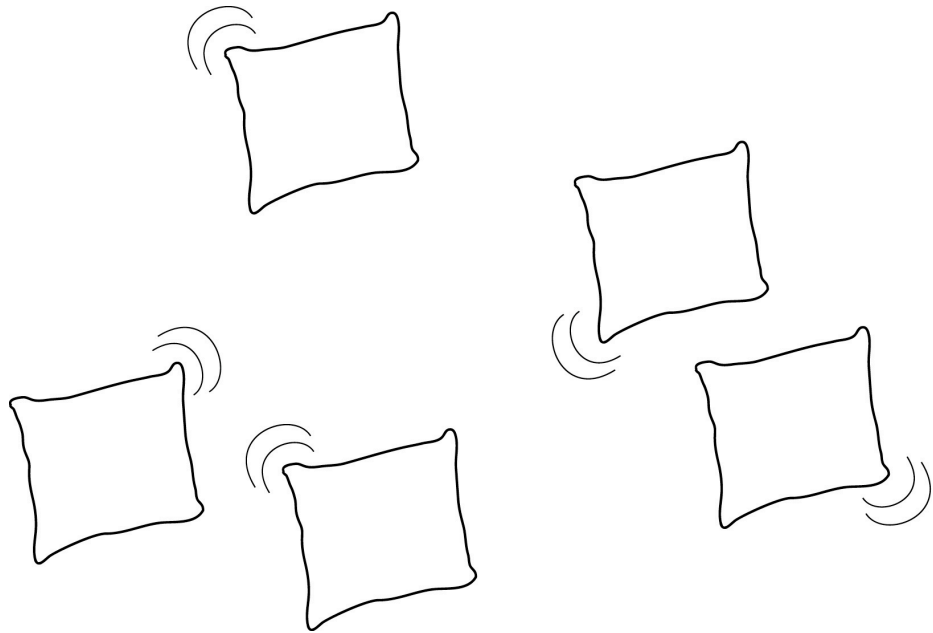
- Detecting similar input patterns based on effort qualities or 'states'. (e.g., all "passive-listening" pillows are in a group: states are defined, but need to be tested for usefulness)
- Detecting proximity or spatial location
- Detecting RFID
 - Half duplex between 2 pillows
 - Full duplex between 2 + pillows

Group States/Behaviours

This section identifies some initial ways of defining group 'behaviors'. These are initial concepts for enabling 'emerging' behavior.

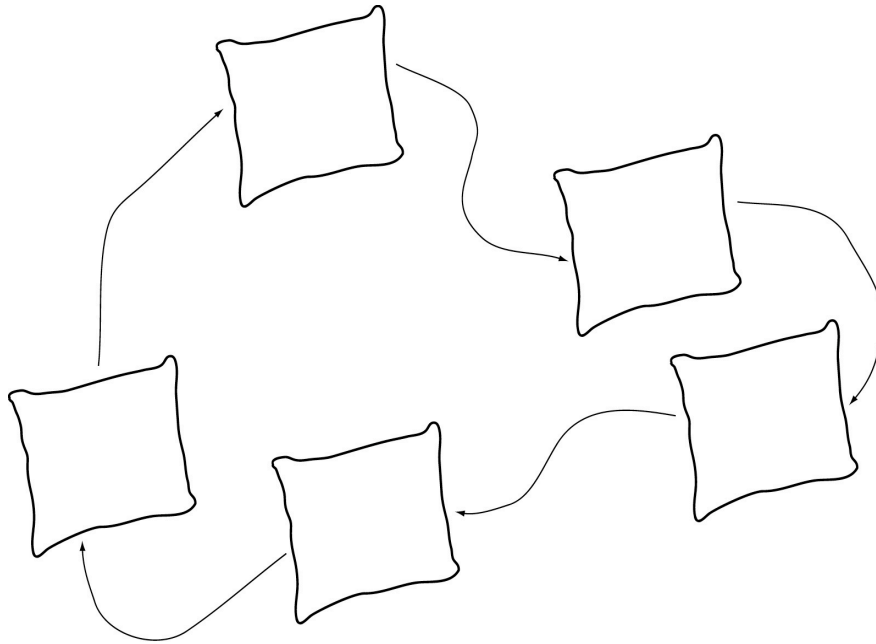
- Resonance
- Token passing
- Broadcast

1. Resonance



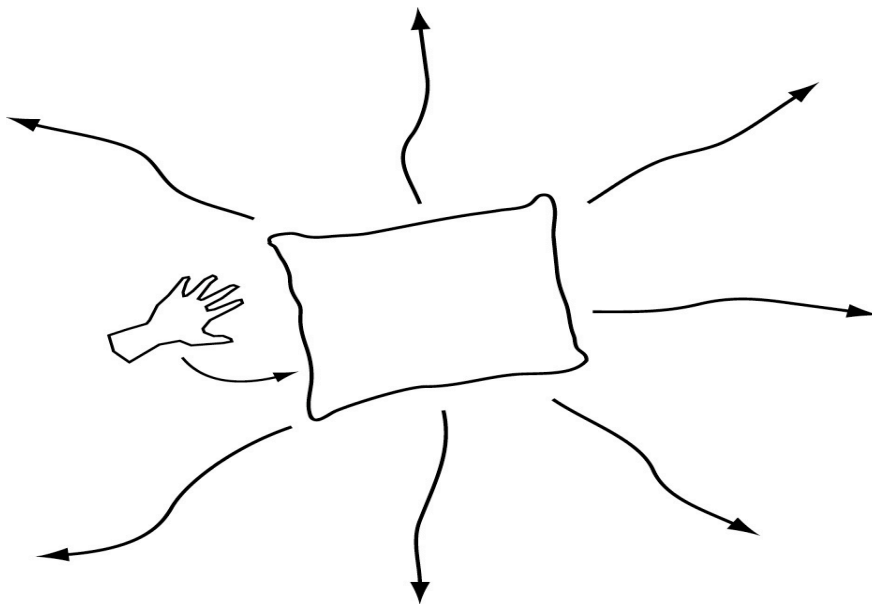
- Similar shared patterns with 'resonant' variation or harmony
 - o light
 - o vibration
 - o sound
- for example: all pillows vibrating, humming, shaking, 'laughing', 'singing' at once
similar to the metaphor of everyone talking or laughing at once – there are random variations in rhythm, tone, or pattern, but they are 'of a similar' resonance

2. Token Passing



- Passing a pattern between pillows in a sequence
- The pattern passes from one pillow to and through another
- There is a timing sequence from pillow to pillow
- (this is like passing a peace pipe)
- Pattern passing can use light, sound, vibration
- The metaphor feels like a life force passing through the pillows)
- Variations on Token Passing:
 1. Light, sound, vibration can pass in 'unison' from pillow to pillow
 2. Light, sound, vibration can pass in 'canon' from pillow to pillow (same passing pattern, slight timing phase shift between light, sound and vibration)
 3. Other variations on phase shifting and direction
 4. Aggregation – the pattern is modified by each pillow in the token ring, either by extending the pattern or merging with the pattern
 5. Gating – the pattern is blocked by a pillow or 'bounced back'

3. Broadcast



This could be one or any of the following:

- pillow spam
- shared experience
- one pillow's state is broadcast to all other pillows
- for example: this could occur when a pillow is 'thrown' or let airborne, its apogee (maximum height or zero gravity-acceleration = 0) OR its "landing" (the moment of impact) is broadcast to all pillows (as sound and/or vibration and/or light pattern)

Some Additional Notes:

Polling (asking pillows question: what is your state?)

States

Laban Effort States – Active – Passive (in Effort terms: fighting/indulging)

The amount of information in input, changes a number of aspects of the state. Vector in the input or the transition from one state to another. States represent multiple values or have to be described with multiple values (multidimensional). And state is a collection of values describing a state, and input acts as a transformation of state (also called a node).

Vector has a direction of passing from one state to another state.

Possible communication mechanisms (use token, broadcast)

- Polling – asking everybody? (this does not make sense for Emergent Behavior)
- Token passing – (peace pipe passing, only 1 person speaks at once)
- Half duplex (take turns- walkie-talkies)
- Full duplex (simultaneous sending and receiving)
- Broadcast – telling everybody
 1. Broadcast with receipt – send to n people, don't do anything until you get n or n – some number (do you want majority response or all response) responses back. Example if pillows “applaud” something that happens with another pillow’s input, that is broadcast with receipt
 2. Broadcast w/o receipt (like pillow spam)

Laban Effort States (Primer)

Efforts:

Weight (light <-> strong),
 Space (indirect <-> direct),
 Time (sustained <-> sudden)
 Flow (free <-> bound).

Use the Laban Basic Action Drive:

Divided into two main categories:

INDULGING (synonyms are passive or receptive)	FIGHTING (synonyms are active or emissive)
Float – all indulgent elements: Indirect Space Light Weight Sustained Time	Punch – all 'fighting' elements Direct Space Strong Weight Sudden Time
*modifications	
GLIDE – Direct Space (Fighting)* Light Weight Sustained Time	SLASH – Indirect Space (Indulging)* Strong Weight Sudden Time
WRING – Indirect Space Strong Weight (Fighting)* Sustained Time	DAB – Direct Space Light Weight (Indulging)* Sudden Time
FLICK – Indirect Space Light Weight Sudden Time (Fighting)*	PRESS – Direct Space Strong Weight Sustained Time (Indulging)*

* modifications indicates elements changed from most extreme contrast of 'float' 'punch', thus making all except Float and Punch mixtures of fighting and indulging qualities.

Combinations of Two Effort Qualities – these are listed as possibilities to render or ‘represent’ states. Some states may be easier to represent computationally than others. We can select from a simple set of representable states:

The four effort factors can be combined in two’s (in six groups):

1. Space-time (AWAKE state)
2. Weight-time (NEAR RHYTHM state)
3. Weight-flow (DREAM state)
4. Space-flow (REMOTE state)
5. Flow-time (MOBILE state)
6. Space-weight (STABLE state)

NAME OF STATE	2 EFFORT Qualities	Names of Variations of Efforts
AWAKE	Space + Time	Indirect- sustained (slow) Direct – sustained (slow) Indirect – sudden (quick) Direct – sudden (quick)
RHYTHM	Weight + Time	Light – Sustained (slow) Light – Sudden (quick) Strong – Sustained (slow) Strong – Sudden (quick)
DREAM	Weight + Flow	Light – free Light – bound Strong – free Strong – bound
REMOTE	Space + Flow	Indirect – Free Direct – Free Indirect – Bound Direct – Bound
MOBILE	Flow + Time	Free – Sustained (slow) Bound – sudden (quick) Free – sudden (quick) Bound – sustained (slow)
STABLE	Space + Weight	Indirect – light Direct – light Indirect – strong Direct – strong

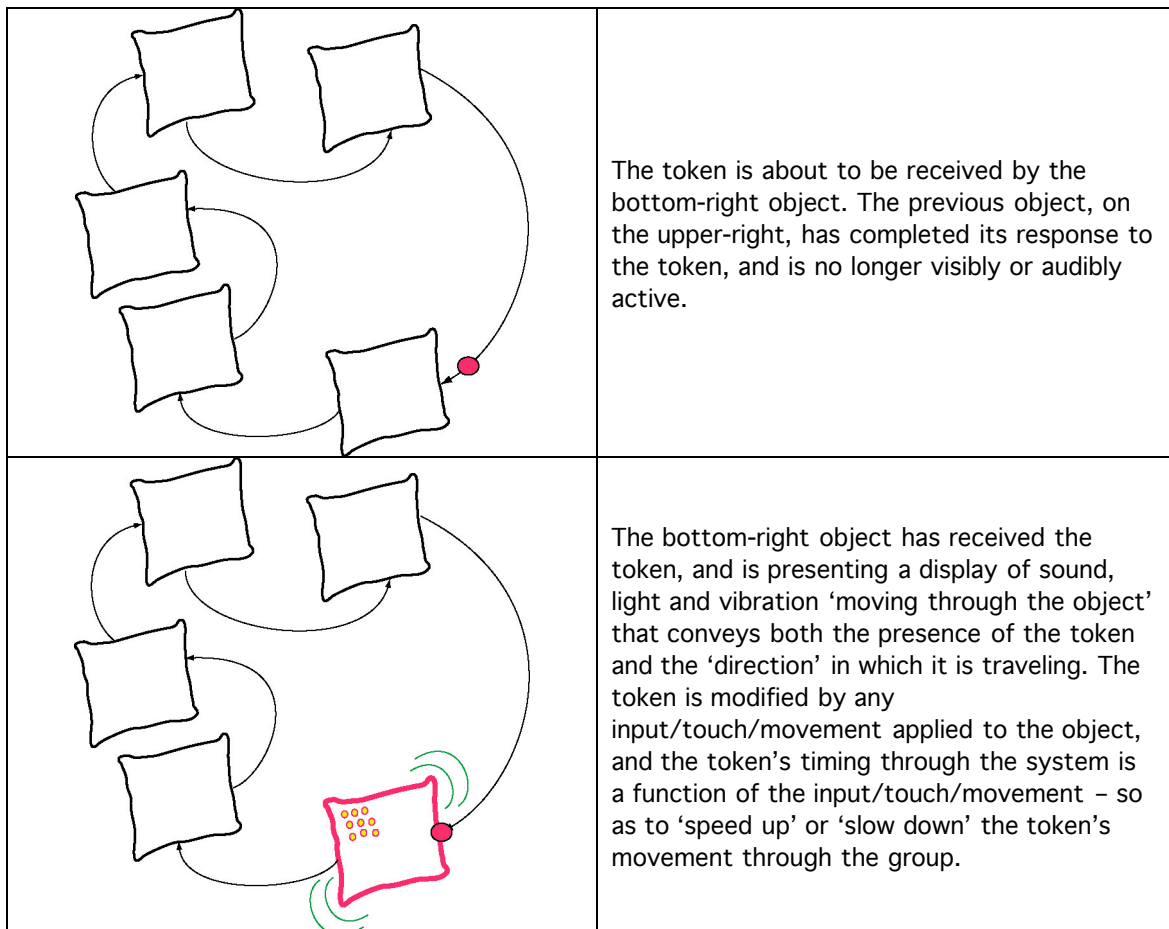
Introduction to Token Ring

The token ring is a network comprised of a complete logical 'circle'. A unique 'message' (light, sound, vibration) called the 'token' is passed through the ring from node (object) to node (object). The token identifies where the data is 'expressed' and who can modify the data at any particular time. It is just ONE of a number of networked communication architectures that can be used in the system to support emergent participant behaviour.

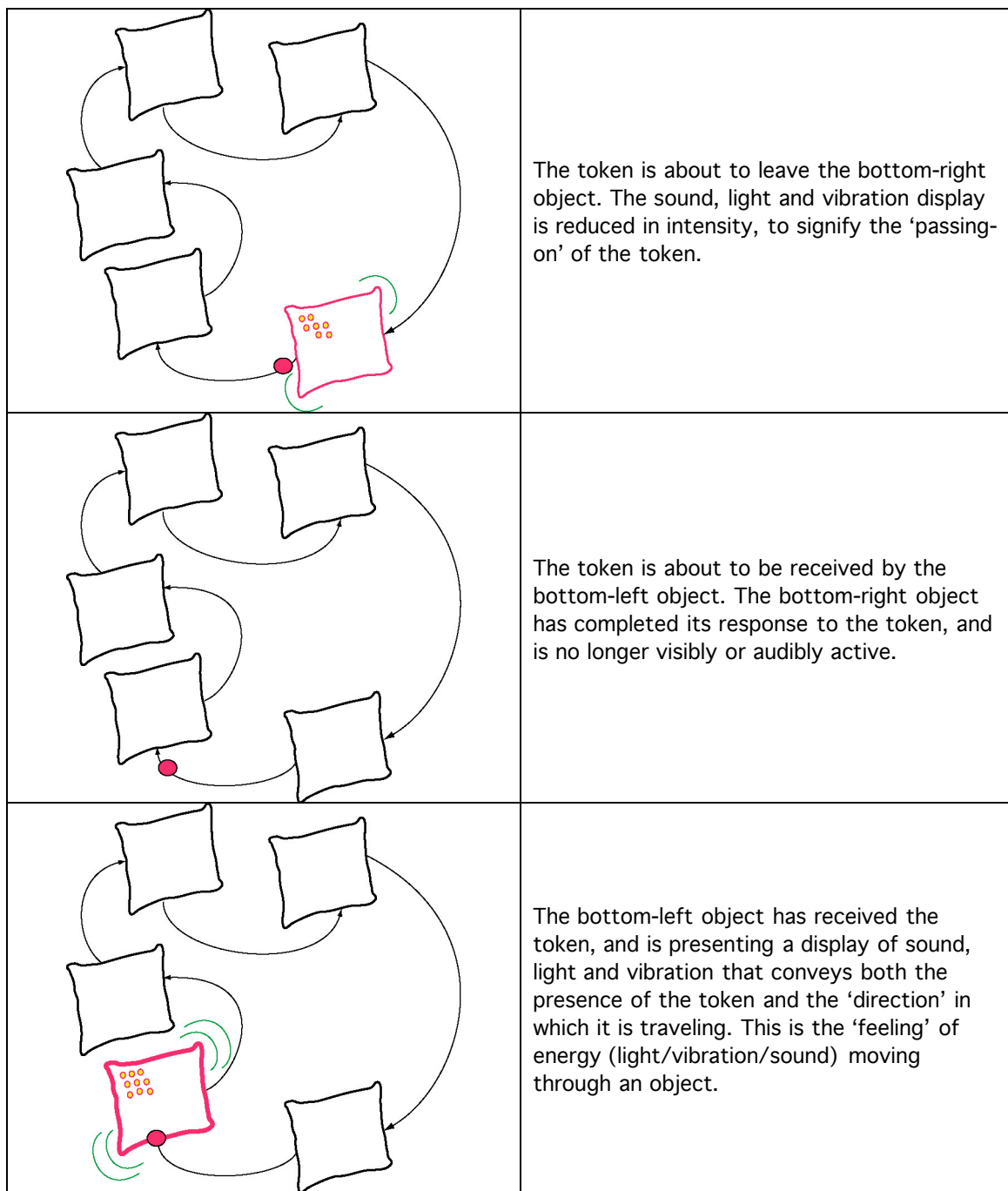
Data in the form of light, sound and vibration moves through the circle of soft-objects. This can appear or feel like the movement of energy, life-force or any other metaphor or association made by the participants during the experience. I think of experience as being an emergent property.

Each soft-object has a unique IP address within the space. In the communication of the token ring we can send the expression/mood/message through the ring in order by the IP address. This is a logical order, and the soft-objects may physically reside in the space in an arbitrary order and position. Without loss of generality, we can think of the soft-objects as having addresses starting at '0' and going to 'n'. The token is initially created by object '0' and then sent to object '1', eventually reaching object 'n', which sends it back to object '0'. Thus, the path that a token takes is unambiguous and is not affected by proximity – soft-objects that are in the path order can be moved near each other by participants, to emphasize the path, but need not be in order for the token to 'get where it needs to be next'. This allows participants in the space to move and re-order the soft-objects to create emergent patterns, sound and to emphasize, speed up, or slow down, the movement of data through the token-ring. Each participant creates the whole through their input with their object, or through their physical displacement in the space.

An accompanying state diagram is included in a separate PDF document.



Appendix E The Journey of a token through the soft-object networked circle



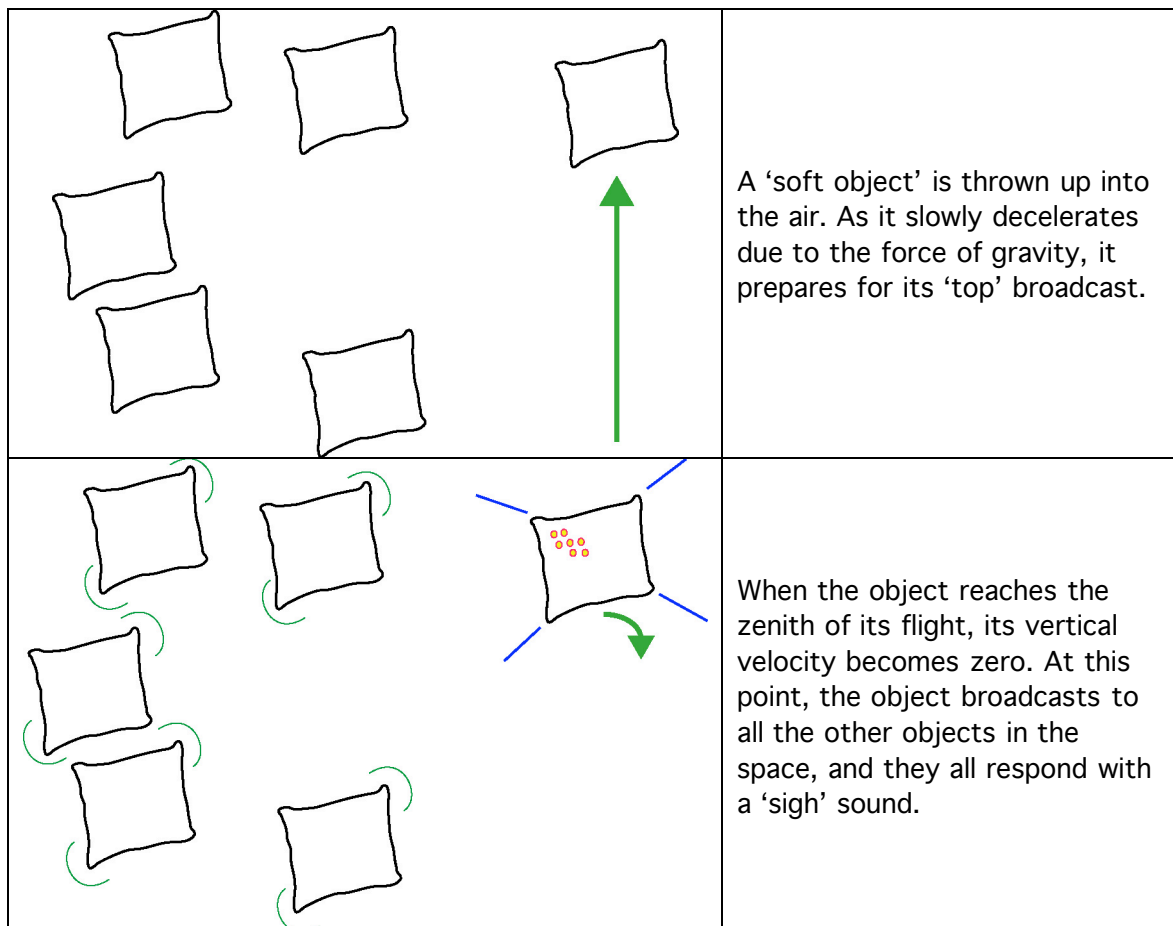
The Journey of a Thrown Object

This is an example of self-2-others implemented using a “broadcast” network communication mode.

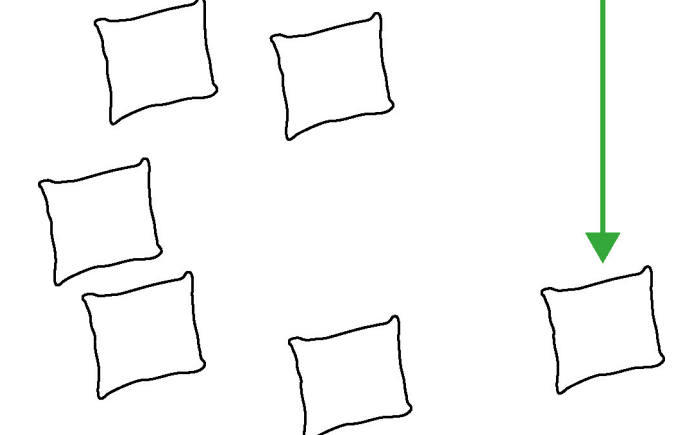
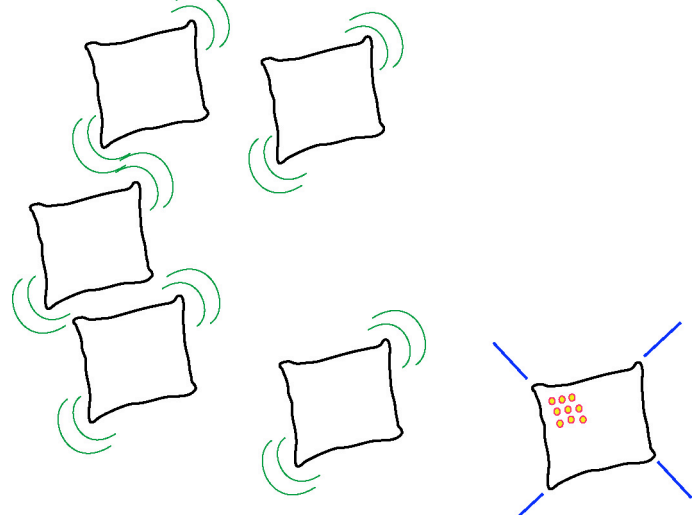
We could also call this “broadcast empathy” for the “thrown” path of another “soft-object”.

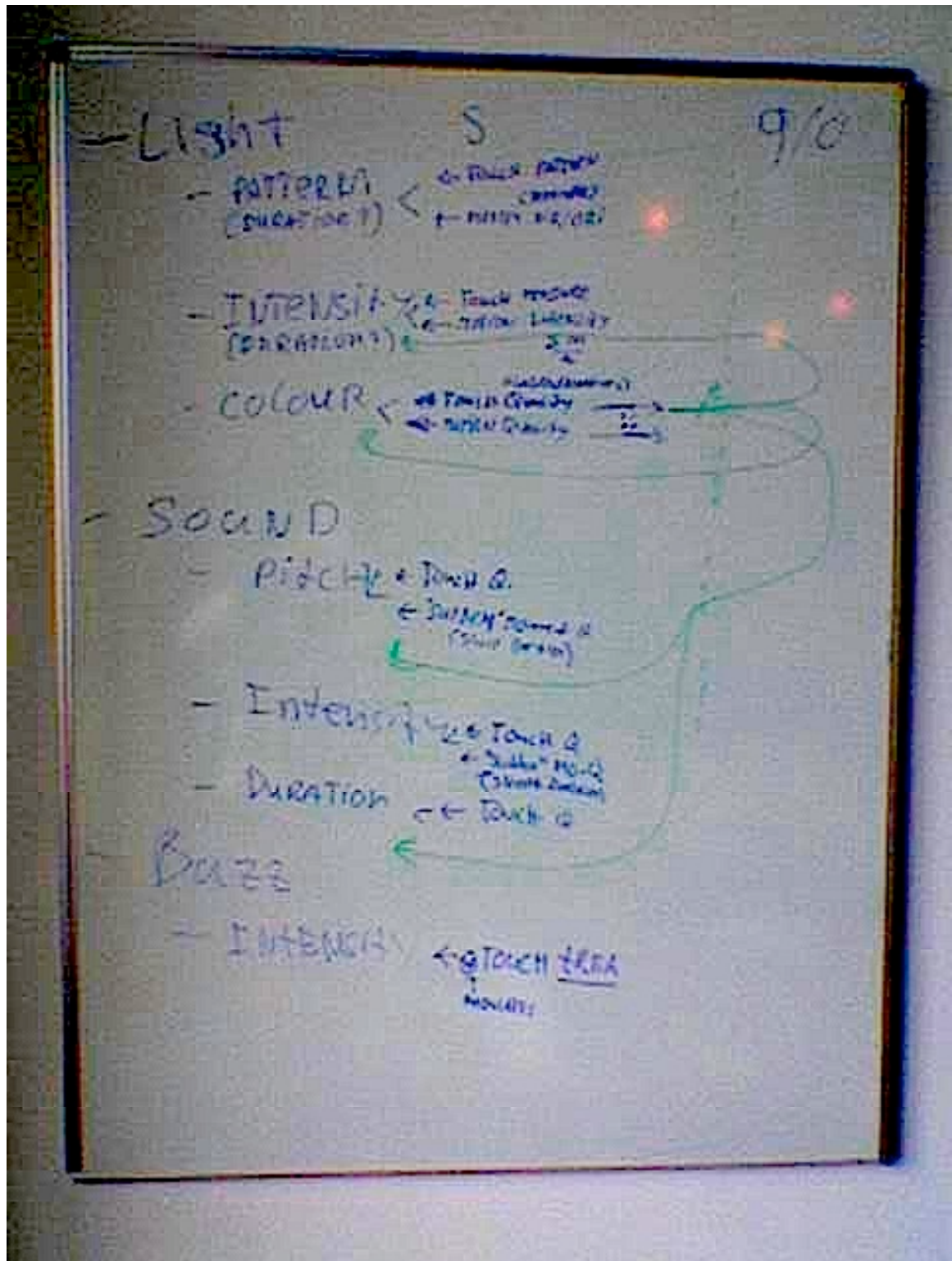
Description:

- When a ‘soft-object’ is thrown up in the air, at the moment when it reaches ‘zero’ gravity, it ‘broadcasts’ to all the other ‘soft-objects’ in the space, and all the ‘soft-objects’ respond with a ‘sigh’ sound at the apogee of the throw or toss (speaker output).
- When the same ‘soft-object’ lands after the ‘fall’ (after being thrown up in the air) all the soft-objects’ respond with a strong vibration actuation (vibration output)
- In Laban terms it reaches the “Float” effort (all ‘indulging’ qualities), followed in succession by reaching the “Punch” effort (all ‘fighting’ qualities). These two efforts are on ‘opposite’ sides of the effort scale.

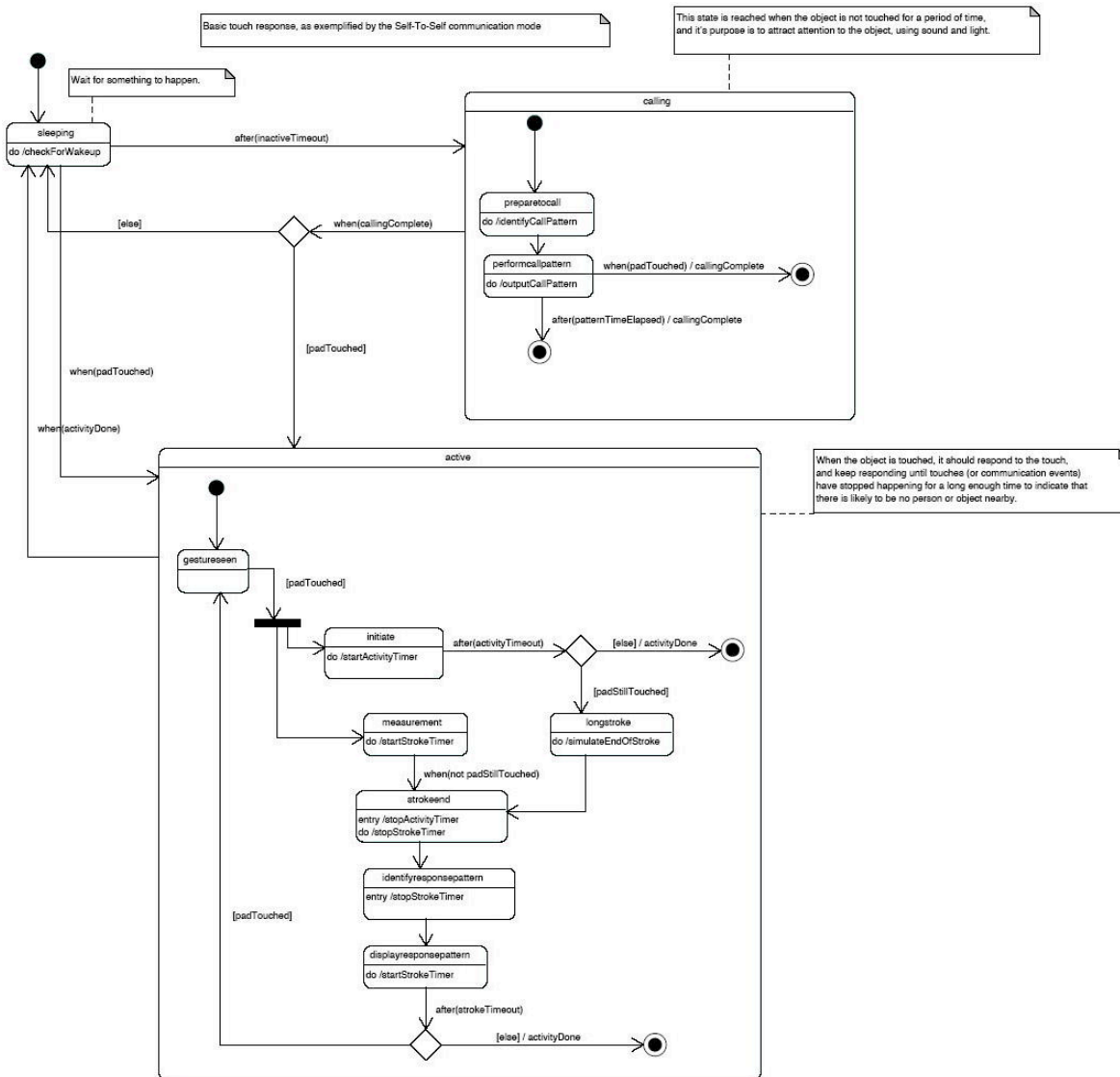


Appendix E The Journey of a Thrown Object

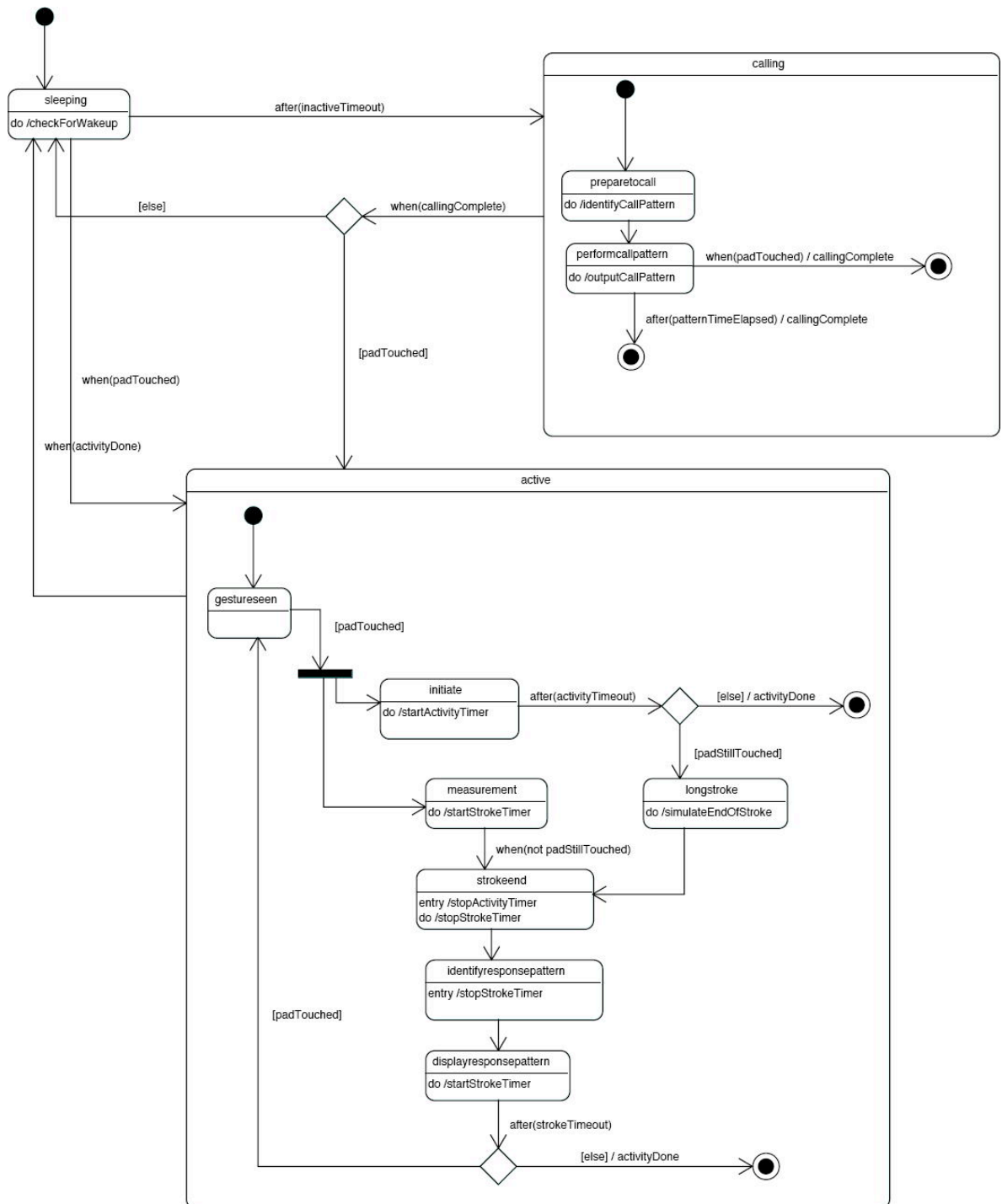
	<p>As the object begins to accelerate to the ground, it ceases its 'top' broadcast and the other objects resume their previous activities.</p>
	<p>When the object makes contact with the ground and its velocity again returns to zero, it sends a 'bottom' broadcast to all the other objects, and they respond with a strong vibration.</p>



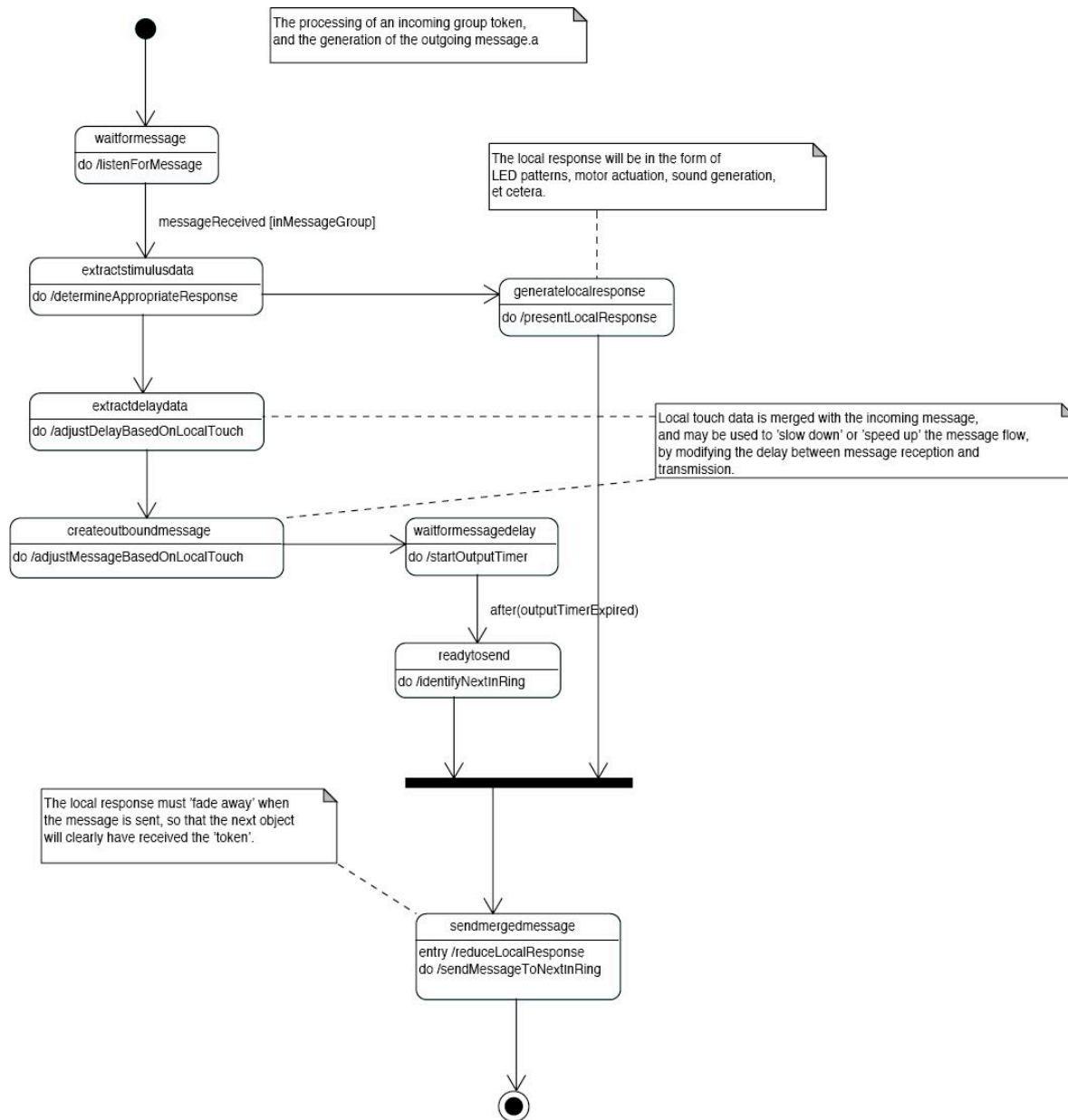
Appendix E Self to Self Touch Response



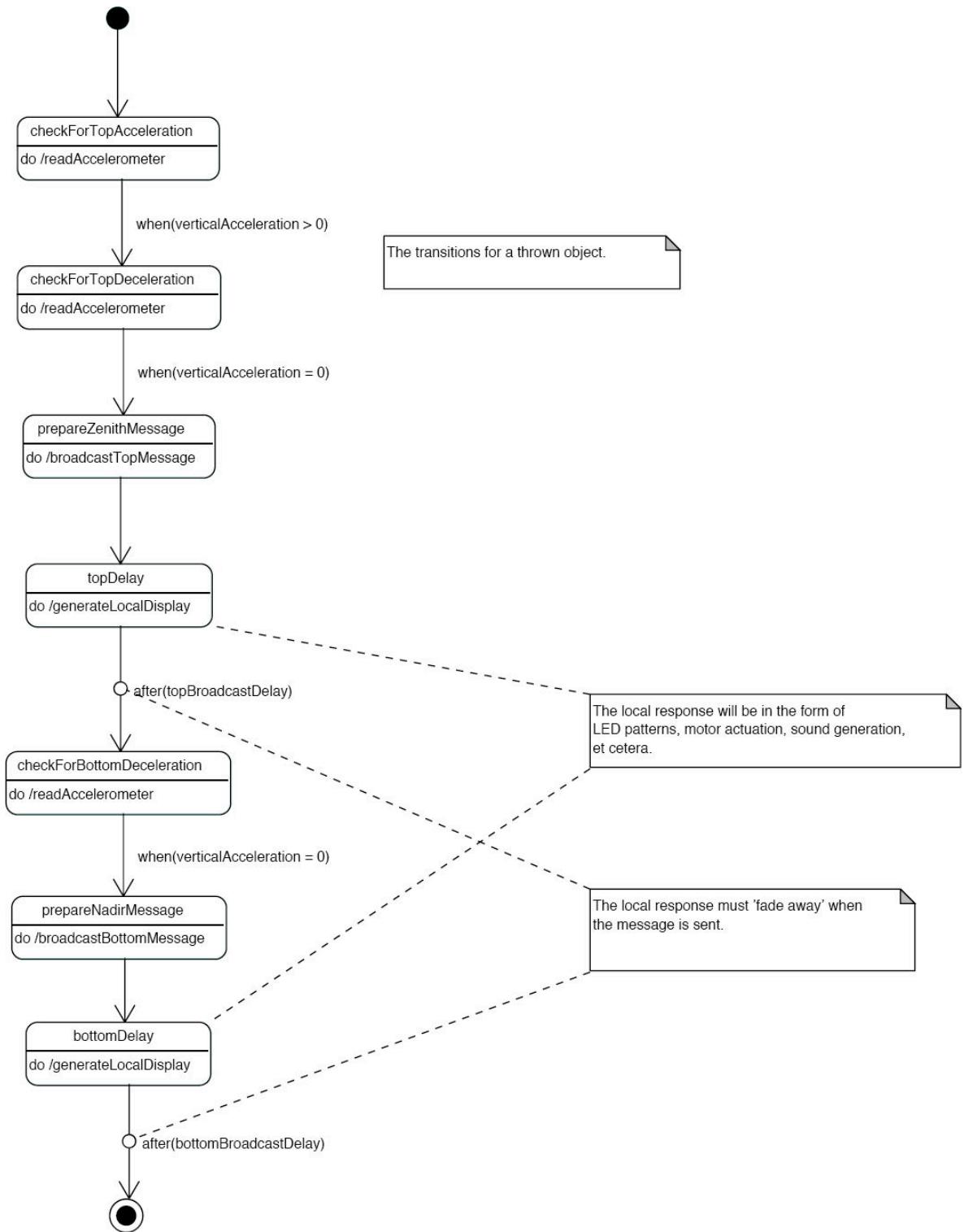
Appendix E Self to Self Sleep Call Touch Response

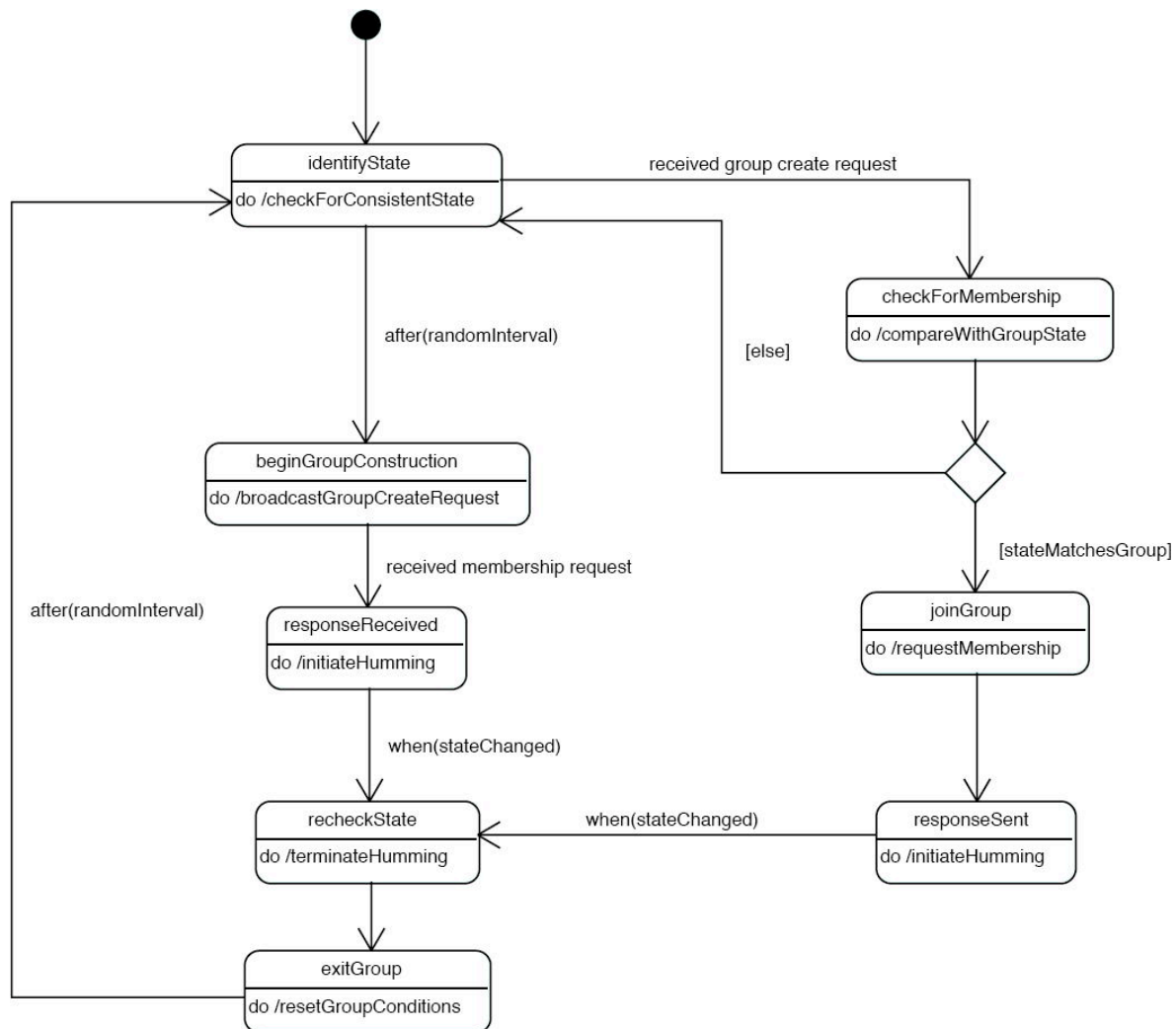


Appendix E Token Ring Response State



Appendix E Thrown Object





Interaction Modes and States

– Possible Restructuring of Interaction Mapping Diagram

In the system that we are designing, composed of multiple ‘soft objects’ and people, there are, effectively, four forms of state:

- 1) the very low-level input state, which is distinct for each ‘soft object’, and corresponds to the algorithm which interprets the touch pad and accelerometer inputs and generates the Laban Effort Shape data which is used throughout the system;
- 2) the low-level communication state, which is the aggregate of the various simultaneous ‘interaction modes’ that are active for each ‘soft object’;
- 3) the mid-level communication state, which is the aggregate of the ‘interaction modes’ that are active over all ‘soft objects’ and
- 4) the high-level system state, which is the ‘emergent structure’ that is perceived by the participants in the system.

The lowest level is handled by independent software that uses a rule-based strategy to identify the efforts. The highest level will develop through interaction between the ‘soft objects’ and the participants.

Any individual ‘soft object’ can be involved in multiple independent ‘interaction modes’. For example, ‘soft object’ A can be exchanging data with both ‘soft object’ B and ‘soft object’ F, while participating in a group with other ‘soft objects’. As well, it can be receiving unsolicited messages from ‘soft object’ M, for which it has no formal relationship – if ‘soft object’ M is broadcasting to all other ‘soft objects’.

A particular ‘soft object’ will, initially, be ‘idle’, waiting for something to happen – movement, touch, messages, et cetera. Once it is ‘active’, it will participate in the ‘interaction modes’ that have been set up for it – relationships, such as group membership, that may be predefined, or dynamically determined relationships that are established by proximity. The mid-level is, basically, a means of recording all the parallel ‘interaction modes’ that have active ‘soft objects’.

In essence, a ‘soft object’ is not ‘idle’ for an ‘interaction mode’ – it must be ‘idle’ or ‘active’ for all ‘interaction modes’; whether the ‘soft object’ participates in a particular conversation is dependent on the established flow of an ‘interaction mode’. Thus, the state of a ‘soft object’ consists of the various ‘interaction modes’ for which it is active, along with data that is particular to each ‘interaction mode’.

This viewpoint results in a restructuring of the ‘Interactions Mapping’ table, placing the ‘soft object state’ in the leftmost column, with the ‘interaction mode’ to the right. This will provide a first approximation to the state transitions of the ‘soft objects’, but it omits interactions between the communication paths represented by the ‘interaction modes’, such as the situation where ‘soft object’ A is in a group with ‘soft object’ B, as well as in a direct, self-to-other relationship with ‘soft object’ B – and then ‘soft object’ B is thrown in the air, and broadcasts it’s status to all other ‘soft objects’. In this scenario, ‘soft object’ A may receive three distinct messages from ‘soft object’ B, and must properly respond to all three.

If we view the system as communicating ‘soft objects’, with independent state, then this is not difficult to do. ‘Soft object’ A is in a well-defined state – or else we can’t reliably write code for it – and sees three distinct messages. Each message will transform the communication paths that they arrived on:

- 1) the group message from ‘soft object’ B is forwarded to the next member of the group, with possibly some transformation of the message;
- 2) the self-to-other message from ‘soft object’ B is replied to with a new message, which can supply data based on the state of ‘soft object’ A and
- 3) the broadcast message from ‘soft object’ B may result in a transformation of the state of ‘soft object’ A, but no reply from ‘soft object’ A is expected.

Note that the messages can be processed in any order.

Sensor Evaluation and Laban Analysis

The Laban recognition will be partly based on the [Laban](#) research already done for the [Whisper](#) / Exhale project by Norman Jaffe and Thecla Schiphorst.

Evaluator Class

A routine checks if the pillow is being touched or not. It is based on the older signal analysis in [Move Me/Sensor Evaluation/Event Detection](#). If it is being touched, this is an 'event' and an event is either

- started,
- finished or
- somewhere in between.

This is received by the current evaluator, together with the pressure data (a dictionary).

```
def evaluate(self, event_state, pressure_dict):  
    ...
```

The evaluator manages the current gesture and stores a previous one (to see if a gesture is repetitive). It also stores some threshold values that can be changed realtime from the GUI. Each time a gesture is created the current set of thresholds is passed to it. Something like this:

```
self.thresholds = { 'noise_threshold':0.4, 'stationary_moving':  
0.01, ...
```

Gesture Class

The [PressureGesture](#) keeps track of the touch data and time:

- for event start: [__init__\(\)](#) and [start\(\)](#)
- in between: [process\(\)](#) and [updateLabanParameters\(\)](#)
- event end: [end\(\)](#) and [getLabanShape\(\)](#)

The [updateLabanParameters\(\)](#) function uses Norman Jaffe's 'laban_matrix' to fill out the 'laban_shape' of the gesture (globals). This is done with various basic [categorize<param>\(\)](#) functions. To make this mapping possible, some extra functionality was implemented to convert the pressure format into more abstracted parameters.

Center Of Gravity Path

A vector is constructed that traces the path of the center of gravity. A convex hull algorithm is now able to draw a polygon around and a diameter algorithm uses the hull to calculate the points that are furthest away from each other.

Convex Hull

Polygon Area

<http://mathworld.wolfram.com/PolygonArea.html>

Laban Mappings

These are the mappings:

- primary:
 - intensity: mean pressure intensity,
 - time: duration of a gesture,
 - area: a hull centerpoint / area function,
 - number: number of fingers on the touchpad,
 - speed: average center-of-gravity speed,
 - direction: relative angle the center-of-gravity moves in,
- secondary (function of another parameter):
 - space: center of gravity displacement
 - path: center-of-gravity path + angles
 - disposition: ...,
 - pattern: relation between current and previous Laban shape.

Some parameters are calculated on-the-fly, that is, every time new data arrives. Others are calculated at the end of the gesture. In this case, often an average is kept of the values for that particular parameter. The averaging is done using a running average.

Intensity

Range

Soft-hard.

Description

The intensity of the touch, how hard or soft.

Time

Range

Short-long.

Description

The length of time a gesture takes.

Area

Range

Small-medium-big.

Description

The area of the part of the interaction object that touches the pad. Note: this parameter is called *Size* in Thecla Schiphorst's papers.

Speed

Range

None, slow-fast.

Description

The speed of a touch-effort. This is the overall velocity of movement. This parameter is not used directly to distinguish efforts, but is used to determine space.

Space (Speed)

Range

Stationary-traveling.

Description

Secondary; is a function of speed. If speed is (near) zero, then the gesture is stationary, otherwise it's traveling.

Path (Direction)

Range

Straight-wandering.

Description

Secondary; is a function of direction. If the speed is not zero, and there are no more than one direction registered, the gesture is straight.

Pattern (Gesture)

Range

Continuous-repetitive.

Description

If a gesture is unique in relation to the gesture immediately before and after, it is continuous. Any repeated action or gesture is classified as repetitive.

Unused Parameters

These parameters appear in Thecla's paper but were not implemented in ebrain, although some of them, such as number and intensity disposition, do appear in the Laban matrix (see [source:passepartout/trunk/src/MoveMe/SensorEvaluation/pressure_gesture.py](https://source.passepartout/trunk/src/MoveMe/SensorEvaluation/pressure_gesture.py)).

Number

Range

One-many.

Description

The distinction between one finger or object and many fingers.

Direction

Range

None, left, right, up, down, and four diagonals.

Description

The direction of movement. This parameter is not directly used to distinguish efforts, but is used to determine space and path.

Disposition (Pressure)

Range

Constant-varying.

Description

If the pressure maintains a single value after an initial acceleration, the gesture is constant, otherwise it's varying.

Disposition (Size)

Range

Constant-varying.

Description

No description yet.

Disposition (Number)

Range

Constant-varying.

Description

No description yet.

Completed Gesture

A completed gesture will contain:

- classified laban shape (if any), which can be:
 - 'tap'
 - 'flick'
 - etc., etc. (they can be found in the laban matrix).
- a dictionary with the numeric Laban values plus the thresholds that they were determined with,
- data such as the c.o.g. path, convex hull and diameter of hull.

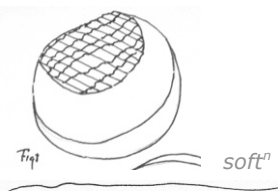
Laban Matrix

['tap',	['soft', 'short', 'small', 'any', 'stationary', 'continuous', 'na', 'any']],
['tapping',	['soft', 'short', 'small', 'any', 'stationary', 'repetitive', 'any', 'any']],
['flick',	['soft', 'short', 'small', 'any', 'travelling', 'continuous', 'na', 'any']],
['flicking',	['soft', 'short', 'small', 'any', 'travelling', 'repetitive', 'any', 'any']],
['pat',	['soft', 'short', 'medium', 'one', 'any', 'continuous', 'any', 'any']],
['patting',	['soft', 'short', 'medium', 'any', 'any', 'repetitive', 'any', 'any']],
['pat',	['soft', 'short', 'big', 'one', 'any', 'continuous', 'any', 'any']],
['patting',	['soft', 'short', 'big', 'any', 'any', 'repetitive', 'any', 'any']],
['touch',	['soft', 'long', 'small', 'any', 'stationary', 'continuous', 'na', 'any']],
['touches',	['soft', 'long', 'small', 'any', 'stationary', 'repetitive', 'na', 'any']],
['hold',	['soft', 'long', 'big', 'one', 'stationary', 'continuous', 'na', 'any']],
['holds',	['soft', 'long', 'big', 'one', 'stationary', 'repetitive', 'na', 'any']],
['glide',	['soft', 'long', 'any', 'any', 'travelling', 'continuous', 'wandering', 'any']],
['glides',	['soft', 'long', 'any', 'any', 'travelling', 'repetitive', 'wandering', 'any']],
['stroke',	['soft', 'long', 'any', 'any', 'travelling', 'continuous', 'straight', 'any']],
['stroking',	['soft', 'long', 'any', 'any', 'travelling', 'repetitive', 'straight', 'any']],
['jab',	['hard', 'short', 'small', 'one', 'stationary', 'continuous', 'na', 'any']],
['jabbing',	['hard', 'short', 'small', 'one', 'any', 'repetitive', 'na', 'any']],
['cut',	['hard', 'short', 'small', 'one', 'travelling', 'continuous', 'na', 'any']],
['knock',	['hard', 'short', 'medium', 'one', 'stationary', 'continuous', 'na', 'any']],
['knocking',	['hard', 'short', 'medium', 'one', 'any', 'repetitive', 'na', 'any']],
['slice',	['hard', 'short', 'medium', 'one', 'travelling', 'continuous', 'na', 'any']],
['slap',	['hard', 'short', 'big', 'one', 'any', 'continuous', 'na', 'any']],
['slapping',	['hard', 'short', 'big', 'one', 'any', 'repetitive', 'na', 'any']],
['knead',	['hard', 'long', 'any', 'many', 'any', 'continuous', 'na', 'varying']],
['kneads',	['hard', 'long', 'any', 'many', 'any', 'repetitive', 'na', 'varying']],
['press',	['hard', 'long', 'any', 'any', 'stationary', 'continuous', 'na', 'constant']],
['presses',	['hard', 'long', 'any', 'any', 'stationary', 'repetitive', 'na', 'any']],
['rub',	['hard', 'long', 'any', 'any', 'travelling', 'continuous', 'any', 'any']],
['rubbing',	['hard', 'long', 'any', 'any', 'travelling', 'repetitive', 'any', 'any']],
['presses',	['hard', 'long', 'any', 'one', 'stationary', 'continuous', 'na', 'varying']],
['knead',	['hard', 'long', 'any', 'many', 'stationary', 'continuous', 'na', 'varying']],
['kneading',	['hard', 'long', 'any', 'many', 'stationary', 'repetitive', 'na', 'varying']],
['unknown',	['hard', 'short', 'small', 'many', 'stationary', 'any', 'na', 'any']],
['unknown',	['hard', 'short', 'small', 'many', 'travelling', 'repetitive', 'any', 'any']],
['unknown',	['hard', 'short', 'medium', 'many', 'stationary', 'any', 'na', 'any']],
['unknown',	['hard', 'short', 'medium', 'many', 'travelling', 'repetitive', 'any', 'any']],
['unknown',	['hard', 'short', 'big', 'many', 'stationary', 'any', 'na', 'any']],
['unknown',	['hard', 'short', 'big', 'many', 'travelling', 'repetitive', 'any', 'any']],

Appendix E move.me Sensor Evaluation and Laban Analysis

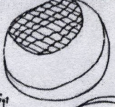
['unknown',	['soft', 'short', 'small', 'one', 'travelling', 'continuous', 'straight', 'any']],
['impossible',	['soft', 'short', 'small', 'one', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['soft', 'short', 'small', 'many', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['soft', 'short', 'small', 'many', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['soft', 'short', 'big', 'one', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['soft', 'short', 'big', 'one', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['soft', 'short', 'big', 'many', 'stationary', 'continuous', 'na', 'constant']],
['unknown',	['soft', 'short', 'big', 'many', 'stationary', 'repetitive', 'na', 'constant']],
['unknown',	['soft', 'short', 'big', 'many', 'stationary', 'continuous', 'na', 'varying']],
['unknown',	['soft', 'short', 'big', 'many', 'stationary', 'repetitive', 'na', 'varying']],
['impossible',	['soft', 'short', 'big', 'many', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['soft', 'short', 'big', 'many', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['hard', 'short', 'small', 'any', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['hard', 'short', 'small', 'any', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['hard', 'short', 'medium', 'any', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['hard', 'short', 'medium', 'any', 'travelling', 'continuous', 'wandering', 'any']],
['impossible',	['hard', 'short', 'big', 'any', 'travelling', 'continuous', 'straight', 'any']],
['unknown',	['hard', 'short', 'big', 'any', 'travelling', 'continuous', 'wandering', 'any']],

soft(n) Workshop Response Card


<p>describe your sensory impressions</p> <p><i>impressions</i></p> <p><i>touch</i> <i>sound</i> <i>light</i></p> <p><i>look</i> <i>feel</i></p>
<p>describe the behavior of the soft objects</p> <p><i>between objects</i></p> <p><i>life</i> <i>intelligence</i> <i>response</i> <i>sense</i></p>
<p>describe your experience</p> <p><i>experience</i></p> <p><i>senses</i></p> <p><i>understanding</i> <i>feeling</i></p>

Appendix E soft(n) Response Cards

soft(n) Workshop Response Cards


softⁿ

describe your sensory impressions

THE OBJECTS FELT LIVING,
TWITCHING, LIGHTING UP, TALKING,
NOT UNLIKE A SOFT, CUDDLY ANIMAL (BUNNY?)
THAT IS PLEASING, AND WHOSE TACTILE FEEDBACK (AS WELL AS SOUND & LIGHT) IS QUITE
REWARDING AND SOOTHING

(THIS HAS ALSO TO DO WITH THE TESTING SETTING, WITH THE FATBOYS, WHICH INVITED
US TO LIE DOWN AND GET COMFORTABLE)

impressions

touch
sound
light

look
feel

describe the behavior of the soft objects

THE SOUND WAS A BIT UNSETTLING (NOT UNLIKE LISTENING TO A CONVERSATION/MONOLOGUE between objects
IN A FOREIGN LANGUAGE) BUT THIS - I THINK - REINFORCES THE IDEA
THAT THEY HAVE THEIR OWN LANGUAGE AND THEIR WAY OF REACTING
TO STIMULI - LIKE A LIVING BEING.

THE VIBRATION FELT TOO ARTIFICIAL (DIVERGING FROM THE ORGANIC NATURE
OF THE SOUND AND SHAPE OF THE OBJECT)

BUT IN GENERAL, THEY FELT LIKE THERE WAS MORE THAN A SIMPLE ACTION/REACTION
RELATION TO USER ACTIONS (~~THEY~~ THEY BEHAVED) MORE LIKE A SENTIENT/INTELLIGENT BEING
RATHER THAN A MACHINE) - I REALLY LIKED THIS

life
intelligence
response
sense

describe your experience

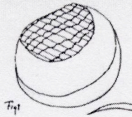
CALM AND RELAXING - THE SOFT OBJECTS ARE CURIOUS AND UNPREDICTABLE
BUT NOT AGGRESSIVE OR INTIMIDATING

CURIOUS - I FELT LIKE I'D LIKE TO UNDERSTAND THEIR RESPONSE TO
THE WAY ~~THEY~~ I MANIPULATE AND USE THEM;

PERSONAL - THE FEEL OF THE OBJECTS AGAINST THE BODY IS ALSO
VERY PLEASANT (DUE TO THE FACT I CAN'T CONTROL THEM? I FEEL
THAT THIS FACT REALLY INVITED ME TO EXPLORE THEM IN A
VERY PHYSICAL SENSE)

experience
senses
understanding
feeling

Appendix E soft(n) Response Cards


softⁿ

describe your sensory impressions

EXPRESSIVE AND SOFT "FEMININE" FEEL
IRRITATING
SOFT AND SENSUAL MOOD

ORGANIC & "ALMOST-NATURAL"
FEMININE AND SENSUAL

impressions

touch
sound
light

look
feel

describe the behavior of the soft objects

HAS ITS OWN LIFE
AN INDEPENDENT MINDSET
NOT WHAT I EXPECT
I CAN OBVIOUSLY FEEL IT HAS ITS OWN WORKINGS
WHICH ~~TENDS~~ INVITES MY "SOFT" SIDE WHEN APPROACHING IT

between objects

life
intelligence
response
sense

describe your experience

WIERD - I WAS WONDERING WHY I FELT SENSUAL WITH
THESE "SOFT-OBJECTS"

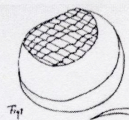
INVITING MY SENSUAL AND OFTEN PERVERTED
SIDE

JUST KNOWING THAT THESE OBJECTS COULD
CONTROL MY EMOTIONS IS BOTH A THRILL & FEAR

SENSUAL, ORGY AND SOMETIMES PORNOGRAPHIC SENSE.

experience

senses
understanding
feeling



soft

describe your sensory impressions

I felt them as pets, some fantastic
creatures I wanted to tug or/and
play with.

impressions
touch
sound
light

look
feel

describe the behavior of the soft objects

Quite unpredictable and
behaving in their own manner.
I was happy not to find any
ways of controlling them,
autonomise and individual characters
distinguish the "objects" from just "things".

between objects
life
intelligence
response
sense

describe your experience

I felt like playing, throughling the
objects, petting them and
getting comfortable lying in between.

experience
senses
understanding
feeling

PART I Summary of Workshop Results

This is a summary of observations of workshop for soft(n) conducted on 2 feb 2007. The entire transcription of the workshop follows this summary, so you can read it all if you wish.

Soft Object Design

A number of aspects of the soft object design iteration was clarified or illuminated during the workshop.

The summary is divided into

1. FORM of the SOFT OBJECTS
2. ENVIRONMENT for the SOFT OBJECTS
3. ACTUATORS
4. BEHAVIOURS

1. FORM of the SOFT OBJECTS

This section primarily affects the construction of the soft objects. Bonana and Thecla have discussed these aspects and Bonana is using these as guidelines in her construction work. For the electronics construction, the key is that some of the soft objects will be bigger than the original 3 that Bonana made for the 2 Feb 2007 workshop.

SIZE

- the group of 10 – 12 soft objects should be BIGGER in general. The size should be somewhat closer to human scale (but not human size! That would be too big): a reasonable reference is that the biggest soft object would be no more than about 2 to 3 feet. The smallest soft objects we now have can be the smallest ones of the group
- the group should be able to 'stand alone' without the necessity of sofas, chairs or fatboys.

SHAPE

- The shape of the soft objects should remain 'non-literal': the organic feel of aspects of the body works well. No obvious circles, squares or rectangles at all – nothing reminiscent of a pillow.
- Shapes that are organic like kidney shapes, some aspect of simple curves but no perfect geometric shapes.
- The group of 10-12 should look somewhat like a collection of abstract garden-like or family-like, or ecology-like, or organ-like shapes, some 'fat' some 'thin' some 'short and squat' some 'round and full' some 'taller and shrub like'

TOUCH PAD areas

- It works well to have each touch pad in a different area on the soft object and be well defined through the material that is used
- The softness of the suede and the more vinyl type of fabrics both worked well
- We need to be able to come up with a way to attach the touch pads with the rest of the soft object that allows cleaning of the soft object – Bonana and I talked about zippers for the soft objects to enable this

CLEANING

- Soft object covers need to be able to be cleaned

STUFFING and INSIDES

- The stuffing should 'protect' the inside electronics
- The soft object should feel 'soft' and 'squeezable' and a body should be able to hold it, sit or lie on it or with it comfortably
- The electronics needs to be encased in something without edges (nothing rectangular) – just like the body has hard and soft bits in it, but you never feel any corners in it when you squeeze

FABRIC

- White, cream or neutral that can be drycleaned
- Touch pads with alternating textures where necessary
- Inviting fabrics

2. ENVIRONMENT FOR THE SOFT OBJECTS

- The environment should invite participants to move soft objects around in relationship with one another
- A white or cream short ply carpet that is comfortable and that marks an area for the soft objects to be placed upon will invite participants to sit, or squat or lie comfortably
- Soft ambient low lighting that enables the environment to be demarcated and also enables a low enough light for the soft objects illumination to be visible when walking by

3. ACTUATORS

VIBRATION

- Vibration needs to be more continuous, with greater increase and decrease (as if the vibration has a tonal quality, think of the way that breath increases in 'gain' and then decreases in a rhythmic 'in and out' way) – one could say that vibration should map to the light pattern we now have in terms of rhythm and pace

LIGHT

- More LED arrays in each soft object utilizing the same light emissive "light bleeding" property of emergent behaviour

SOUND

- The sound was the most 'problematic' of the outputs, simply because it has not been designed to respond to behaviours yet in any real way
- I have a sound designer named Marc Brady from Vancouver who will do the sound design for our circuit. We need to get him the information for the sound circuit and our algorithm so he can work on sounds that support the emergent behaviours. Marc wants the objects to LISTEN as well. Can we put a very small mike in them?

4. BEHAVIOURS

- we were only able to test very simple behaviors in the 2Feb2007 workshop, but we were able to assess that the group of 3 soft objects did invoke a sense of 'connection', 'communication', and 'community' (see transcript for more details). The most striking characteristic of the workshop results was the level of intelligence that was read into the interaction simply by allowing people to explore and play.
- we will use the Feb 22nd workshop to test the emergent behaviour properties of the soft objects based on the Laban quality recognition

PART II Transcription of video interview

Thecla: I am going to record this for the conversation.

Rui: Tell me what was going on in your heads when you first were alone with the pillow, or with the soft object?

Thecla: we are calling them soft objects instead of pillows

First Workshop Participant: yah, I guess, I was just trying to get some kind of meaningful response to understand, how, well, what was really going on with the object, and I got really comfortable when I got it just lying like a regular pillow because

Since the shape is also irregular and not just like a normal I just feel compelled to find the best position and that it also gets on speaking and vibrating so that

Its pretty much like when you are trying to fall asleep and then you just change your position, it actually got me like, hey this way works, this way doesn't work now its shut up, and (moving hands over his head) and now it works, and now it doesn't

I really couldn't understand what was really making it work, I just could figure out that if I just treated it like ... a pillow, a soft object, it did work somehow, and I really was just trying to figure out what was going on ...

Rui: do you think that if you understood clearly what was going on, that would make it better?

First Workshop Participant: no.... no.... I think it would be much less fun

That is what happens usually, Usually when you get what is going on behind the scenes its, well [its not so good] So I really like the fact that you cannot understand how this mechanism is going on

Rui: you don't have to wait, you can all talk at the same time.

Third Workshop Participant: for me it was quite surprising when after I was trying to put it under my head lying, the moment that I stopped moving, the object stopped doing anything as well, so it kind of synchronized to my intentions, because I was trying to shape it and then leave it, as if I would be sleeping, and it was very nice to see this relation, it kind of understood what I wanted from it, it was probably a coincidence, but it felt really nice that it kind of felt my ... mood in a way, that was nice to feel, because if I was using the object as a pillow its nice that it measures, like the moment I freeze then its stops, and it leaves me to sleep or to watch TV, for instance, or do something else, that it kind of recognizes the situation as I felt it ... that was nice

Second Workshop Participant: when I came in at first, I thought, wow, just pillows? I mean, I didn't want to look like a retard, just playing with pillows, I mean just holding the pillow, I didn't know what to do with it.

But ok, alright, lets try it, lets try to sleep with it ...

So ... I keep on listening to it, and then its, anytime I changed position then it was making another sound, but the sound is also a bit irritating,

Appendix E soft(n) Workshop Transcription

But eventually I did find one position between here and here (pointing to front of pillow) and I felt that was a great place to sleep

I really liked the vibration, for me I think that you should put more vibrations, especially when it is in between, you know, your thighs, it gives you a really nice feeling, not in a perverted way, it does give you some kind of really nice feeling, like you are not alone, but if you saw from the other one, I also put 2 pillows because I realized one was too small, and then you kind of feel like you are with a Workshop Participant, and you feel like to you don't want to be with a very small Workshop Participant, its feels kind of pedophilic

First Workshop Participant: yes that is what happen, putting them together, trying to get a bigger mass just to feel like there is something there, and trying to get a fuller response

Bonana: and what about did you notice the 'selection' touch pad, and did you do something with it?

First Workshop Participant: I found myself always trying to put that part against my head ... so I wouldn't, because I didn't want to ...

Third Workshop Participant: I tried pressing it [the touch pad], and tried holding it down and pressing it *in* there, because at some point, well I was doing like this, and I was pressing it down because I thought that it actually has to do with the sound somehow, when I was pressing it, after I was just pressing it, I was trying to calm it down somehow, like press it, like make it stop in a way, and I was inviting, and it was reacting and it was really going down and the sound it was getting less, and there was no vibration at the time, but I felt somehow that I could really communicate with it, that I could give it some

Bonana: about the size, should it be bigger, or smaller

Well I think the size could be a little bit bigger

Third Workshop Participant: If its bigger its fine you know really, with this particular size I put it underneath my stomach if you noticed, because after the couple of times of throwing them around and feeling them I felt that this portion really felt very sensitive, and I thought, oh, why not try from different angles then also, that one together with the vibration does give you a very comfy feeling, like, again, you are not ... alone.

But I think, if it was bigger, it would be really great, it would feel ... you know ... and also the mood, because the place was dark, and you could see the "glowing", it also gave it ... ah ... a romanticized feeling.

Yah ... it does "tune" your mind, I wasn't even thinking anything technical in any way .. I was just thinking how it feels, you know

And it does feel a little bit sensual you know, for me it feels a little bit sensual, plus the 'red', and the 'glowing', but, but I am disappointed about the vibration, because ... it is just gives you just a little vibration, and then it goes off.

No but not that short

Appendix E soft(n) Workshop Transcription

Thecla: are you saying that you would like the vibration to last longer and to have more qualities to it, so that you could control it more ...

A continuous rise and fall of vibration

First Workshop Participant: yes, yes, at this point it just feels like a cell phone

It needs to be various strengths, it felt like a cell phone, it starts and then it stops, it feels like something arbitrary is activating the vibration and then it stops

Thecla: a continuous strength of gain in volume, a feeling of strength and going down

Third Workshop Participant: I would gladly trade sound for vibration actually,

Second and first Workshop Participant: yes, yes, yes

Third Workshop Participant: because sound was tonations, so that vibration going in a similar ways could have difference tonations, and you get different frequencies from it, and different strengths, it would be really interesting

Second Workshop Participant: And I like what you did with the two sides (talking about kidney shaped soft object) with this part being a bit more

Third Workshop Participant: ... Lower it looks like a heart

Second Workshop Participant: yes, and in the darkness when you touch it, you feel it's almost close to a bit natural

Third Workshop Participant: Because of the inconsistent surface, it has a bottom side and an up side

Second Workshop Participant: and it looks and feels very grabby ...

Rui: if you have to talk about the parts of that object, or if you had to make a metaphor with the human body, what would you call that?

Second Workshop Participant: I would call that "the perfect bum" (the kidney shaped soft object)

Rui: Is that one also the same (speaking of the other soft objects)

Second Workshop Participant: no I would not call that one the same, because I did have some very nice experiences with that one ...

Bonana: is it because of the texture?

Second Workshop Participant: yes, it is because of the texture, because the thing is that you do set the **mood** here, so for me I have a different mood with this one than (suede bottom touch pad) with that one (kidney shape) ... and that one does sort of tickle my mind to be more "grabby" or to grab it

Third Workshop Participant: this is like a different kind of animal or like some kind of ... like an agorant alien

Appendix E soft(n) Workshop Transcription

First Workshop Participant: I just noticed that they were different, I just noticed that this one is in the base and this one is in the side and I didn't notice that before ...

Second Workshop Participant: this one (kidney) feels different from that one (bottom touch), this one (kidney) feels a bit, just slightly plasticky,

[all passing the others around]

Third Workshop Participant: [holding touch pad bottom one] this is leather though ...

I think that leather also gives some certain quality of tactile feeling and I find it also quite animalistic, you get more careful when you feel this kind of material, and it gives you this idea that it brings you something more alive, that you have got to be more careful probably. This is the one that I smashed against the wall ... but I would not do that if I would feel this material, because it gives me some kind of feeling that I have to like grab it or like really [he is squeezing it tight in both of his arms]

Second Workshop Participant: it does tickle your mind to want to do grabby, want to grab it.

Third Workshop Participant: and it is nice that you can like **shape** them [he is squeezing and forming it into a smaller area], that you can like **press** it, and I was trying to press it because I was thinking that it might change the mood somehow, I was like trying to press it ... if I would like "oooooooooh" [pressing it and saying oooooooooh] ... it was reacting on pressing ...

First Workshop Participant: I was wanting hold it and just do stuff, when I was testing I was thinking really ...

I thought I should be doing something more active, but most of the time I really just wanted to go around like this, [holding different parts of the soft object and turning it and squeezing it]

Third Workshop Participant: I also wanted to fight it somehow all the time, I don't know why, I am not really an aggressive type Workshop Participant, it was like, ok, ok, I am [ill?] with you

Rui: I think the sound might somehow trigger that ...

[laughter all around]

Third Workshop Participant: yah, yah, that is true ...

Second Workshop Participant: I am more tolerant, ... I really would be tolerant if any, if somebody was lying by me, and was making lots of noise, I could tolerate it, but up to a certain point, and then just, ok, ok, just be there, and it really feels at some point, because I really felt very comfortable when I was lying on the side and I could grab it and it felt really very fine, and I could feel the vibration and everything, so it felt much more, and whilst I was feeling this very sensual feel, then there was this very irritating noise, and so I like, will it calm down? Will it just shut up so that I could just concentrate?

So the sound should be really very mellow ... very groovy ... so it would be difficult for you to tell me time is up, I would just be here fondling this, stay awake ...

Appendix E soft(n) Workshop Transcription

Whoever ... designed this, is a little perverted parts .. because I swear I can feel it ... it has very special parts

Rui: can you throw me that one?

Bonana: so you prefer that kind of shape?

Second Workshop Participant: It is not about preference at all. If there was a way in which: one, two, three would combine, then that would be swell: that would be just funky.

Thecla: when you say that, when you say combine: are you talking about the size, the shape, that they can be put together and taken apart, or if there is one object that is a perfect combination of all three. And what if there were 10 or 12 objects?

Rui: or are you meaning that each soft object will fit perfectly a different part of the body?

Third Workshop Participant: well, without experience that, that is probably hard to ask for, but can I mention that ...

Second Workshop Participant: for me to issue if it was a bit bigger, and if it had that feel, and that feel, now that would be really nice ...

Third Workshop Participant: I guess size really determines the mood somehow, because the bigger you get, if it is bigger, somehow, its not quite that you feel more respect to it, but you are not going to do some crazy things with it I guess

Thecla: it is more equality or something like that ...

Third Workshop Participant: that it gets closer to you size so that you are more touching it and less throwing it like a small size gives you the feeling that you can do anything with it, because I was throwing it in the air, and seeing how it behaves, but if it would be bigger it would be more pushing it down and trying to press it and maybe kick it but I would not throw it up,

First Workshop Participant: one thing I felt it was that , in some occasions I could rally feel that there was something inside the pillow , that I mean you have this mass, and then you have some hard part, and especially with the vibration in one case, it was in the first one, I could really feel the vibration and what was making it, well I am not sure, but I am wondering if you could just feel it as one object and not as like a shell, like a soft shell, I am just wondering if you can get more soft stuff around the circuits, maybe then you cannot then just grab them and find the shell.

Bonana: maybe if it is bigger

Rui: or maybe if you can find something, you do not find a box but something more round, like a harder knot of something that it can

Thecla: if you held a body for example, a body has things in it, like bones and organs, some are hard and some are soft, but the shape is not a box

Rui: there are no corners in it, that would be nice if

Appendix E soft(n) Workshop Transcription

Third Workshop Participant: it would be nice if it could be embodied in something, if it could be surrounded by something. ..

Second Workshop Participant: or even placed within it so that you could placed inside here to shield it in some way, it would do some real good, and then the SIZE and then the VIBRATON, that would be really nice

And then the MOOD, you could do some more stuff with the mood, because this RED is really funky, but the thing is that it is also too hard, so it, then there is a contrast, because if you notice what I did the first time, I kept tossing it here and there because this (squeezing it together) gives you a different feel, and then you have to lie on this HARD thing, and there is just too much contrast.

TAPE 2

First Workshop Participant: there was something when I got in and that I was just remembering, the whole, shake and then the light, it just reminded me of that iPod feeling, and when you talked about the white carpet and then the lounge thing, I mean I really felt like this kind of iPod feeling, like an object, that is made just touch it like it is supposed to, that is why at the beginning I was just like, you know I would **never** throw it against a wall even if you would just if you told me, it just seemed so pristine and so nice and so white, and it is there, so careful and direct you also don't want to wreck it

Rui: its because it is white ...

First Workshop Participant: yes, and that is just the association that I was making, but on the other hand, this fabric [the cotton] and the whole thing [the touch pad], takes a little out of it and well I guess that is good, and then you can feel that you can touch it, and go around and feel this, instead of just treating it like a design piece, so

Third Workshop Participant: it doesn't give you this ... at least that it is meant for ...robust ...

Thecla: well an iPod is hard and these are meant to be soft

Rui: what is your opinion about their weight? Are they too light? Should they change weight? Are you expecting that one should be heavier than another? Did you sort of get a surprise?

Second Workshop Participant: I think that if it was too heavy that it wouldn't get the,

Third Workshop Participant: I think it is a comfortable weight, I think that it is

Second Workshop Participant: if it was too heavy then it wouldn't trigger any of the things that is happening how, I think that also there is a mental part that is going on; that is why we prefer it bigger, is that there is a mental, because it is so Because it is so, so feminine ... that's how I call it

[laughter]

sorry, may I could call it ... but it is so feminine for me, and you know, you would like to, you know, nicely,

Appendix E soft(n) Workshop Transcription

Thecla: feminine and female are not necessarily the same thing, feminine is allowing certain qualities to be present, like the softness for example

Rui: which kind of objects did you have in front of you, like did you thought it was like a technological object or if you had to place this in a category like or some quality thing,

Third Workshop Participant: ... an artificial pet, I think it would be something similar to iBo, but not really iBo, but something that sits in the corner of your room, and that you can interact with when you feel that you can get, that you can also, if you are pissed off you can bring your anger out, or if you feel low, you can just hold it and you can pet it, or you can just get comfortable with it, and you can relax and you can use it as a cushion, I think, for me it feels like a small artificial animal I would say ...

First Workshop Participant: I think that they look pretty organic but the light, I think that it gives it pretty much saying this is technological

Second Workshop Participant: but for me, for me, I am able to kind of separate it, and say ok look, the lights and the stuff, is on this side, and the (I don't call it a pillow) the comfort is on this side, because it isn't very, I didn't see it as a "technological" something or an "artificial" something, even though the shape does give you an "unreal" shape for a pillow, I think that is also the idea, but for me, I felt that it is something, it is supposed to bring you comfort, for me

Second Workshop Participant: I think that if you are trying to set a particular type of mood, I think that there is some sort of a conflict and that should be resolved between the light and the sound.

Rui: so if you had to interact with the three of them, what did you think of that

Second Workshop Participant: there is a conflict, there the color red, there is the color white, there is a bluish ... I think that the diffused light and the sound are contrasting, the diffused green is supposed to set a mood that is – the light is very continuous and the sound is very ...

Third Workshop Participant: at some points I would like them to match I guess the sound and the vibration, at some points I would like them to be together to be in the same mood, at the same time at some times it would be nice if they were in contrast, maybe interesting if sound and light would swap, and sound would go really low, or in

Thecla: but what I heard you say before was what you are doing in relationship to what you are doing, or you don't mind if it is doing something else ...

Third Workshop participant: Well, I think that these qualities, these dynamic qualities that it does have already, it gives you different, it enlightens you for different actions somehow ... I find when it has sound, and when it gives out sound, it is more like a bat I find, and it is more dynamic in the mood giving effect, it is quite unstable I would say, I don't find it as an object that gives me certain feeling, I find it is an object that triggers my mood to change

Second Workshop Participant: For me it does trigger me to feel something, for me it does, for me it is contrasting with the sound and the light because the light is a very calm light, and the sound is a very irritating thing, ultimately if the whole effect is to bring you comfort or to trigger some feel then it is working.

Appendix E soft(n) Workshop Transcription

But not optimally
They are contrasting things

And the vibration, if the vibration could be timed in a way, and if it is dropped very beautifully it goes up to a certain level, and it drops, and you could see that it is dropping very nicely, then you would, you would achieve this very nicely,

because this whole object starts you from some point

Rui: can you talk a bit about how you felt with three pillows at once, did that change anything?

Second Workshop Participant:

I have perverted thoughts with all three pillows, for me, straight up, it was just straight up, oh wow!

Rui: so having one or three it was just a number, that was the difference for you

Third Workshop Participant: oh no, it does make a difference

First Workshop Participant: it was just nice to see, that they, well you could feel sometimes, I was just putting one away, and then I was just applying pressure to the other two, and then the other one was answering, and so I could expect something different

They would react to one another: I really like the SoundScape of 3 pillows.

Third Workshop Participant: I was trying to get them to socialize somehow, when I had all three I was trying to build a pyramid, or I or put them together, or was trying to get them to turn their sides to one another, I was trying to get them to communicate.

Thecla: So when you say socialize, do you mean physically socialize? Or in some other way?

Third Workshop Participant: well, socialize, I was trying to get them to interact with each other. I was trying to figure out if there were certain positions that if they were like if they can communicate, not exactly communicate, or interact between, or somehow influence each other, I was hoping maybe if one was giving sound that maybe another one would get that sound I was expecting this social exchange of the sound, or of the light, or maybe if one vibrates and you bring another and they start vibrating and they would still vibrate for awhile and then maybe they would stop for awhile, and things like this, and they give each other example of behaviour, that is what I was thinking

Second Workshop Participant: well, don't you think that you are also influenced by the fact that you have for example, unlike me, I don't have the information that they are "wireless"

Third Workshop Participant: isn't that on the website ?

Second Workshop Participant: well, the whole idea is to test these pillows, so taking technology -out- for me, is just taking technology out and put it on the side, it is not about the technology, whether it is "wireless" or not wireless

Appendix E soft(n) Workshop Transcription

Thecla: what are your sensory responses, because you have talked about it being sensual for example, all of you have talked about that, is there one of the senses that was more prevalent, or how for example, can you say something about what that felt like, if one took over from the other, or if they worked together, if you noticed from the other one different situations, made you interact with it, because there are different senses going on: you have different senses and the pillows have different senses.

Second Workshop Participant: for me, like I am, subconsciously you always have this us, ... it doesn't matter what I say right?

For me, it is about, uh, the, unnatural, or natural desire, how would it be like to have 2 or 3 women in a room, well, of course, they are women, but you know what I mean?

Intimate, intimately, then you think about it, but you know that it is one of the biggest things that you don't want to risk, having 3 women in one room, so for the first time, as these things begin to trigger, I will speak for myself, as these things begin to trigger my feeling of comfort and of being with something very feminine

Third Workshop Participant: like a simulation?

Second Workshop Participant: yes, like a simulation, more like a simulation, then I begin to feel like, oh. then I am comfortable with these "women", and they are not fighting with each other, nothing is happening, I can feel the others ..

Rui: did you notice that the objects were influencing you more than you were influencing the objects?

Second Workshop Participant: yes, yes, for me, the objects were influencing me, more than I was influencing them, and if you notice also with the last one, I really brought all of them together close. I really felt ... oh wow! Wow! They can be close.

First Workshop Participant: I also wanted to bring everything closer together, and then, being in contact with everything, and then ...

Second Workshop Participant: I also, I also, unconsciously, I realized that it is also a bit of a control as well. That I could have you know, oh wow, these three women together, nothing is happening, but you could still feel them

Third Workshop Participant: I felt, I felt, I recognized them as a material somehow, I wanted to build some kind of a nest from them, I wanted to put them around, and then I wanted to lean somehow on this construction afterwards, that it was some kind of a, not a building material, but something that may be more like a, kind of a smaller angels that would make me a company that I could be with together like harvest or

Rui: were there any kind of questions that it triggered you, did any kind of question mark come up, in your head when you were playing with them?

First Workshop Participant: I was actually trying to, well I just got technical and I was trying to figure out, ok, what is making this work, what is going on here? And from your whole suggestion of the whole sensual and the whole sexual, I really think, and this is based on the whole idea of the sound and the light and the vibration not being totally understood, it is pretty much like you are not in power, you are not controlling them, they are actually having their own way, they have their own life, and it is pretty much like when you are with another person and they say "well I need to go now!"; it

Appendix E soft(n) Workshop Transcription

is not like you don't understand or anything like that, it is just that somehow, they have their own life! So it is not about needing to understand them, it is about working with their own life, and so this looked pretty much that, I have this object and I am with it, but on the other hand, it has this life and I cannot get in, and so far I am just restricted to a physical relationship and trying to understand what this is all about, but on the other hand it keeps showing me that I am not in control, because all of its mechanisms are so different than me, I mean ... I think if the light and the sound and the vibration were in a place that I could feel that ok, pressure (pushes) its living and pressure (releases) its dead; and I like the way that, for example if you get with (using your example –looks at workshop participant two) a lot of women, and they can talk on the side you can be with two of them and they are talking with a third, and all of a sudden, they can make this collusion, and all of a sudden you are out of it: well that is pretty scary if you see it from a sensual and from a social point of view, just like this whole fantasy [of yours] of being with three women and they, they just start having fun without you , and that is the kind of thing that came up for me, and I just like the fact that you cannot get hold and control these objects and go away and say, ok, I totally got this, and this experience is finished

THE NEED FOR QUESTIONS/QUESTIONING TO BE A PART OF EXPERIENCE

Second Workshop Participant: for me, it is **not** the desire to control, the desire to control has nothing to do with they themselves, having their own minds as they are themselves, of course it doesn't change the fact that you would want some form of control, but ... on the other hand, my question would be, if the whole of this, test and this whole soft object is to trigger a sensual mode, invite a sensual feel, from us, if that is the whole idea, then it does work, it does work on me, but then, it does become somewhat confusing for me, it does become, almost in some ways pornographic, there you have – cameras, also looking at me trying to get deep into what I think about these pillows

Thecla; we are trying to understand – is this idea that we have – does it work

Rui: I think I can explain this – something has been worrying me, I have been working on these pillows as well, and what I have been worrying about is that they have been controlling me, so what I notice that the way that I touch them is not normal, is because I know what is inside, and this is what I want to see, because someone whose is not being manipulated by pillows for 2 months already or half a year, they have been manipulating me, so I am a slave by now, so like all my behaviour is just controlled by them, so we just wanted to see the behaviour of someone who was not manipulated before

Bonana: I think that any objects makes you a slave if its comfortable, you get a slave with the objects

Rui: I have been working for quite long with them, and I didn't do like 2% of the kinds of things that you did with them, I never did it, I most of time, touch it with one finger,

First Workshop Participant: because you know that is the soft spot with them and that there is no point to just start pinching them ...

Rui: so this is really great. This is why we need this test, to see like what real people do to the pillows, because I don't consider myself a real person.

Second Workshop Participant: no, but there are also other things that people would like to do with pillows, if there weren't cameras and other people watching

Appendix E soft(n) Workshop Transcription

Bonana: yes, you have 3 different individuals, I mean your mood is very different from his, and from yours again, but all of the soft objects that trigger in your mood

Thecla: why did you fight when you were together the 3 of you. Do you think it was because you were 'guys'? or another reason?

Second Workshop Participant: well, Three different people getting together, the first thing they are going to do is fight.

The only thing, we are not going to be sitting here touching pillows.

Rui: there is something that we have to take into account, they were invited to come in and interact with them. Would you be so compelled to play with them for so long.

It depends on the environment, with the carpet and the mood that you are thinking about

First Participant: will the pillow fighting, was actually just a part of being fun, it was playing, I was thinking if I went to the MacDonalds place alone, I would try to look for a play experience, invite different feelings, double constraint of the situation being recorded I felt more compelled to just play and have more fun, trying to find an excuse to have fun.

F

Appendix F: Bound In Publications

The following published material represents research conducted during the registration period of the degree of Doctor of Philosophy.

Publications bound in are listed below, and appear in the following order:

Schiphorst, T., "Body Matters: the Palpability of the Invisible Computer", Leonardo, Special Issue: Materials for Creativity, Accepted for Publication, In Press, Spring 2008.

Schiphorst, T., Motamedi, N., "Applying An Aesthetic Framework of Touch for Table Top Interaction", *IEEE TableTop Interaction 2007 Proceedings*, Newport, Rhode Island, October 10-12, 2007, pp. 71-74.

Nack, F., Schiphorst, T., Obrenovic, Z., KauwATjoe, M, Bakker S., Rosillio, A., Aroya, L. "Pillows as Adaptive Interfaces in Ambient Environments", *HCM'07*, Augsburg, Germany, Sept 28, 2007, pp. 3-12.

Schiphorst, T., "Really, Really, Small: The Palpability of the Invisible", CC07, Creativity and Cognition Conference, Washington, DC, June 13-15, 2007, pp. 298-301.

Schiphorst, T., Frank Nack, Michiel KauwATjoe, Simon de Bakker, Stock, Lora Aroyo, Angel Perez Rosillio, Hielke Schut, Norm Jaffe, "Pillow Talk: Can We Afford Intimacy?", TEI (2007), Tangible and Embedded Interfaces Conference, February 15-18 2007, Baton Rouge, Louisiana, pp. 23-30.

Aroyo, L., Nack, F., Schiphorst, T., Schut T., and KauwATjoe, M. "Personalized Ambient Media Experience: move.me Case Study". Conference on Intelligent User Interfaces (IUI) 2007, Hawaii, Jan. 28-31, 2007, pp. 298-301.

Schiphorst, T., "Affectionate Computing: Can We Fall in Love with a Machine?", MultiMedia Impact, *IEEE Multimedia*, January – March 2006, pp. 20-24.

Schiphorst, T., "Breath, skin and clothing: Using wearable technologies as an Interface into ourselves", *International Journal of Performance Arts and Digital Media*, PADM 2 (2) pp. 171-186, Intellect 2006.

Schiphorst, T., "exhale: breath between bodies", ACM SIGGRAPH 2005, August 1-4, 2005, ACM, New York, NY, pp. 62-63.

Schiphorst, T., "Soft, softer, softly: whispering between the lines", Book Chapter, *aRt+D: Research and Development in Art*, V2_Publishing, NAI Publishers, V2 June 2005, Rotterdam. ISBN 90-5662-389-3.

Schiphorst, T., Jaffe, N., Lovell, R., "Threads of Recognition: using Touch as Input with Directionally Conductive Fabric:", altCHI, CHI 2005, CHI April 2005, Portland, Oregon.

Appendix F Bound In Publications

- Ascott, R., Cox, D., Dolinsky, M., Gromala, D., Novak, M., Rogala, M., Schiphorst, T., Slattery, D., Vesna, V., Artist Round Tables, ACM SIGGRAPH 2004 Art Gallery (Los Angeles, California, August 08 - 12, 2004). S. Gollifer, Ed. SIGGRAPH '04. ACM, New York, NY, pp. 131-134.
- Cunningham, M., Vaughan D., Schiphorst, T., Carolyn, B., Kuhn, L., "Four Key Discoveries: Merce Cunningham Dance Company at Fifty", Theater, Vol. 34, No 2, 2004, Yale School of Drama, pp. 105-111.
- Schiphorst, T., Andersen, K., "Between Bodies: using Experience Modeling to Create Gestural Protocols for Physiological Data Transfer", altCHI, CHI 2004, CHI April 2004, Vienna.
- Wakkary, R., Schiphorst, T., Budd, J., "Cross Dressing and Border Crossings: Exploring Experience Models Across Disciplines", Extended Abstracts of ACM CHI 2004, April 2004, Vienna, pp. 1709-1710.
- Chen, T., Fels, S., Schiphorst, T., "FlowField: Investigating the Semantics of Caress", ACM SIGGRAPH 2002 conference abstracts and applications, Siggraph '02, pp. 185.
- Jeremijenko, N., Schiphorst, T., Mateas, M., Strauss, W., Wright, W., Kerne, A., "Extending interface practice: an ecosystem approach", ACM SIGGRAPH 2002, July 21-26, 2002, ACM, New York, NY, pp. 90-92.
- Schiphorst, T., Kozel, S., "pulp fashion | wearable archi[ves]tectures", proceedings, V2- anarchiving conference, Rotterdam, July 2002, <http://deaf.v2.nl/deaf/03/221-117-229-207-116-102-152-49-79-100-19-11-14-99-208-171.py> (online essay)
- Schiphorst, T., Lovell, R., Jaffe, N., "Using a Gestural Interface Toolkit to Interact with a Dynamic Virtual Space", Extended Abstracts, ACM CHI 2002, Ap 2002, pp. 754-755.
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- Schiphorst, T., Siggraph Panel, Siggraph 2001, panel moderator in *Designing Experience: collaborative spaces in art and design*, with Ron Wakkary, Susan Kozel, Steve DiPaola, Alice Mansell and Thecla Schiphorst.

Body Matters: the Palpability of the Invisible Computer

by Thecla Schiphorst

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ABSTRACT

The body matters. As computer interaction becomes more intimately connected with our everyday experience, lying closer to our skin, embedded in our clothing and literally touching our lives, we need to account for the body and its experience as it physically materializes through our technology. This paper explores embodiment and 'body experience' in designing for invisible computing. Weiser [Weis1994] has suggested that invisible computing calls for design methods that focus on the 'whole person', and that this greater focus necessitates engaging in a dialogue with the arts and humanities. This paper contributes to the discourse of embodiment within technology and introduces a framework from the field of *Somatics*. Somatics offers an account of experience enacted through first-person methodologies incorporating technical expertise and reflection-in-action that has the attributes of being "rigorous in its own right"[Scho1983]. Its frameworks are rooted in its historical ties with performance and movement practices, and can be traced to philosophical underpinnings within contemporary phenomenology and pragmatism. An emerging discourse within human-computer interaction is evidenced by an extra-ordinary wealth of literature exploring experience, embodiment, subjectivity and felt-life. This exploration is accompanied by research questions that are attempting to re-balance our understanding of the relationship between subjective and objective knowing, making and doing. *Somatics* brings with it epistemologies of practice and embodied approaches to learning and interacting that focus on attention, context and awareness. I present a set of design examples that demonstrate ways in which Somatics (and its roots in performance) can be applied to technology design within HCI.

INTRODUCTION

Our physical technology continues to grow smaller and smaller. This is the foreseeable result of a continual process of miniaturization, yet this continuing 'disappearance' marks a

cognitive and creative shift from seeing to feeling, from the visible to the invisible. It is here that the experience of the body matters. This is an opportunity to engage the full range of our sensing and experience in new ways. As a privileged 'sense' of the enlightenment, vision has influenced the definition of knowledge, validity and experience [John1987, Gibbs1966]. Yet, invisible computing is moving us toward perceptual palpable interfaces. Embodied computing can take fuller advantage of all of our senses accessing a richer and more fully articulated human being. Weiser's [Weis1994] definition of invisible computing includes a return to the 'whole person' engaging with practices in arts and humanities and focusing on experience. This aligns with the growing acknowledgement within HCI of the value of designing technology *as experience* [McCa2005].

The Palpability of the Invisible

If our goal is to increase legibility, coherence and social relevance in relationship to the 'whole human' then we need to develop richer sense-making models for interaction. We need to align techniques of active embodied practices with technological rigor and imagination. The metaphor of palpability refers to the increasing physical yet invisible embodiment of technologies. Palpability refers to an intensity that is perceivable and felt. Palpable interfaces describe those which 'make sense' of felt-life. Gibson refers to the senses as *active* seeking mechanisms for looking, listening, touching, and understanding information in the world, where the role of kinesthesia is inseparable from perception, constantly co-operating in and coordinated with acts of perception. Perception is active attention [Gibbs1966]. Although the computer and the interface may be 'disappearing', our world and our bodies are continuously present and made even more visible through our participation. Active sensing results in learning to trust a greater range of sensory data and does not rely solely on visual perception. The invisible computer necessitates the development of new models and metaphors that support design, creativity and use.

THE DIALOGUE BETWEEN SUBJECTIVITY AND REASON

We are witnessing a reformulation within human computer interaction centered in the need to create richer models of human experience. The relevance of theories that account for embodied reasoning is gaining significance in HCI. As our technology 'disappears' into the seams of our world we are moved to understand, contextualize and integrate the consequence of this physical and metaphoric shift. There is an outpouring of interest in knowledge and methods that originate from within a seemingly endless variety of fields. We are seeing the influence of Cognitive Science [John1987], Sociology [Nard2001],

Phenomenology [Merl1969, Dour2001], Psychology [Gibs1966], Neurophysiology [Dama1999], Performance Practice such as Theatre [Boal1992, Sche1985] Dance [Kjöl2004, Schi1997b] and Somatics [Cohe1994, John1995, Laba1974], Reflective and Contemplative Traditions [Yasu1987, Depr2003], and Critical Theory [Mass2002]. This trend is bridging methodologies by synthesizing ways that we imagine, validate, and evaluate our discoveries.

The Body in the Mind

Sensory design that accounts for 'the body in the mind' can broaden and expand approaches to interaction design. In Cognitive Science the theory of embodied image schemas have found relevance within human computer interaction [Hurt2007] in their ability to support and design prototypes for intuitive interaction. Image schemas arise from the embodied nature of our everyday experiences [John1987] where thinking and acting are inseparable from imagination. Among other researchers that advocate the embodied nature of rationality are Gibson [Gibs1966] in his exploration of the senses as perceptual systems, Damasio [Dama1999] in his descriptions of the neuro-physiological coupling of feeling, thought and action, Polanyi [Poly1983] in his treatise on the tacit dimension of knowing, Putnam [Putn1981] in his philosophical argument that value is inextricably tied to reason, and Johnson [John1987] who describes truth as relative to embodied understanding. If subjectivity can be seen to provide a rigor of 'felt-life' that co-mingles and informs our objective methodologies, we can use the notion of embodiment as a precursor to rationality. "How imagination can be both formal and material, rational and bodily – is that there is not an unbridgeable gap between these two realms in the first place. Once we not longer demand a disembodied (or nonphysical) rationality, then there is no particular reason to exclude embodied imagination from the bounds of reason" [John1987, p.169]. Seeking a balance between objective and subjective knowing provide one of the possible methodological explorations in designing for experience.

The Focus of Experience within HCI

A recent issue of *Interacting with Computers* published a special issue on the emerging roles of performance within HCI and interaction design [Maca2006]. Examples of approaches to interaction design that express experience through embodied goals [Moen2007] attention to sensing systems [Schi2006], aesthetics [Cand2006, Schi2007], and awareness or situated contexts [Schm2002, Such1987] is proliferating and creating a growing vitality within the research community. McCarthy and Wright have suggested placing 'felt-life' in the centre of

HCI and sketch an approach for its instrumentality [McCa2005]. In her approach to interaction design Larssen explores how movement feels rather than how it looks, borrowing strategies from movement analysis and performance [Lars2007].

SOMATICS AS AN EXPERIENCE TRADITION

Somatics is a field of study that explores the lived *experience* of the moving body. As an experience tradition that defines knowledge through embodied practice, Somatics can contribute to the discourse of HCI, particularly with regard to the body in everyday life. Contemporary Somatics refers to a set of body-based disciplines that have flourished largely outside of academia, and include practitioners such as Rudolph Laban and F.M. Alexander. Somatics offers an account of experience enacted through first-person methodologies incorporating technical expertise and reflection-in-action that is rigorous in its direct approach to practice. Its frameworks are rooted in its historical ties with performance and movement practices, and can be traced to philosophical underpinnings within contemporary phenomenology¹ and pragmatism² and to ancient concepts of the 'self' that date back to Hellenistic³ traditions and Eastern philosophic thought⁴. The historical development of Somatics is congruent with concepts of first-person experience as located within phenomenology (Husserl and Merleau-Ponty), contemporary Embodied Cognition and Neurophysiology. Somatics complements (and differs from) these academic disciplines in its direct application of physical practices and techniques. Within Somatics technical practice is centered in first-person, self-reflexive, attentive and intentional *technical enactments of experience*. These techniques are structured to transform experience through directed

¹ For example Elizabeth Behnke who founded the Study Project in the Phenomenology of the Body in 1987, focuses on first-person Husserlian phenomenological practice.

² The American philosopher John Dewey whose approach to pragmatism and experience has recently entered the literature of user experience within HCI, studied with F.M. Alexander, one of the 'father's' of Somatic training, for over twenty years. Dewey credits his work with Alexander's in the development of a number of his later philosophical frameworks.

³ This refers to an analysis of Foucault's "care of the self" in his late work, *The Hermeneutics of the Self*, in which Foucault's textual analysis of ancient history of Hellenistic thought, suggests that the Delphic prescription "know yourself", which has been understood to be the founding formula of the history of philosophy, should be understood as being formulated in a kind of subordination to the precept of "the care of the self" from the point of view of a history of practices of subjectivity (first-person practices); that to know the self one must "attend to the self, not forget the self, take care of the self". Foucault suggests this as an "event in thought" where knowledge in a philosophical sense is subordinated to subjective physical practices that transform the self. He distinguishes this position from 'Knowledge' as it was transfigured in "the Cartesian moment", which he states functioned historically in two ways: re-qualifying the importance of "knowing the self" while "discrediting the practice of 'the care of the self'." This original Hellenistic form as Foucault presents it, of activating the knowledge of the self through the practices of the 'care of the self' has a great many resonances with the form of contemporary Somatic epistemologies of practice.

⁴ In Eastern Philosophy, the concept of self-cultivation is seen as a practice toward the goal of unifying mind and body. This is achieved through a set of rigorous technical first-person practices based on the somatic self, awareness (or attention) and cultivated within a somaesthetics of experience, see Yuaso Yasuo, (1987). *The Body: Toward an Eastern Mind-Body Theory*, SUNY Press. The notion of self-cultivation is resonant with technical practices of Somatics.

attention. The design examples presented here characterize select technical practices, illustrating their instrumentality in technology design. These examples illustrate the intertwining of performance and Somatic practice and lay the groundwork for the use of technical practices of embodiment within the field of Human Computer Interaction. One of the goals is to re-balance our understanding of the relationship between subjective and objective knowing, making, and doing.

In Somatic practice learning to access and direct attention is a central theme. One could say this is akin to becoming an 'Expert User' in attention techniques. Ginsberg [Gins2005] offers examples that illustrate the value of attention skills. Other fields such as phenomenology and cognitive science [Depr2003] share these goals and practices. At the simplest level, retraining the sensorimotor system, and re-enlivening sensorimotor pathways is a mechanism for retraining embodied habits and perceptions. An example includes slowing movement down as much as possible in order to increase awareness of one's physical state. This technique is practiced in Noh and Butoh traditions, as well as movement therapies that work to retrain sensorimotor habits. Consciously slowed motion enables the body to shift its attention to an immersive state in relation to its environment, where attention is intensified and sensory details are sharpened.

Augusto Boal terms this type of experiential exercise *de-specialization*. He states that in our every day lives "the senses suffer. We feel very little of what we touch, listen to very little of what we hear, and see very little of what we look at. We feel, listen and see according to our specialty. The adaptation is [both] atrophy and hypertrophy. In order for the body to be able to send out and receive all possible messages, it has to be re-harmonized [through] exercises and games that focus on *de-specialization*." [Boal1992] Boal's goals in theatre are to create imaginative, social and political agency. His work is premised on the notion that agency at the bodily level (agency of the self) enables agency at the social and political level. Many exercises in Somatics and performance focus on this idea of retraining attention in order to increase awareness and agency through the body, and can be applied to many levels of awareness that extend beyond the personal.

A Role for Somatics within HCI

In the performance domain, Dance Analysis and Somatics construct models directly from the *experience* of the moving body. From the Somatics perspective, knowledge is constructed *through* experience [John1995] and requires that experience be directed or

focused through *awareness*. When sensory stimuli no longer result in a perceptual motor response, the body's sensorimotor system has reduced its ability to act. In Somatics this would be termed "somatic amnesia". However, when experience is specifically directed through the focus of attention, knowledge acquisition takes place. This is referred to as "Somatic learning", an activity expanding the range of what Hanna [Hann1988] terms volitional attention. Csikszentmihaly [Csik1990] has acknowledged that human experience operates within a limited field of attention, while Somatics considers attention to be generative enabling it to be augmented and increased through a process of somatic learning.

What Somatics Offers Felt-Life

Somatic Techniques and Experience Traditions share a common set of goals. Rudolf Laban's movement analysis systems [Laba1974] are examples of movement typologies based in experiential practices of dance [Schi1997, Schi2004] that model qualities and modes of movement. These typologies can be applied to gestural recognition and modeling qualitative movement characteristics such as intentionality, interest, attention and body state. They present potential experience models for the classification of aspects of movement, and define a means to approach embodied design. Participatory design, experience design, performance, theater, dance and Somatics share a common focus in modeling or representing human experience. These domains share the ability to articulate sensorial quality, emotional response and experience through movement.

CASES + STRATEGIES FROM ART AND DESIGN

Experience is felt, palpable, perceived and lived. How can these concepts be used in design processes that cultivate attention? Somatics techniques increase the *resolution* of our attention and the *resolution* of our experience. Can user experience be designed to such a degree that experience itself becomes personalized developing degrees of skill and refinement to the use of our own body states, refining the inseparability of mind from body? Can user-experience be designed to acknowledge shifting focus between the world the self? And can it explore the concept of generating user attention rather than competing for limited attention space of the user?

Three Cases are presented that apply somatic principles. In Case One, the use of a series of design workshops is used to illustrate an exploratory approach to creating an interaction model through participants attention to their own lived experience. In Case Two, the

physiological data of breath is used in order to create a heightened and empathic connection between shared participants wearing networked garments. In Case Three, touch and tactile quality recognition is used to explore qualitative interaction where experience, intimacy and play are a central theme.

Case One: whisper[s]: wearable body architectures

This case illustrates the outcome of a series of exploratory workshops⁵. The goal was to explore how people pay attention to their own body state and share that state with others in a space. A range of techniques were used to train attention or awareness. The workshops relied on improvisation, props, ritual space, and placebo objects. Very little digital technology was introduced at this stage. The central theme of the workshops was asking participants to employ simple acts of 'paying attention'. For example participants were asked to listen, notice, touch, move, feel. Participants were asked to imagine and visualize; focus on bodily experiences such as breath, heartbeat, stillness, and slow motion movement. We wanted to design experience that could be replicated, re-enacted, and re-played in the context of a public art installation using wearable computing technology. The public art space was an environment that could be simultaneously intimate, playful, and social, while sharing a level of awareness of the participant's 'selves'. A set of examples from three of the five workshops is described below.



Figure 1 Experience Modeling connection and extension

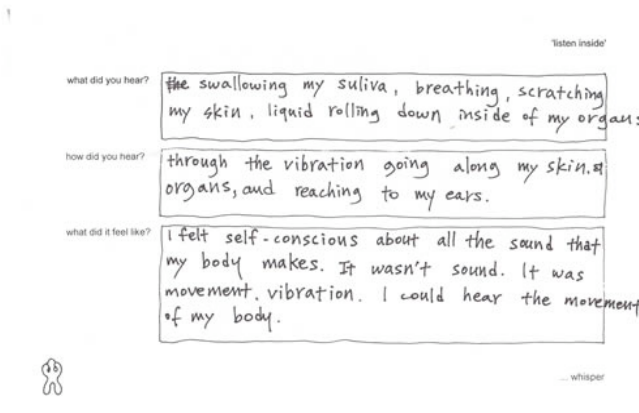


Figure 2 Response Card Example

The <listen> workshop

One of the major themes is the notion of 'paying attention' to one's self. The design for the installation centered on measuring physiological data as a representation of oneself: data that we do not normally pay attention to in everyday life, but can easily access. How do we perceive directing attention to our body data? Participants were asked to find a place for themselves in the space and to remain silent. Each participant was given a pair of earplugs and they were then left alone with themselves with no further instructions for about 15 minutes. Each participant was handed a card (see fig. 3). The card asked the questions: What did you hear? How did you hear? What did it feel like?

In the space of experience, this is the simplest of experiments. By depriving the body of its external hearing it can become aware of the internal sound otherwise made invisible by the louder external sounds. We are removed from our own ears, but not from our hearing. In performance, artists like Pauline Oliveros and Augusto Boal have created practices such as "deep listening", and "listening to what we hear", which probe and access these very same questions of experience. The responses to the very simple question on the cards: *What did you hear?* focus on access to this level or resolution of experience. Responses indicated the participants' discovery of the internal soundscape.

'Heartbeat; earplugs as they settle, breath, slapping sounds from others in the room; humming noise; myself; contact with my own body'

This seems to trigger strong emotions ranging from slight unease to feelings of fear or elation in the answers to the question: *What did it feel like?*

'I felt self-consciousness about all the sound that body makes; it wasn't sound; it was

movement, vibration. I could hear the movement of my body'

Some workshop participants were able to recognize that listening occurs not only through the ears, but also through the bones, the resonant cavities of vibration in the body, that the body is a metaphor for listening, and that, what is heard is not only sound, but movement, vibration, feeling, and sensation.

The <between> workshop

<between> explored the ability to transfer invisible data to another person and the willingness to enter into an exchange of information that is otherwise private and unknown. In order for such a transfer to work, the participant needs to engage or invite trust not only to the other, but also to the 'listening' self.

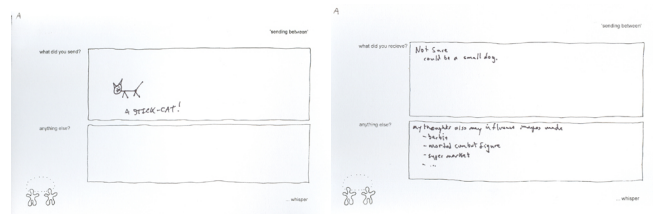


Figure 3 Sending and Receiving Invisible Signals

At the beginning of the workshop, the participants were asked to move in slow motion, as slowly as possible. They were then left to move very slowly for 10 minutes without speaking.

In Dance practices such as Butoh, this technique is utilized to enable the body to shift its attention to an immersive state in relation to its environment, what Csikszentmihalyi would term 'flow', where attention is intensified, and sensory details are sharpened. In neurophysiology and psychology experimental studies show that the slowing or stopping of movement changes the conscious states we normally have and allows for observing the constant shifts of thought, sensation, or expands the ability to observe characteristics of basic experiencing [Gins2005].

The <extend> workshop

We wanted to continue to investigate issues of privacy and trust using physical objects that could mediate the interaction through physical gesture. In <extend> the participants were given ordinary medical stethoscopes and a small booklet with ten identical pages.

'I felt like I was inside myself the pounding amplified my perception of myself, yet my

breathing made me feel close'

By introducing the stethoscopes we gave access to another type of body data. More importantly, we introduced the possibility of sharing this data with someone else. The design of the stethoscope with a 'listening' end and a 'probing' end allows for the data to be shared by either probing someone in order to investigate their data, or giving someone the earpiece to offer them a particular sound. This latter gesture of offering inverts the interaction model of probing or surveillance, to an interaction that invites intimacy, trust, and peer connection.

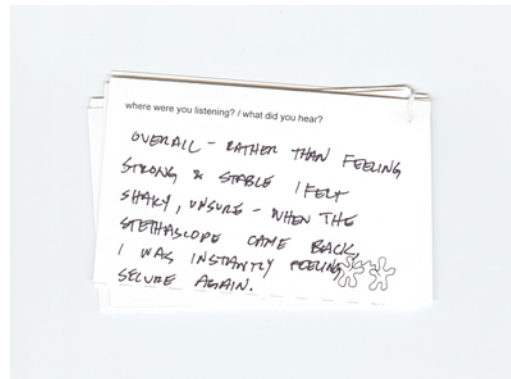


Figure 4. Response Card Sharing Physiological Data

The <phase>Workshop

By creating protocols that facilitate sharing and exchange there is a potential blurring of the boundaries between the participants as well as between what is inside and what is outside. We investigated this blur between inside and outside by asking participants to put on men's shirts. The shirts were given sticky Velcro patches to apply connection points anywhere they wished. The participants were encouraged to experiment with moving as each pair of shirts offered different possibilities for movement and control. The cards asked the questions: How did you extend yourself? How did you move?



Figure 5. Extension | Creating One Larger Body

How did you move?: *'Held hands with someone other than my husband; became silly; enjoyed the unusual and unknown; became aware of another's movement'*

How did you move?: *'I found myself thinking of our 'body' as a complete unit - it just had this other piece I wasn't controlling; the attached arm felt very unusual once I got complete control back'*

How did you move?: *'I was no longer just myself, I had to extend myself to become a part of a whole; as a whole we had to work together; when we failed it was almost disappointing because we were apart'*

Here we see several examples of body extension. The workshops series as a whole contained a broad range of experience results that enabled us to construct an interaction model for an art installation. We continually returned to the artistic aim: that 'paying attention' to one's self enables a re-direction of attention with a greater access to optimal experience [Csik1990].

Case Two: exhale: (breath between bodies)

exhale: breath between bodies is an interactive art installation where group breath is shared between eight networked skirts. This example illustrates how our own body data can be used to create and share awareness in an intimate way in a social space. Each exhale skirt is sewn from lush vibrant raw silk in rich saturated colors. The skirts are lined with small vibrators that synchronize in correspondence with the participants' breath rhythm. Breath can be shared (given and received) through the use of RFID tags sewn into pockets in the side of the skirts. An LED array on the surface of the skirt illuminates the breath rhythm. Exhale creates a palpable interface where physical vibration created by small motors and the tiny movement of air created by small fans respond intensely and physically providing alternate 'physical displays' for the body [Weis1994].



Figure 6 exhale 'skirt trees' hanging in space

The exploration of breath in exhale is based on the notion of creating body states through somatic awareness. Shared breath creates empathic connections between participants and causes vibrations in the linings of the skirts, and light to respond to breathing patterns. Damasio [Dama1999] has studied the connection of 'feeling states' in the body and asserts that a given feeling state is associated with specific physiological patterns (such as breath rhythm) along with a set of processes including thought patterns and emotion. His research suggests that these 'feeling' body-states are an inter-connected set of feeling, thought, emotion and physiological functioning: each of these being present and affecting the other. He asserts that the induction of a body-state can be brought about through attention to *any* one of the inter-connected patterns: so that attention to physiological patterning (for example breath) can induce a body state. This inter-connectedness between physical data, and the state of the body creates a complex but coherent set of body-data and experience.



Figure 7. exhale skirt with LED array and RFID

Case Three: soft(n) tactile networks

(*softⁿ*) is an interactive public art-installation based on exploring emerging network behavior through interaction between a group of 10 soft networked objects. Each soft object has a specially designed hand sewn tactile surface that recognized 12 tactile qualities based on Laban's Effort Analysis. This illustrates how somatic movement systems based on quality of experience can be computationally applied to human computer interaction. The Parameters that determine the tactile qualities are shown in Table 1. Implemented tactile qualities include jab, knock, touch, caress, glide, tap, pat and float. One can think of (*softⁿ*) as a counterpoint to, or a critique of, the hard: a survival strategy for interaction that allows misplaced action, mistake, forgiveness, a bad attitude, weakness, and stillness, giving in.

(*softⁿ*) allows critique through the computational act of quality, where the quality of caress defines the interaction and response from each object. The objects have three states, inactive (sleeping), active (listening to other objects in the family) and inter-active (being touched or thrown about).



Figure 8. *soft(n)* tactile networked objects

	Parameter				Modifier		
	pressure intensity	time duration	size area	number	space (speed)	path (direction)	disposition (pressure)
tap	soft	short	small	ø	stationary	n/a	n/a
pat	soft	short	big	one	stationary	n/a	n/a
touch	soft	long	small	one	stationary	n/a	n/a
stroke	soft	long	ø	ø	travelling	straight	ø
glide	soft	long	ø	ø	travelling	wandering	ø
hold	soft	long	big	one	stationary	n/a	constant
poke/jab/flick	hard	short	small	one	stationary	n/a	n/a
knock	hard	short	medium	one	stationary	n/a	n/a
slap/punch	hard	short	big	one	stationary	n/a	n/a
press	hard	long	ø	ø	stationary	n/a	constant
knead	hard	long	ø	many	ø	ø	varying

Figure 9. Laban Touch Qualities extracted from input surface

The soft objects respond to tactile caress by actuating light, sound and vibration. Small tonal sounds, sighs and melodic 'dialogue' is shared between the objects when they are touched. The objects form an ecology of sound, vibration and light. Each (*softⁿ*) touch pad is hand sewn using a specially constructed combination of conductive fiber, conductive foam and everyday needle and thread. This illustrates the ability to use domestic cottage industry approaches to 'hand-made' input devices that share algorithmic intelligence with other tactile heuristics normally applied to consumer input devices [Schi2006, Schi2007]. The group of soft objects that are strewn about, and tumbled within, a public urban space, are networked to one another, and create a group-body, based on tactile input. The (*softⁿ*) objects communicate wirelessly to each other within their network.

(*soft*ⁿ) includes the development and testing of an Interaction Model based on input heuristics of touch, based on Laban effort shape analysis, a somatics system of movement analysis.

SUMMARY

This paper has offered a framework from the field of *Somatics* particularly with regard to the body in everyday life. The design examples use Somatics techniques in the design of embodied interaction. In Somatics the body matters and defines our subjective selves within experience. The notion of palpable yet invisible interfaces is viewed in the light of emerging exploration within HCI that explore experience, embodiment, subjectivity, and felt-life. The call to experience can be explored through valuing subjectivity and the foundational constituent knowledge of embodied approaches within interaction design. One of the promises of the invisible computer is that by its very disappearance, we are left with ourselves in our world, and the opportunity to perceive ourselves more clearly in connection to our own felt-life. Perhaps the invisible computer can make visible connections to ourselves that we were not able to perceive when the mechanisms of physical technology were 'in the way' obscuring our lines of sight and insight.

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BIOGRAPHICAL INFORMATION

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Applying an Aesthetic Framework of Touch for Table-Top Interactions

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Abstract

In this paper, we propose a conceptual framework for understanding the aesthetic qualities of multi-touch and tactile interfaces for table-top interaction. While aesthetics has traditionally been defined as the visual appearance of an artifact, we promote a tactile aesthetics that is firmly rooted in the experience of use and interaction. Our model of tactile aesthetics comprises four distinct yet overlapping areas: 1.) Embodiment which grounds our framework within the larger philosophical context of experience. 2.) Materiality which emphasizes the importance of the physical shape, form and texture of interactive systems. 3.) Sensorial Mapping which is the creation of appropriate cross-modal relationships between touch and our other senses. 4.) Semantics of Caress which is the investigation into the meaning of touch which can then inform computational models of gesture recognition. We apply this framework to evaluate a series of tactile and multi-touch artworks and discuss how our model can benefit the design of future multi-touch systems.

1. Tactile Aesthetics

In an era where ‘emotion’ and ‘experience’ are key descriptors of interactive systems [1] [9], there is a growing recognition in HCI that considering aesthetics may be useful when designing for experience [3] [12]. But traditional aesthetic theory poses a problem for interactivity. Primarily concerned with visual appearance, these theories are incompatible with interactivity because of the large role that tactility, the body, and usability have in mediating the user experience. In response, many HCI researchers [3] [12] turned to ‘pragmatist aesthetics’, a theory where the emphasis is on the aesthetic experience of physical use [16]. What is missing, however, is an aesthetic framework which connects pragmatist aesthetic theory with decisions derived directly from interactive art practice. From interactive art we can learn how to apply strategies used by artists to create emotional and meaningful experiences with technology.

In this paper, we propose a model of tactile aesthetics that has resulted from identifying four recurring and entwined themes emerging from our work with multi-touch tabletop artworks. The first theme is the overarching philosophy of *embodiment* which grounds and contextualizes our work in experience design [2]. The second theme is *materiality* which stresses the importance of the physical shape, form, and texture in mediating an aesthetic experience. Our third theme is *sensorial mapping* which is the potential of combining touch with appropriate visual or audio feedback to simulate a rough haptic sensation. The final theme is *semantics of caress* which is the investigation into the different meanings encoded in touch and gestures. Since our framework emerged from our artistic practice, we explain our model by sharing a narrative on the trajectory of our work in tabletop interactive artworks. The development of our tactile aesthetics begins with the interactive artwork *BodyMaps*, and is then traced to the *Soft(n)* project. Finally, we conclude by outlining current and future work in multi-touch tabletop interfaces.

2. Experience of BodyMaps

Bodymaps is an interactive table installed in the center of a darkened gallery room with speakers distributed around the four corners and hung from the ceiling on either end of the table. As an interactive artwork *Bodymaps* was designed specifically to direct the users attention to their tactile sensations, inviting a ‘purpose-free’ exploration of active touch, and using the synthesis and simultaneity of the visual and auditory material to invoke an intensified and heightened sense of affect and ‘connection’. As an artwork this was intended to move interaction experience more toward ‘phatic’ technologies [18] that emphasize the experience of connection rather than information content, thereby creating a more deeply resonant emotional space. A table was selected (rather than a bed or another furniture object) because of its metaphoric use as a familiar everyday domestic object and its flexible open-ended use in social settings such as gathering, sharing, eating, working and celebrating.

In *Bodymaps*, the gallery visitor sees an image of a body projected from above: it lays still and silent on the surface of the table. Images and sound utilized in *Bodymaps* enable an open interpretation, and its metaphorical use of visual material such as water and fire, sheets or tablecloths allow multiple meanings and emotional associations [15]. This design strategy is commonly used in artistic practice as a way of poetically evoking experience and thoughtful reflection. It is a mechanism to provoke experience utilizing the pleasure of direct sensation to bring imagination and memory into play. Contemporary artists such as Bill Viola and Paul Sermon have used similar strategies to achieve poetic and resonant experience. As someone approaches the table, they hear the sound of a single drop of water dripping from directly above the table. When the user reaches out to touch the table, proximity and electromagnetic field sensors detect the presence, proximity, and location of the hand as it hovers above the surface. This triggers the sound of water being splashed and mixed in direct correspondence to the user's hand movement. The sonic sensation is one of water running through the fingers. Once the user physically touches the table's surface, they feel the warmth and sensual texture of the silk velvet inviting them to caress and stroke the fabric. Touching the projected body causes her to move in a direct relationship to the user's gesture (Figure 1). For example: stroking her shoulders causes her to turn on her side, while tickling her feet forces her to roll off the table. As the intensity of the touch increases (with greater pressure, speed and area covered), the room fills with layered and ambiguous sounds such as crying, laughing, sighing or breathing. This multi-layered reactive space immerses the user in a sensual and affective sound and image-scape. As the user steps back from the table, the imagery and sound slowly begin to fade, waiting to be touched again. When all tactile interaction stops, everything becomes quiet. All that remains is the sound of a single drop of water dripping from above.



Figure 1: Bodymaps installed in a gallery

3. Embodiment

The first theme is the philosophy of embodiment and how ‘being-in-the-world’ is critical for understanding experience in HCI [2]. In the context of multi-touch interfaces, we know that gestures in the physical world are rich and intricate and can be mapped to create more intuitive gesture commands [11]. Being aware of the capabilities of tactility is essential for creating interfaces which utilize the full resolution and bandwidth of touch, such as the skin's ability to detect temperature, proximity, weight, and volume [7]. With *BodyMaps*, one of the explorations was to create an interface that invoked a tactile response in people and allowed them to interact with the system with a gesture repertoire beyond the typical binary ‘touch/release’ input range common in interactive systems. Since people intuitively feel surfaces by moving their hands across the texture in order to gather information on the object [4], the piece was designed to respond to this temptation. As a result, the sensor hardware embedded inside the table had to be able to detect presence, location, and the proximity of hands as they hover across and touch the surface creating two levels of tactile engagement. The material used for the construction along with the appropriate visual and sonic sensory mapping played a large role in compelling people to interact with the piece.

4. Materiality

The second theme in our framework is the importance of materials in mediating an aesthetic interaction similar to the role materials have in traditional arts and crafts. The specific form of the table including its height and scale was designed with a strategy to enable ambiguity and open interpretation [15]. The height of the table is slightly lower than a dining table so that its physical correspondence to a human body could also begin to suggest alternative objects (such as a bed or a coffin). In the case of *BodyMaps*, it was critical to identify a material that had the affordance of caress [5] and encouraged users to explore the surface with their hands. After an extensive search where numerous natural fabrics were prototyped and evaluated according to these parameters, the final selection was to use white silk-velvet. This fabric possesses several properties that made it suitable for compelling a tactile response in users. First, stroking across the surface changes the direction of the nap leaving behind a shadow. This can be erased with a stroke in the opposite direction, or it can be left as a visual memory of touch. Also, silk-velvet captures and retains body heat making the table surface warmer to

touch. When combined with the material's softness, this encourages gentler and slower gestures. The net result of these properties gives the textile display a high degree of tactile resolution.

The resolution of textile displays is measured using different metrics than conventional computer screens or projections. Whereas optical performance is the main criteria for conventional displays, textile displays are evaluated for their haptic quality or how the material feels. Understanding the trade-off between technical resolution and affective resolution is an aesthetic decision and one that impacts the overall experience of the system [6]. While the degree to which materials impact the experience is still not entirely known, the choice of material still has tremendous impact not just on the technical performance of the system, but on the overall feel and experience. Selecting materials primarily for their optical purposes may be critical for multi-touch projection systems, but this choice should not neglect or ignore the material's tactile attributes.

5. Sensorial Mapping

The third theme in our framework is sensorial mapping where touch is combined with appropriate visual and sonic feedback to simulate a synesthetic haptic sensation. This effect has been shown to exist even with lower level tactile inputs such as a mouse with appropriate visual changes in the graphical cursor [17]. In *Bodymaps*, the relationship between touch and audio-visual senses occur on two separate layers of the user experience (Figure 2). The first occurs when a hand penetrates the electro-magnetic field that blankets the area above the surface. This triggers the sound of water splashing and mixing which is mapped to the user's gesture, simulating the haptic sensation of running fingers through water. People can interact with the piece by feeling this virtual fluid sonically before they eventually touch the table when they feel comfortable. Touching the velvet surface is the second layer of the sensorial interface. A projected image of a body responds directly to the relationship of the user's touch. If someone touches her shoulder she will turn on her side, or if someone tickles her feet she will roll off the table. At this point another audio layer is added as sounds of natural human emotions such as sighing, breathing, and crying grows louder as the amount of contact on the body intensifies. Since the audio is ambiguous, the user is open to interpret their actions and meaning [15]. We observed that there was often a heightened affective response of users to the interface, and participants reported being very moved, or

becoming reflective as a result of the interaction. Sensorial mapping differs from haptic interfaces in that instead of creating a direct physical relationship between two sense modalities, it is implied and left to the user to make the connection and 'feel' inside their body and mind.



Figure 2: Two layers of tactile interaction: hovering and touching the surface

6. Semantics of Caress

The final theme in our model is the development of our work in building a taxonomy of affective 'tactile gestures' based on the semantics of caress. This resulted originally from direct observations of participants' interaction with *Bodymaps*, and has been developed and tested through a number of interactive art prototypes and devices. We observed and documented patterns of commonality in the tactile gestural *quality* used in the system. For example, people tended to jab the surface harder and use quicker gestures when they were impatient or they would use gentler and longer gestures during moments of strong affect. Analyzing movement quality has been used in choreography and in movement analysis[8]. We formalized observations by studying the quality of multi-touch gestures. Initially, implementation of our qualitative semantics was based on definitions from Laban-Effort-Shape Analysis [8] (Figure 3) which was computationally mapped onto the Tactex MTC Express multi-touch tablet using computer-vision signal processing for recognition [14]. Afterwards, these same heuristics were applied to custom-made multi-touch foam pads that were sewn into a family of pillow objects for the *Soft(n)* project [13]. *Soft(n)* is an interactive art installation with 12 networked pillows that communicate to one another and to their users based on touch qualities. Each pillow was able to recognize different touch qualities and respond to touch input. Our work in classifying the qualitative touch gestures compliments existing taxonomies which

focus on gestures for graphical manipulation, CSCW, and other task-oriented commands [10] [17] [19].

touch-effort	Description
tap	A soft, short, small, touch, usually rendered with a single finger.
pat	A bigger version of “tap” and a soft version of “slap”. Usually rendered with an open hand or palm.
hold	A lingering, soft, big, touch. A “hold” has an encompassing feel.
touch	“Touch” is a small version of “hold”. It is an indication of comfort and is rendered with the fingers, hand, or palm.
stroke	A traveling touch, soft but directional, rendered with fingers, hand or palm.
glide	A traveling, meandering, touch. Soft and directionless and rendered with the fingers, hand, or palm.
jab	A hard, short, small, touch. A hard poke by a finger or blunted object. Also known as “poke”.
knock	A medium-sized, fist against, rapping hard. In our scheme, it is different than “jab” and “slap” in size only.
slap	An open-handed, hard, short, touch. In our scheme, a large version of “jab” and “knock”.
press	This is a long, hard, touch.
rub	This is a moving, hard, touch.
knead	Kneading involves many fingers moving hard and in a slightly wandering fashion.
other touch-efforts not attempted in this system:	
punch	This is like a “knock”, but is different in intensity and slightly different in timing.
flick	This is like a “jab”, but is slightly different in shape over time. A “flick” travels slightly in relation to a “jab”, which is more stationary.

Figure 3: Touch efforts with corresponding metrics for computation

7. Discussion & Future Work

In this paper, we outlined the beginnings of a conceptual framework for evaluating the tactile aesthetics in table-top interactions. The main strength of our model is that it originated directly from artistic practice. However, we will need to use our model to assess other designs and artworks to gauge the validity of our framework. We also plan to expand and refine some of the ideas we presented. Currently, we are in the midst of a project where we are networking multiple multi-touch tables in remote locations. In this research, we are interested in adapting or expanding our affective gesture library to include touch efforts that connect people separated by location. This will also involve expanding our gesture library to include bimanual multi-touch interactions for larger surfaces. In addition, we want to include research into the qualitative semantics of ‘feel’. Just as we encode meaning in the gestures we make and in the way we touch, we also decode meaning from objects that we

feel, and in the way we are touched. Indeed, as aesthetic theory is still in its infancy in HCI, our work on tactile aesthetics can only grow and improve.

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Pillows as Adaptive Interfaces in Ambient Environments

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ABSTRACT

We have developed a set of small interactive throw pillows containing intelligent touch-sensing surfaces, in order to explore new ways to model the environment, participants, artefacts, and their interactions, in the context of expressive non-verbal interaction. We present the overall architecture of the environment, describing a model of the user, the interface (the interactive pillows and the devices it can interact with) and the context engine. We describe the representation and process modules of the context engine and demonstrate how they support real-time adaptation. We present an evaluation of the current prototype and conclude with plans for future work.

Categories and Subject Descriptors: H.5.2 [User Interfaces]: Haptic I/O, Input devices and strategies, Interaction styles, User-centered design

General Terms: Design, Human Factors

Keywords: Human-centred computing, Input devices and strategies, social interaction, haptic sensing, presence, tactile UIs, tangible UI, user experience design

1. INTRODUCTION

Designing ambient technology introduced into the potentially intimate personal space of a user is a complex problem, as a large range of design variables need to be addressed. Such technology inherently requires the ability to detect and understand the user's activity, body state and identity [2, 12]. A difficult and general problem with Ambient Intelligence is thus to translate low-level signals from the environment to meaningful environmental adaptation for the end-user.

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The aim of the work presented in this paper is to address this problem by exploring interfaces that go beyond direct manipulation. The interfaces we are interested in are based on everyday objects in adaptive ambient environments, such as the home or public, urban, and social spaces, i.e. lounges at cafes, bars. In this context adaptation is based on the input from a sensor-enhanced object with one or more low-level input streams, such as galvanic skin response (GSR), touch quality in form of pressure, or heartbeat. The environment tries to interpret this input, e.g. to identify excitement or detect an action, so that it can adapt itself in the most useful manner, e.g. adapting the environment to serve the mood or adapt the functionality of an object to support the currently performed task.

The key concepts investigated by our work include mobility, connectivity, invisibility, and configurability. We have developed a set of small interactive throw pillows containing intelligent touch-sensing surfaces, in order to explore new ways to model the environment, participants, artefacts, and their interactions, in the context of expressive non-verbal interaction. The long-term aim of our work is to establish a framework for ambient environments that is configurable by users either by integrating already established interaction and adaptation solutions for particular objects (such as the pillow) or designing new ones by themselves.

We first outline the motivation for choosing pillows as interfaces, based on a scenario situated in a living room. The main part of the paper provides an in-depth look at the technology used to turn a pillow into an interactive item according to the described scenario. We describe the structural layers of our system architecture and related technical detail. For providing the reader with an easy to grasp description of a pillow's abilities as well as of the feedback loop within the environment, we describe a subset of the living room scenario. Finally, we discuss the related body of work in the context of evaluating our approach and conclude with plans for future work.

2. MOTIVATION AND SCENARIOS

A problem with adaptive ambient environments is to interpret the **current user context** so that either appropriate **support of performed tasks** can be provided or the environment can be adapted to **improve or serve the user's mood**. In many cases it is both aspects that need to be addressed at the same time.

The aim of our work is to develop technology that facilitates environments to be adaptive to present parameters. We address four key issues, namely the representation of context, the selection of parameters that allow us to detect user actions as well as the user's mood, define efficient and non intrusive ways to collect those parameters and to define means to utilise these parameters for proper adaptation.

Context

Assume a user is in a private living room. There might be several interfaces running simultaneously, such as the TV, the stereo and the browser on the PC. Context-aware systems have to be aware of the user, interpreting hints, such as user position and actions performed, to find out which of these attracts the focus of the user's attention at the moment.

Context represents not only the material world, of which the user is a part, but also the user's cognitive state (i.e. attention, emotion). For example, the user might watch a program on TV and the system discovers a constant low attention rate. The reason might be that the program is bad but it could also be that the current light setting is irritating the user and thus distracts his or her attention.

The **first requirement** for our system is to represent the current state of the environment through descriptions of the various agents as well as the relations between them. The current state of the environment is therefore always a snapshot of the most recent event, which needs to be related to those events that already happened. A key issue is here the method to represent change.

What to Measure?

The two basic notions to be monitored in our approach are actions and cognitive states. Actions allow us to detect the user's focus of attention. The action performed immediately also tells something about the application utilised. Measurement of biometric data facilitates us to draw conclusions about the cognitive state of the user.

The **second requirement** of our system is to establish a key description set of

- user specificities, such as preferences for actions or strategies, likes and dislikes for content, etc,
- biometric data sets, e.g. containing touch efforts, GSR, heartbeat and methods of mapping those to high-level semantics.

How to Measure?

Collecting data, such as actions, is rather simple as technology is the general means to interact with audio-visual content. Logging this interaction is common practice. The collection of very personal data, such as GSR, pressure or heartbeat, is a sensitive matter. First, the required data needs to be reliable and thus feature extraction mechanisms on a meta level, such as the analysis of video surveillance, is by far not good enough for the time being. As we wish to support people in everyday environments it is also not suitable to treat them as guinea pigs in a laboratory by connecting them to sensors via cables.

The **third requirement** for our system is that taking measurements in an ambient environment needs sensors that collect biometric data. The sensors need to be made available through objects that invite the user's touch preferably for a longer time. Moreover, the object needs to be useable in private as well as public environments by a large

variety of user groups, i.e. children, teens, middle-aged adults and the elderly, and thus need to be also easily moveable between locations.

What to Adapt?

The reason for the adaptation of the environment is to either support the performance of the user in task processes with respect to the particular application the user is currently busy with or to adapt particular environmental parameters to improve or serve the user's cognitive state.

The fourth requirement for our system demands methods that map the results collected from the context descriptions to adaptive strategies, which address

- the currently used object itself or related objects depending on the task to be performed,
- environmental parameters, such as lighting or noise, for supporting, enhancing or calming the current cognitive state of the user.

Living Room Scenario

We developed an environment that addresses the outlined four requirements in a home scenario¹. The home scenario (see Figure 1) is based on the living room where the user consumes or interacts with different media sources. The environment is understood as an experience space, which the user should be able to explore freely without being overstrained or unchallenged. We utilize a set of small interactive throw pillows as the sensor-enhanced every day objects.



Figure 1: The living-room in the home scenario.

For example, the user might sit on the sofa, cuddling the preferred pillow, and watches a TV program. As the system has detected that the remote control is out of reach (context model) it has turned the surface of the technologically enhanced pillow into a remote control. The user makes frequent use of it, i.e. changing channels and uses the fast forward button. All that indicates a state of unexcitement, which is further confirmed through biometric data collected from the biometric sensors on the pillow. The action related data as well as the biometric feedback could now be used by

¹ We designed a second scenario, using the same framework, which is situated in a café/lounge environment, where participants are invited to re-mix a set of moving images projected in large scale on the walls within the café through the physical interaction with a set of the small interactive pillows. The focus of this work lies on an environment that is aware of users and objects but not necessarily knows much about them. This work integrates somatics and gesture interaction with textiles and interactive object design [16]. A description of this environment can be found in [5].

the adaptation engine to improve the excitement level of the user by suggesting to play a game. The result is another change of the functionality of the pillow surface, turning it into a play console. While playing the same data sources can be used to detect a level of cognitive awareness, which facilitates the environment to turn a part of the pillow into an alert interface, stating through soft vibrating and a text message, that the news channel on the PC provides interesting information related to the article the user was reading before she started relaxing in front of the TV. The aim of the home scenario is to explore the interaction between a single but well-known user and a single object interaction and its possibilities to influence the overall environment.

In the living room scenario there are a number of potential objects, such as chairs, sofas, teddy bears, blankets, pillows, watches or remote controls, that, enhanced with sensors and actuators, can serve as input and output devices. Yet, only a few fulfil the needs described in requirement 3.

Chairs and sofas are certainly touch-sensitive but their problem is their static nature. Teddy bears or alike would be excellent options with respect to their haptic sensibility. Yet, their user group is limited. Objects like a watch or the remote control are promising because they are hold or worn for a longer time. Yet, the way in which they are used is very limited.

Blankets and pillows are ideal candidates. Both are applicable in various surroundings and scenarios according to the user's needs. They can be found in the home environment as well as in public, urban spaces. More importantly, both evoke metaphors of intimacy and affection. Their surfaces of textiles or light-emitting material ask for touch. Finally, both can be, depending on its configuration, act as an input- as well as an output-device.

Our decision to use a pillow as a primary object of investigation was rather a question of pragmatics, as a blanket is too thin to hide batteries, boards, sensors, etc. Thus, for our prototype environment we decided for a pillow, of which a prototype is portrayed in Figure 2.



Figure 2. Pillow with actuators touchpad, LED display and vibrator.

3. MOVE.ME SENSORS, ADAPTATION AND FEEDBACK

In this section we introduce the technology developed for the pillow and the main technical developments of the *move.me* environment. The descriptive examples are taken from a subset of the implemented living room scenario. The subset scenario covers three states of a pillow, namely **sleeping state**, **game state** and **device**

state, as well as the transitions between them, i.e. **waking up**, **tune in** and **fading out**.

The main aspect of our prototypical ambient environment, called *move.me*, involves three parts:

- The user
- The interface, which contains the interactive pillow as input sensor and output devices, such as a vibrator, light-emitting diodes, screen, sound system, lamp.
- The context engine, which provides the analysis of the current state of the environment on which it might suggest an adaptation strategy, is a back-end server.

With respect to its interaction design our approach extends Don Norman's traditional execution-evaluation model [9] beyond the user's view of the interaction by including not only the interface but the entire elements necessary to judge the general usability of the interactive system as a whole. This allows placing the environment in different social contexts with an overlap on particular task.

As *move.me* is a reactive environment, we adapt for the context representation strategies from case-based reasoning (CBR) [1], in particular those strategies that trace the history of actions [7] to provide the means for a systems to adaptively interact with a user. Our real-time adaptation cycle is very similar to the reasoning process in CBR, which is often represented as a cycle composed out of five steps: elaborate (establish target case), retrieve (compare with existing cases), reuse (adapt the target case), revise (identify unspecified knowledge) and retain (establish new case in the case data base). We apply this cycle to the interpretation of sensor data. We start with a set of raw data, on which we then elaborate, based on user and environmental data (both together form our context), how to perform contextualized adaptation. The adaptation as well as the context history are then stored and are used in the ongoing process of ambient user adaptation.

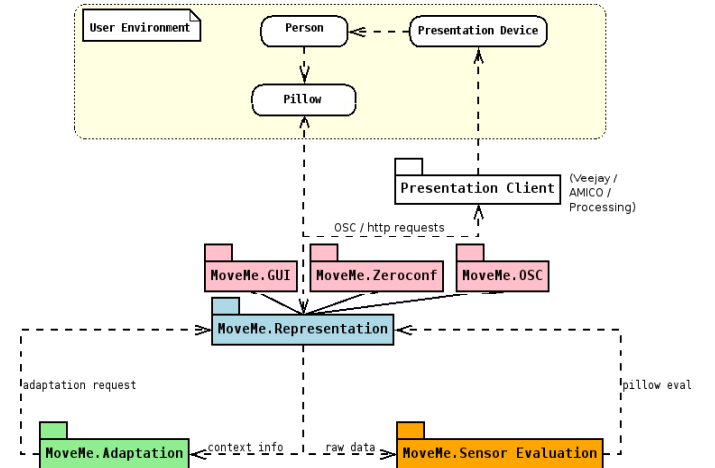


Figure 3: High-level architecture of the ambient environment, where the User environment box represents the room with client (e.g. the pillow) and everything outside this box represents the server or central system.

In the remaining part of the section we outline the various modules of the *move.me* environment, as portrayed in Figure 3, namely:

- *Sensors*, i.e. the input sensors of the pillow

- *Sensor evaluation module*, which instantiates the device drivers for every detected pillow and evaluates incoming raw data. Its main task is to perform some statistical analysis (some low-pass filtering and mean value calculations) in order to keep the overhead of processing load low (the Sensor Evaluation box at the bottom right in Figure 3)
- *Context module* that consists of data structures describing the current context with respect to users, devices and the interactions between them. (the Representation box in the lower middle of Figure 3)
- *Communicator module*, (the presentation client as well as the Zeroconf and OSC box in the middle of Figure 3) which enables the flexible connection of all components, and provides interfaces towards external systems, such as a the TV, a laptop, the stereo, the light sources, etc.
- *Adaptation engine*, which uses data from the context module to establish a mapping between detected action and the appropriate environment adaptation. It also conveys instructions about the source to be adapted and the means of adaptation to the other components (the Application box at the bottom left in Figure 3).

The central system (sensor evaluation module, context module, and the adaptation engine) is developed in Python (ver. 2.4) and runs on GNU Linux and on Apple OSX 10.4 in combination with Fink. The Communicator part of the system is implemented as a Java application based on the AMICO (Adaptive Multi-Interface COmmunicator) framework (<http://amico.sourceforge.net/>).

In the following sections we describe the various modules in more detail.

3.1 Pillow Sensors

A pillow in our environment is the main medium for collecting sensor data, and providing limited feedback to the user. A pillow can be equipped with any of the sensors and actuators displayed in Figure 4.

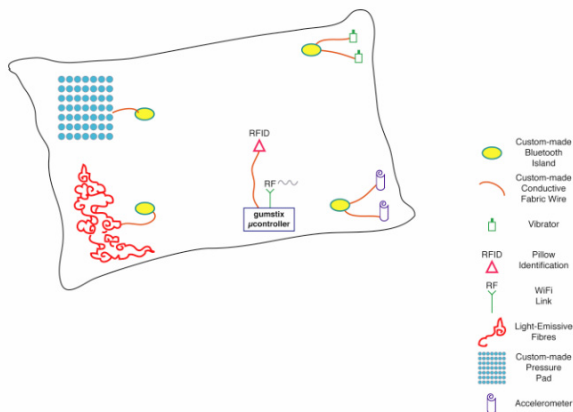


Figure 4: Pillow technology

Figure 5 portrays a particular pillow prototype, equipped with a touchpad (large rectangle on the pillow in Figure 5), a LED display

(smaller rectangle below the touchpad) a vibrator (the little round box to the bottom left of the pillow) and a Gumstix² Connex Linux computer expanded with a SIOS (Sensor Input Output System) daughter board plus the RFDI reader (the part left of the pillow). This prototype is shown without a cover. Complete prototypes with cover are shown in Figure 6.

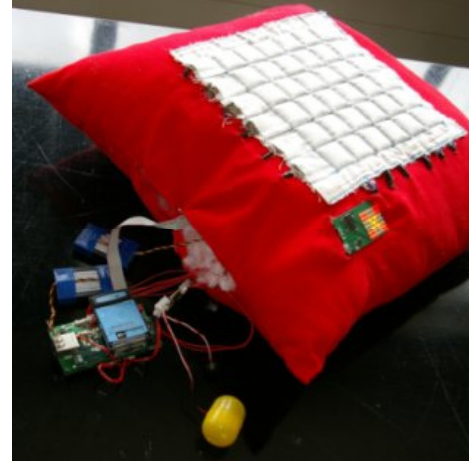


Figure 5: Functional pillow without pillow cover, exposing the technical components



Figure 6: Fully functional prototype pillows with covers

The main sensor we apply is a touch-based interface for measuring pressure. Beepers, vibrators and light sources, either in form of light emitting fibres or as a LED display, provide localized feedback.

The touch-pad itself is a simple grid (64 sensitive regions) of carbon impregnated open cell polyethylene foam. This material exploits the characteristic that electrical resistance of the foam drops as the density of the foam increases. We utilize this behaviour to identify a point of contact or applied pressure. We exploit this behaviour to identify a point of contact or applied pressure. I2C is used to read and steer the pressure sensor circuitry. To control the Led display we use the SPI Bus. Please note that the current pillows connect the various hardware parts via wires instead of the bluetooth islands as suggested in Figure 4.

The processing unit located inside the pillow is a Gumstix³ Connex Linux computer expanded with a SIOS (Sensor Input Output System) daughter board developed by the V2_lab. The Gumstix filters the incoming pressure data and communicates these in discrete packages to the server application. The communication between pillow and server uses the OpenSoundControl (OSC) protocol. We employ OSC because it is a simple protocol widely used by other applications. Thus, using OSC enables us to talk

² Gumstix is a registered trademark by Gumstix inc.; <http://www.gumstix.com>

³ Gumstix is a registered trademark by Gumstix inc.; <http://www.gumstix.com>

easily with many other platforms, as long as both sides agree over the semantics of messages send. When switched on the pillow automatically propagates itself on the network, sending its IP-address and port number, using a combination of Zeroconf networking (<http://www.zeroconf.org/>) and an OSC Querying System. This allows listening programs to detect and register the pillow and start receiving or sending messages.

For identifying users in the closer surroundings of the pillow each pillow contains an RFID reader (SonMicro CY8C0105-B5 RFID Module). The module also acts as a Writer, allowing us to include personal codes into programmable RFID-Tags, which users of the environment wear as bracelets or which are via small tags embedded within each pillow.

Emphasizing the sensual aesthetic of a pillow, covers are designed to encourage connection in an associative and intuitive way. Pillowcases are made out of conductive fabric textiles, such as silk organza [15], which allow qualitative recognition of touch on the surface of the pillow. They are also transparent enough so that icons displayed on an LED are still visible. Pillow prototypes are portrayed in Figure 6.

Pressure is the essential type of data we process to extract a caress and its effort. We have identified a set of parameters that can be extracted or calculated from the information that the response area provides over time. At the moment we utilise the following pressure input parameters: **touch intensity**, **size** (the size of the interaction object that touches the pad), the **speed** of the touch and the **direction** of the touch.

3.2 Data Evaluation and Abstraction

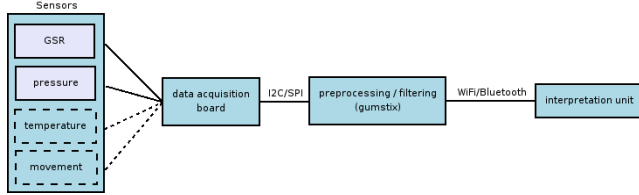


Figure 7: Schematic overview of dataflow from the sensors to the interpretation unit in the central system

The pillow itself only provides a basic filtering of the signal which is then transmitted, as described in Figure 7, along with additional information, such as which other pillows or users are near this pillow, to the central system, where all the other processing happens (e.g. calculating time and space variables). The transition rate for the data of the differently sized pads available (3x3, 6x6, and 8x8) is between 20 to 32 Hz.

Once the data for pressure, size, speed and direction is received by the central system the sensor evaluation module performs a first abstraction on the data. The way that incoming sensor data is analyzed depends on the context and the configuration of the pillow. For example, if the pillow contains a pad that allows measuring pressure and an accelerometer for computing movement a different abstraction scheme is provided as output compared to a pillow that only contains a pressure pad. This means that the system treats each individual pillow configuration/setting differently, as it also does for users. Only at a later stage the individual views are combined to the global context view.

When analysing streams of data, here the input data for every taxel of the pad (a taxel is one of the different tactile grid cells), it is

desirable to keep a history of past events especially when we are looking for trends in the data [11]. However, storing the whole dataset and re-iterating over the last n samples whenever a new sample arrives quickly becomes inefficient as n grows. We, therefore, apply a method that keeps a history of past events without actually storing them but summarizing instead the entire set of (or the last n) past events in a few critical parameters. If we calculate the mean, standard-deviation, minimum and maximum value over the past events, we can compare the value of the current event with a set of threshold values generated from the history of past events. Incoming values are first compared with the current set of thresholds, and then they are used to update them. Thus for every taxel of the pad we can calculate the current state based on the following calculations:

output	condition	meaning
0	$x < \min$	x is lower than ever before
1	$\min < x < (\text{mean}-\text{sd})$	x is very low
2	$(\text{mean}-\text{sd}) < x < \text{mean}$	x is lower than average
3	$\text{mean} < x < (\text{mean}+\text{sd})$	x is higher than average
4	$(\text{mean}+\text{sd}) < x < \max$	x is very high
5	$x > \max$	x is higher than ever before.

where X represents the current input signal from the pillow on the taxel and the output value (output) represents the type change to the taxel since the last measurement.

During our evaluation sessions (see Section 4 for details) we found, however, that a pure threshold-based approach often leads to unpredictable pillow behaviour.

We therefore introduced an additional evaluation step, which is based on the idea of utilising the Centre of Gravity (or Centre of Mass) to determine the average pressure point location of the touch pad. Giving every cell a mass proportional to the pressure applied (we define the cells variance as its mass) we can compute the COG as the average of the cells positions in the matrix weighted by their masses. If there is no change in action the COG converges to the absolute centre, which is simply the average of all locations weighted by 1. We use this property to determine the start and end of events. From the COG we also derive direction and speed.

Although this approach proves to be more flexible and lends itself for a more precise fine-tuning of the detection of action and its location, at this point we cannot distinct (using COG alone) between a positive (pressed) or a negative (released) event. If a pressure is sustained for long enough the COG will converge to the absolute centre and a release will trigger a new event. Thus, at the moment we simply have more events to cope with.

The results of the sensor evaluation provide a localized event description, as changes can be related to taxels, in form of a matrix that represents all taxels of the touch pad, where every taxel is identified as started, running or ended (a sort of second order of gravity). This description of position and event status is send to the corresponding session buffer of the context module, where the next level of abstraction on the results is performed.

3.3 Context representation

The **Context Module** describes the current (present) status of the environment with respect to resident users, devices and the interactions between them.

User as well as device profiles are loaded into the Context Model once their RFID is detected. For each detected user or object a memory structure is established (**Context User Model (CUM)** and **Context Device Model (CDM)**), which reflects only those characteristics that are relevant for the current context.

User characteristics are, for example, the user identifier, the current biometric status, current action, current interest (i.e. leisure as derived from the playing mode of the device mainly used at the moment), current location, as well as descriptions of likes and dislikes with respect to the potential media to be consumed and the related presentation devices.

Device characteristics include the device IP, its input sensor set, its actuator setup, current activity, current state for every input sensor and output actuator, its current location, and particular behaviour descriptions, such as adaptability with respect to input sensors, where adaptation here, for example, means automatic functionality changes of regions on a touchpad). Note, it is the sensor set and the behaviour descriptions that trigger the instantiation of the device drivers and are thus partially responsible for the type of sensor evaluation. For example if a pillow is in the ‘device state’ the touchpad of the pillow might be organised as described in Figure 8.

0	1	2	3	4	5	
Top left	Top left			Top right	Top right	0
Top left	Top left			Top right	Top right	1
		Center	Center			2
		Center	Center			3
Bottom left	Bottom left			Bottom right	Bottom right	4
Bottom left	Bottom left			Bottom right	Bottom right	5

Figure 8: Region pattern for a ‘device state’ of a touch pad

Depending on the associated role of the device, e.g. the touchpad functions as a remote control, the provided events for the region (see section 3.2) will be interpreted differently.

The reason why we provide devices with similar description structures as those for users is so that devices themselves can become proactive towards users. At the moment we only store simple data, such as user id, action performed and its duration but we wish to explore further in that direction (see section future work). It is also important to mention that the CUM and CDM are subsets of the general user or device model, which contain the overall description of the user or device. The user model might also contain descriptions of relations to friends, which might not be applicable for the current context of watching TV alone in the living room.

An instance of a CUM or CDM will be deleted from the context model in the very moment the related agent (user or object) is not part of the context any longer. A reason might be that the user left the room or that an object is switched off or removed from the room. In that case the context module also updates the general user or device model.

An appropriate representation of the current status of the environment requires that the model is constantly refreshed. We have noticed during our user tests (see section 4. Evaluation) that the average adaptation rate that causes a latency of around 0.2

seconds is not perceived as slow by users. A quicker adaptation callback would put unnecessary load on the computer system, and would not produce better user experience.

Yet, both CUM and CDM are rather static schema, providing a current situational “snapshot”, with which it is difficult to observe and track the dynamics of the environment. We introduced, therefore, the concept of a session, which monitors the interactions between a user and a device or between devices over time. A session is a data structure containing the identifications of the agents involved in the interaction, the start/end time of the session, the recorded sensor data, and resulting derivations such as type of pillow activation, pillow state and user state.

Thus, a session provides a unified view on a series of interaction events exchanged among agents. As long as a user interacts with a pillow, the session records all detected changes of user and pillow and the relations between these changes, e.g. which action influenced which change. The session description is in a way a ‘case’ composed out of events. At the moment the current event and the recent history of events are used by the adaptation engine to determine user state changes, which are used to propose adaptation strategies if required. In the future we would like to post process session description for further automatic improvements of the user model as well as improvements of the adaptation behaviour.

A session is instantiated by the Context Module once a device detects the ID of the user and the pillow sensors register relevant data. For example, a use case in which the user utilizes the pillow to control a presentation of an audio system is described by two sessions: the user interacting with a pillow (session A: userID – pillowID) and the pillow interacting with the audio system (session B: pillowID – AmplifierID). Sessions are closed, either once the interaction stops or when the user leaves the context. Why is this distinction relevant? There are cases where several users might share a device, e.g. several users touch a pillow. In such a case, where more than one user is detected by a device, the one using the device the longest is considered the prime user. If the prime user leaves the context, the session is terminated. Simultaneously a new session is opened, though, where the user being second in the list will automatically assigned prime user. It is at the device to indicate this change to the remaining users. Once a session is terminated it is stored in the History Model.

The **History Model** is our approach towards an individualized long-term memory of the interaction patterns for every user and device. It is updated once a session has been terminated. The model contains at the moment two data sets, namely **identification** [userid or deviceid / context type / indate / outdate] and **session** [agent1 / agent2 / context type / actionlist / datalist / adaptationlist]. The identification set is automatically instantiated when a user enters a context. This set serves as cross check source for the adaptation engine to evaluate user behaviour. The session set describes every interaction the user or device was involved in (pattern, duration). The data set stores the collected biometric data (thresholds, duration) and the adaptation list contains the adaptations performed by the adaptation engine based on the data in the same time frame (adaptation method, success value, duration). At the moment we only keep track of sessions, and thus make them accessible to the adaptation engine, in form of a sqlite2 SQL database. Real instant or post evaluations (e.g. at the end of a day, week, month, etc) still need to be developed.

The outlined representation structures serve as input sources for the adaptation engine to determine if an adaptation is required and in case it is, which type of adaptation needs to be performed.

Before we explain the adaptation engine we first briefly describe the *Communicator module*, (see Figure 3) as it serve as the output source for the adaptation engine.

3.4 Communication between objects

As the pillow can be used as an output device the environment needs to be able to easily establish a connection between the pillow and the presentation device it might be connected to. For connecting the pillow server with other multimedia component, we use the Adaptable Multi-Interface COMMunicator (AMICO) AMICO is a generic platform, used to support rapid prototyping with OSS components in different domains [reference removed for double blind review]. The proposed brokering infrastructure is based on the publish-subscribe design pattern. It is well suited for integration of loosely-coupled parties, and often used in context-aware and collaborative computing. When using simple data structures, the loosely coupled approach can be highly adaptable, so that new applications can both reuse existing data in the repository and add their own data without breaking the infrastructure. This approach is also fault tolerant, as components run as independent processes. In the loosely coupled model, components can run on different machines in a distributed environment. Components communicate by exchanging events through a shared data repository consisting of named slots. Components can update the slots, and register for notifications about changes.

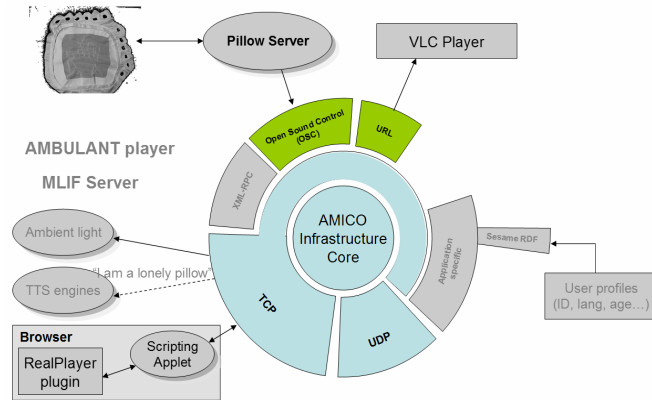


Figure 9: Configurations of AMICO middleware for integration of the pillow server with other multimedia components.

Figure 9 illustrates how this infrastructure is used to connect the pillow server with other multimedia components. We have integrated the pillow server with the infrastructure through the OSC interface, which is also used for the communication between the pillow's hardware and its driver software. AMICO uses the outcome of the adaptation engine, namely commands for the multimedia players⁴, controlling sound intensity and playback, as well as

sending a message to the user, which have been generated on the basis of the discrete actions provided by the pillow.

3.5 Adaptation and Feedback

In our environment adaptation focuses on three major processes, namely **stimulation**, **relaxation** and **representation**. *Stimulation* describes the attempt to either engage a non-active user into an interaction with the environment or to increase a low-base activity. *Relaxation* tries to reduce the amount of activity or excitement. *Representation* aims to present the state of the environment and the user in a visible and audible form, to give the user a feedback about actions and their effects. The adaptation engine, therefore, constantly evaluates data from the Context Module, and reacts on changes only if they are outside the provided constraint set.

The adaptation process is based on the idea of a finite state machine (FSM), a model of behaviour composed of **states**, **transitions** and **actions**. The states are defined by CUM and CMD descriptions, and the session structure from the Context Module. The transitions are based on the constraints set by the administrator, which, in case of our home scenario, can be everybody in the house. At the moment we implemented a system with a single constraint set for a room but the aim is to later provide constraint sets applicable for every single individual.

We employ two types of constraints. The first type covers excitement levels, ensuring that a certain upper or lower excitement threshold is not crossed. The other type of constraints are time constraints, which describe for example the duration in seconds the system should wait to suggest new activities or the time interval for verifying that a suggested action is indeed performed by a user. These constraints are set by a user and become part of the user model, in the preference section. This is one of the possibilities of the user to control the system, which enforces a certain trust in its capabilities to adapt.

If a constraint cannot be fulfilled, the adaptation engine utilises actions to ensure, for example, that the tolerated excitement levels is reached again within the temporal constraints defined by the user⁵. Actions describe the adaptation performed at a given moment. An action features an instruction for the behaviour of an object, e.g. instructions for the vibrator of a pillow to vibrate in a particular pattern suggesting a particular information code. An action might also trigger a number of events at the same time, such as changing the TV channel.

Actions are organised in form of rules and context scripts. The organisation of rules is based on context scripts. In our environment the scripts are designed by us and thus represent an already established interaction and adaptation solutions for a particular object, namely the pillow. As the language for the rule set is simple, it is, however, also feasible to assume that users can improve or enhance the behaviour set or designing new ones for different objects.

For a single user single object interaction the knowledge base is rather simple. Elsewhere [reference removed for double-blind review] we described that this approach also works well for more

⁴ We used several multimedia players, included VLC player, connected through HTTP interface, the AMULANT SMIL player, connected through XML-RPC interface, and RealPlayer player embedded within Web page and connected with our infrastructure.

⁵ It is the user who determines the actual meaning of the thresholds, where the system only reacts on them. This reduces the inference level of the system greatly.

complex settings, such as interaction between a group of people and one object, a group of people and several objects, etc.

The general structure of rules in *move.me* is as follows:

```
<proposition> ::= if <input-statement> then <output-statement>
<proposition> ::= if <input-statement> then <output-statement>
                    else <output-statement>
```

An input statements can consist of an input fact, a negated input fact or multiple nested input statements. Input facts correspond to the states that result from the sensor evaluation module. They might look as follows:

```
<input-fact> ::= <corner-touch>
<input-fact> ::= <c1-touch>
<input-fact> ::= <not-pressed>
```

Output facts correspond to a particular device, i.e. the LED, the vibrator, etc. as well as to the commands to be sent to the AMICO presentation client. Note, a naming synchronization between AMICO and our environment is necessary so that the actions can be performed accordingly. Output facts for animating an icon might look like this:

```
<output-fact> ::= <show-play>
<output-fact> ::= <blink-wait>
<output-fact> ::= <animate-icon-7>
```

where show triggers a single icon, blink repeatedly turns it on and of with short intervals, and animate displays a predetermined sequence of related icons. Note, a set of so far 30 icons is preloaded into the sensor board.

Actuators, such as the vibrator or a loudspeaker, provide parameters related to their modality space. Examples for a vibrator (buzzer) or loudspeaker or look like this:

```
<output-fact> ::= <buzz-soft>
<output-fact> ::= <buzz-gradual-increase>
<output-fact> ::= <beep-note-G3>
<output-fact> ::= <beep-increasingly-louder_C1>
```

The three parameters are flexible enough to be configured endlessly and thus it is the design of the rules themselves that provides the sense-making. It lies in the hand of the user to determine the behaviour of the environment, which adds to its trustworthiness.

Let us describe the adaptation mechanism based on the state model portrayed in Figure 10, which represents the pillow states **sleeping**, **game** and **device**, as well as the transitions between them, i.e. **waking up**, **tune in** and **fading out**.

We already mentioned that the adaptation engine constantly evaluates data from the Context Module, and reacts on change. Assume that the system detects that a user enters the room (detection of the RFID tag). The context will load the user data relevant for the scenario (i.e. living room) and wait for new interaction sessions. If none is established within the time threshold for inactivity provided by the user parameters the adaptation will try to engage the user into an activity. All actions to be executed here fall into the *stimulation* category.

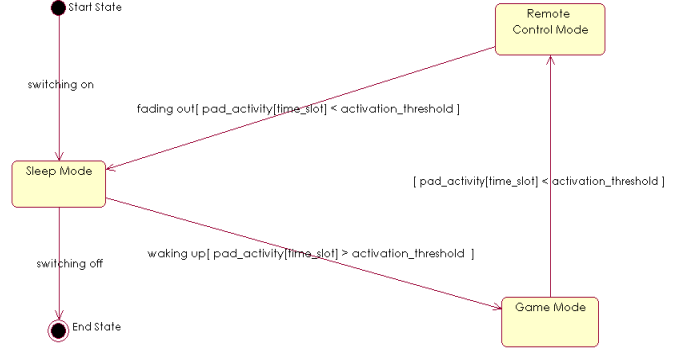


Figure 10: Potential pillow states and transitions between them.

‘Stimulate user’ activates a list of action scripts, of which one might cover attracting the user to the nearest pillow. As a result the adaptation engine will send a command to the closest pillow (location information taken from the device model and the user model) via AMICO as shown in the result slot of the rule below:

precondition	result
<sleep-state>	<purr> every 30s
	<show-asleep> every 30s
	<amico-sleep-mode>

This rule stands for: let the pillow make a gentle purring sound (a buzzing pattern), show a pattern of z’s on the LED and let that continuously run.

The adaptation engine observes the context model for signs of contact, i.e. the standard deviation of sensory data rises above a given threshold. If that is not the case within a given time span then the adaptation engine would try another strategy, which means utilize a different action provided by the stimulation set. Note in such a case the system would store the given context, e.g. type of category (stimulate), user id, strategy chosen, and the result (negative) in the adaptation part of the history model. For the rest of the example let us assume that the user responds according to the provided strategy.

After the user has started to interact with the pillow, the adaptation engine will first notify the user that this interaction is recognized (category: representation), as illustrated with the following script:

precondition	result
<sleep-state> and (standard_deviation > threshold) for > 0s	<transition-buzz>
	<show-loading>
	<amico-waking-up-mode>

where <transition-buzz> is a short sequence of buzzes identical for each transition. <show-loading> displays an animated icon that slowly fills the display with burning LEDs. Internally the state of the pillow is now set ‘waking-up’.

Realising that a session is instantiated the adaptation now attempts to instantiate an activity between user and pillow. The user activity list of the user model describes the preferred action states of the user, e.g. TV, Game, PC, etc. Depending on the rank within the list as well as the last state performed during the last session of the time the user was present in the context (living room), the adaptation engine picks a state, for example the game state. Thus, it sends a command to AMICO requesting to show the game icon on the pillow.

The adaptation engine now waits for a particular time (not more than 5 seconds) and checks if the standard deviation of the relevant

cell on the touchpad changes, meaning that the user acknowledged that she wishes to play. As a result the engine instantiates a “go” icon (category: *representation*) and starts a game accordingly. Note, the device model is now updated that the pillow acts as a game console of type synthesizer.

We have implemented a little sound synthesizer the user can play. The sound is a function of the center of gravity, acceleration, speed, the percentage of taxels that are pressed, and the intensity (the percentage of total pressure intensity). We are not playing actual frequencies but notes. The audio output is a simple Pulse Width Modulation circuit. In that case the adaptation engine performs the task of a game engine as well as the observer of the user. Once the adaptation engine detects low activity on the touchpad, it tries to initiate a new stimulation by suggesting an action change from Game to TV.

The user can now use the touchpad now as a remote control, where the functionality of the cells might be as such:

active fact	result
<clockwise-movement> and length > n	<amico-play-movie-next> <show-next>
<clockwise-movement> and length > n	<amico-play-movie-prev> <show-previous>
<c2-touch>	<amico-fullscreen> <show-fullscreen>
<c3-touch>	<amico-volume-up> <show-volume-up>
<c4-touch>	<amico-volume-down> <show-volume-down>
<c1-touch> and <c2-touch>	<amico-pause> <show-pause>

The synchronization between the pillow remote control and the TV is completely handled by AMICO. The adaptation engine now investigates the two established sessions, namely user and pillow and remote control and TV set. The main input will nevertheless be from the pillow, as this provides the biometric data from the user.

If the user leaves the context, which the adaptation engine realizes through closed sessions and the disappearance of the user id from the list of present users, then the adaptation engine applies a pillow transformation (category: *representation*) by letting the pillow fade out of the remote control state into ‘sleep state’.

precondition	result
<remote-control-state> and <number-of-events> > 0 and (standard_deviation < threshold) for > 30s	<showunloading> <amico-fading-out-mode> <transition-buzz>

postcondition	result
<remote-control-state> for > 30s	<sleep-state>

If the adaptation engine does not detect any action, i.e. the standard derivation remains 0 for a defined amount of time or there are no users in the list of present users for a defined amount of time, then it sets all registered objects into state of stand-by.

4. EVALUATION

We performed one elicitation study on the initial prototype, as presented in Figure 2, as well as a test at the demo event of the funding agency that supports this project, where participants had the chance to experiment with a set of pillows as described in Figure 1, 6 and 7..

The qualitative elicitation study [5], took the form of a one-day participatory workshop with 10 users (3 females, 7 males), and covered:

- A hands-on free exploration session with a medium-fidelity pillow prototype.
- A “Wizard of Oz” simulating the complete intended functionality of the system.

The participants’ experiences during both sessions were video taped and later analysed.

Apart from showing that the current architecture is stable and functional, especially in terms of mobility and connectivity, the workshop provided two major findings. First, the initial interactive exploration of the pillow lead to the users’ full engagement with the system even when the feedback in form of iconic messages on the pillow’s LED display was slow. Second, in the interview session, users indicated that they would appreciate the idea of device memories and the long-term memory of the system, even though we where not be able to test these elements during the workshop.

The presentation of the pillow functionality at the symposium showed that the adaptation based on stimulation, relaxation and representation is sufficiently sound to let users understand how the environment reacts on their actions without explicit training session. Moreover, it could be demonstrated that the rule set can be adapted on the fly, even though the coding was done by one of our group members based on the wishes of the visitors.

Because both cases our test sample are rather small, we were only able to perform a qualitative evaluation of the system. However, we have taken these findings as general guidelines, which will allow us to make educated decisions for further developments.

5. RELATED WORK

There has been a great deal of general research in sensing and biofeedback in human-computer interaction [3, 15] This research has indicated that a number of well established sensory methods, such as pressure and GSR, can be efficiently reused in our context to obtain a window into the state of an individual. In addition, there is work that illustrates the elevation of low-level signals to higher-level interaction [14].

The affectionate quality of a pillow is also used in other works, such as the interactive pillows by Ernevi⁶ et al. [10] and Aoki et al. [4]. Both projects investigate interactive pillows as a means of enhancing long-distance communication. We share the notion of a sensual aesthetic of a pillow that encourages connection through feel in an associative and intuitive way, we do support a different vocabulary of expressiveness, based on action.

Buxton et al [6] provides early descriptions of the unique characteristics of touch tablets relative to other input devices such as mice and trackballs. Chen et al [8] describe the use of a touch-sensitive tablet to control a dynamic particle simulation using finger

⁶ <http://www.tii.se/reform/projects/itextile/pillow.html>

strokes and whole-hand gestures, where the gestures are interpreted as a form of command language for direct manipulation. In our work we go beyond direct manipulation, enriching the interaction with parameters about the quality efforts.

The authors in [16] describe the use of kinaesthetic motion-analysis models to represent movements. The current work was influenced by this choreographic approach to motion description and presentation of these studies.

Haptics and touch have been explored by many researches. The University of Tsukuba, for example, has developed a large number system that makes use of haptics such as finger/hand manipulation and locomotion [13]. Although these systems use different technologies, they have provided us with a motivation for usage of touch.

6. CONCLUSION AND FUTURE WORK

In this paper we have described an ambient environment in which a set of small interactive throw pillows containing intelligent touch-sensing surfaces allow users to change the behaviour of the system based on the actions performed by the user. We have demonstrated that pillows serve well as adaptive interfaces in changing contexts and described a novel framework that facilitates the integration of various devices to enhance the adaptation of the environment.

A novel aspect of *move.me* is the approach to map efforts of users actions to higher-level adaptation activities, by defining the mapping space between biometric data and its potential meaning. Although the first prototype shows promising results, we have to provide significant improvements with respect to adaptation response time as well as the range of adaptations to facilitate a richer experience environment that better reflects the motions of the social interchange.

Fruitful future research aspects are how different modality sensors, e.g. pressure and galvanic skin response can be combined into one adaptation framework. Second, we want to experiment with different forms of archival and retrieval of user experiences during interaction.

7. ACKNOWLEDGEMENTS

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Really, Really Small: The Palpability of the Invisible

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ABSTRACT

Our physical technology continues to grow smaller and smaller; so small that the computer itself is no longer seen as an *object* but a set of *invisible* distributed *processes*. Technology is becoming an inseparable aspect of experience, palpable yet invisible. At the same time, an extra-ordinary wealth of literature is emerging within human-computer interaction that is exploring experience, embodiment, subjectivity, and felt-life. This interest is often accompanied by research questions that are continuing to re-balance our understanding of the relationship between subjective and objective knowing, making, and doing. These emerging trends can be seen as a response to the phenomena of the really, really small: and marks a cognitive and creative shift from the visible to the invisible. This paper contextualizes the emerging recognition within HCI that there is value in designing for technology as experience, and offers a framework from the field of *Somatics* that can contribute to the discourse, particularly with regard to the body in everyday life. *Somatics* is exemplified through first-person methodologies and embodied approaches to learning and interacting. I present a set of design cases that demonstrate its application within HCI.

Author Keywords

User experience, Embodiment, Perceptual Interfaces, First-Person Methodologies, Somatics, Attention, Interaction, Touch, Movement, Body-data

ACM Classification Keywords

H5.2. [User Interfaces] Interaction Styles, Theory and Methods, User-centered design

INTRODUCTION

Our physical technology continues to grow smaller and smaller. The computer itself is no longer seen as an *object* but a set of *invisible* distributed *processes* that occur beneath the surface of our skin, our clothing, our buildings and our world. On the one hand we can think of this as

merely the foreseeable result of a continual process of miniaturization, yet on the other hand this marks a cognitive and creative shift from the visible to the invisible, and from the visual to the perceptible. Historically, we have equated visibility with comprehension, truth and agency [29, 19]. We have depended upon and favored vision as the sensory mechanism that defines knowledge, validity and experience. But rather than render us blind, the ‘really really small’ is moving us toward perceptual interfaces, palpable interfaces, ones that take advantage of all of our senses, and that accesses a richer and more fully articulated human being. Weiser’s [66] definition of invisible computing includes a return to the ‘whole person’, engaging with practices in arts and humanities and focusing on experience. Technology is coming to be understood as an inseparable aspect of experience. And there is growing acknowledgement within HCI of the value of designing technology not only for experience but *as* experience [34]. While our technology is becoming embedded, invisible, microscopic, our experience continues to require our attention: our palpable attention.

A response to invisibility

However, all is not necessarily ‘happy in Smallville’¹. Without our well-trusted visual cues, interaction can take on magical proportions. There are times when enchantment and surprise are wondrous [35]. But what is often desired and sought out in the sensuality of the cinematic may not provide similar value in other contexts. In an example of a reactive room that appeared “possessed” [23] confusion can occur when interaction cues disappear ‘beneath the surface’. The perception of loss of control appears through the absence of meaningful interaction. The concept of the invisible computer has generated fruitful discussion regarding the need for appropriate cognitive/perceptual models [50, 23, 66]. There are challenges created with invisible interfaces [50] and solutions have included recovering visibility through a return to graphical interfaces. The framework for exploring palpable design may be less about the limitations of seeing, than an invitation to extend our sensory models to consider the senses as perceptual

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¹ *Smallville* is an American television series that follows the adventures of a young Clark Kent before he becomes Superman

systems, active and interrelated, and engaging with the world as it unfolds in possibilities for action [18, 33].

The Palpability of the Invisible

Palpability refers to an intensity that is perceivable, easily observable and felt. Palpable interfaces describe those which ‘make sense of’ felt-life. Gibson [19] refers to the senses as *active* seeking mechanisms for looking, listening, touching, and understanding information in the world. For Gibson, the role of kinesthesia and movement is inseparable from perception, constantly co-operating in and coordinated with acts of perception. The hand reaches out to touch. The head turns to see. The eyelids close and the head moves downward to listen. Perception is active attention [19]. In comparison, passive sensing (where active intention and movement are much less involved) provides less information and less *depth* of experience and comprehension [19]. Although the computer and the interface may be disappearing, our world and our bodies are continuously present and made even more visible through our participation. If our goal is to increase legibility, coherence and social relevance in relationship to the ‘whole human’ then we need to develop richer interaction and sense-making models that align techniques of active embodied practices with technological rigor and imagination.

The Need for New Models and Metaphors

Now You See it Now You Don’t

Perceptual shifts such as those that accompany the shift from visible to invisible computing can enable us to comprehend and design for the “really, really small”. But substantial perceptual shifts are often accompanied by disorientation [19, 29, 20]. Can we create interaction that invites our full sensory range, and takes advantage of the wealth of the invisible? While we have entrusted vision with our sense of truth and comprehension, developing a similar level of trust in the *wholeness* of our sensing system will require an accompanying perceptual and cognitive shift. Gaining this understanding can be accomplished through active sensing that results in learning to trust a greater range of sensory data. The active sensing of the invisible does not rely solely on visual perception but provides an opportunity to integrate the visual in a larger ‘sense-space’. We can engage with a more fully articulated range of our own experience. In this way, the invisible computer necessitates the development of new models and metaphors that support design, creativity, and use.

THE REBALANCING OF SUBJECTIVITY AND REASON

We are witnessing a reformulation within human computer interaction that is resulting in a re-balancing of the valuation between subjectivity and reason. There is growing interest in the fact that our bodies and digital technology share a reality that is physically embodied. The relevance of theories that account for reasoning as constructed through experience and subjectivity is gaining significance in HCI. As our technology ‘disappears’ into the seams of our world

we are moved to understand, contextualize and integrate the consequence of this physical and metaphoric shift. There is an outpouring of interest in knowledge and methods that originate from within a seemingly endless variety of fields. We are seeing the influence of Cognitive Science [29, 24, 36, 41], Sociology [45], Phenomenology [15, 39, 40], Psychology [19, 32, 41], Neuro-Physiology [13, 2], Performance Practice such as Theatre [5, 54, 55] Dance [12, 30, 61] and Somatics [3, 10, 21, 22, 28, 31], Reflective and Contemplative Traditions [68, 14], and Critical Theory [38]. This trend is bridging methodologies by synthesizing ways that we imagine, validate, and evaluate our discoveries.

The Body in the Mind

An example from the field of Cognitive Science is the theory of embodied image schemas and their metaphorical extensions. Image Schemas have found relevance within human computer interaction [24] in their ability to support and design prototypes for intuitive interaction. The term image schema is described in Mark Johnson’s *The Body in the Mind* [29]. Image schemata are abstract representations of recurring dynamic patterns of embodied interactions that structure the way we understand the world [29, 24]. They arise from our normal everyday experiences, the body in everyday life. Hurtienne and Israel have explored how the application of Image Schemas might be used in the design of Tangible User Interfaces [24].

Container	Balance	Compulsion
Blockage	Counterforce	Restraint Removal
Enablement	Attraction	Mass-Count
Path	Link	Center-Periphery
Cycle	Near-Far	Scale
Part-Whole	Merging	Splitting
Full-Empty	Matching	Superimposition
Iteration	Contact	Process
Surface	Object	Collection

Figure 1. Some Examples of Embodied Image Schema

According to Lakoff and Johnson, image schema form the experiential and cognitive building blocks for our most basic metaphorical extensions. These metaphors are deeply linked with the development of our physical bodies’ through the sensorimotor system as we learn to ‘make sense’ of the world. Lakoff and Johnson term these *experientially grounded mappings* [32]. “More is Up” is an example of one of the correlations between image schema that occurs through early experiential mappings. “More is Up” is an example of a Primary Metaphor. The spatial image schema of verticality (up-down) and the scale image schema (more-less) is experientially mapped to create the metaphor ‘More is Up’. In this example the *subjective judgement* of quantity is conceptualized in terms of the *sensorimotor experience* of verticality.[32].

Knowing is Seeing

We can contextualize this discussion with regard to extending our ability to design with and for the invisible computer. Our primary metaphors correlate to our sensorimotor systems. Our sense of sight frames our understanding of the visible and the invisible. How we see, and how we understand how we see is deeply ingrained in our experience. The primary metaphor “Knowing is Seeing” [32, p 54] correlates the *subjective judgement* of knowledge with the *sensorimotor experience* of vision. This is exemplified in our language “I *see* what you *mean*”, “out of *sight*, out of *mind*”, and the familiar phrase “*seeing* is *believing*”. We equate visibility with comprehension, truth and agency. However, our senses share in their ability to create understanding [19], and although “Knowing is Seeing” we have a variety of mechanisms and metaphors that we use to access understanding.

Seeing is Touching

Another Primary Metaphor “Seeing is Touching” illustrates our bodies’ propensity to perceive one sense *through* another sense. *Sensory substitution* [2] is the body’s sensorimotor ability to map data from one sensory system (such as touch) to other sensory system (such as vision). These capabilities of the body’s own nervous system are now being used to enable the blind to use tactile stimulation in order to create visual impressions, allowing a low-resolution version of sight for the blind. In “Seeing is Touching” the *subjective judgement* is visual perception and the *sensorimotor domain* is Touch. The primary experience comes from the correlation between the visual and tactile exploration of objects. An example from language is “she *picked* my face *out* of the crowd”. We can invert this metaphor (Touching is Seeing, or Touching is Knowing) and we can explore ways of articulating the sense of ‘felt-life’. In the context of HCI, McCarthy and Wright’s explorations of ‘felt-life’ [34], or what something ‘feels like’ rather than what it ‘looks like’ [33], are examples of inverting tactility with visibility [43]. Larssen’s [33] explorations of what *movement* feels like in the context of body-thing dialogues rather than what it looks like is an example of an approach to embodied interaction design. Sensory and interaction design questions that take into account primary metaphors can broaden our sensory mappings, expanding possibilities for interaction [4].

The Rigour of Subjectivity

Johnson speaks of image-schema as *continuous structures for organizing our experience and comprehension*. They come about through the body’s sensing and sense-making as it grows into the world. “The fact of our physical embodiment gives a very definite character to our perceptual experience. Our world takes shape as a highly structured, value-laden, and personalized realm in which we feel the pull of our desires, pursue our ends, cope with our frustrations and celebrate our joys. Image schemas are pervasive, well-defined and full of sufficient internal structure to constrain our understanding and reasoning”

[29]. Among other researchers that advocate the rigour of subjectivity, and the embodied nature of rationality are Gibson [19] in his exploration of the senses as perceptual systems, Damasio [13] in his descriptions of the neuro-physiological coupling of feeling, thought and action, Polanyi [48] in his treatise on the tacit dimension of knowing, Putnam [49] in his philosophical argument that value is inextricably tied to reason, and Johnson [29] who describes a non-objectivist account of truth and objectivity. For him truth is seen to be relative to embodied understanding, and objectivity takes up shared human perspectives that tie to reality through embodied imaginative understanding.

Embodied Rationality

If subjectivity can be seen to provide a rigour of ‘felt-life’ that co-mingles and informs our objective methodologies, we can use the notion of embodiment as a necessary precursor to rationality. “How imagination can be both formal and material, rational and bodily – is that there is not an unbridgeable gap between these two realms in the first place. Once we no longer demand a disembodied (or nonphysical) rationality, then there is no particular reason to exclude embodied imagination from the bounds of reason” [29 pp 169]. Re-balancing objective and subjective knowing provide one of the key methodological shifts in designing for experience.

THE VARIETIES OF USER EXPERIENCE

The Varieties of User Experience refers to the notion that the lived experience of the user’s participation with technology can be centrally held within human computer interaction and its design discourse.² Borrowed from the title of William James’ *The Varieties of Religious Experience*, the intention is to highlight how HCI is ‘making sense of experience’ [67]. James offered an account of experience that placed it at the centre of meaning and meaning-making in the many and various practices found within religious structures and philosophies [25, 26]. James grouped, compared and analyzed numerous types of experience. He concluded that it is not the credos, dogma, prior beliefs, or the structure of morality that is at the centre, but the felt and lived experience that defines the spirit of religious understanding. Within HCI the call to experience is being explored as an aspect of the value of subjectivity and the foundational constituent knowledge of embodied approaches within interaction design.

The Focus of Experience within HCI

A recent issue of *Interacting with Computers* published a special issue on the emerging roles of performance within HCI and interaction design [37]. Examples of approaches to interaction design that express experience through

² McCarthy and Wright [citation] urge technology designers to place ‘felt-life’ at the centre of HCI based on an argument founded in references to Dewey and Bakhtin

embodied goals [47, 60, 57, 42] attention to sensing systems [4, 58], aesthetics [9, 56], and awareness or situated contexts [63, 65, 44] is proliferating and creating a vital research community. Previous research in the use of exploring experience/ performance methods within the HCI community has occurred in the domain of Forlizzi and Ford's exploration of user-centered and participatory design [16]. Also included are Buchenau and Suri exploration of *experience prototyping* that fosters an "empathetic" and "embodiment" approach to user-centered and scenario-based design [7]; Burns, Dishman, Verplank, and Lassiter [8] Interval Research's exploration of *informance*: informative performance and *bodystorming*: physically situated brainstorming, *repping*: re-enacting everyday people's performances, and explorations of how Low-tech solutions can create a design environment that focuses on the design question rather than the tools and techniques, Burns, Dishman, Verplank, and Lassiter [8]; Scaife, Rogers, Aldrich, and Davies [53]. Salvador and Howells [52] shifted the focus group methods to something they called Focus Troupe: a method of using drama to create common context for new product concept end-user evaluations. Simsarian [64] has explored the use of role-play in extending the richness of the design process. In the *Faraway* project, Andersen, Jacobs, and Polazzi [1] explored story telling and 'suspension of disbelief' within a context of game and play in a design context. In addition, exploring other subjective aspects of creative process, such as the use of creating ambiguity in design has been described by Gaver, Beaver, and Benford [17].

SOMATICS AS AN EXPERIENCE TRADITION

Somatics is a field of study that explores the lived *experience* of the moving body. Somatics is defined as the *experience from within the lived body* [22]. As one of the experience traditions that defines its own knowledge-base through embodiment, *Somatics* can contribute to the discourse of HCI, particularly with regard to the body in everyday life. *Somatics* is exemplified through first-person methodologies, and offers experiential models that can begin to re-balance our understanding of the relationship between subjective and objective knowing, making, and doing.

First Person Methodologies as Defined within Somatics

First person methodologies as defined and used within performance practice and Somatics share a common set of features. They exist as a set of rigorous, definable physical processes. These can be learned and their application produces repeatable results. These techniques are based on the direction of attention in order to affect alter or produce body state. It is possible to retrain perception utilizing directed attention, which is produced through directed intentional movement. First person methodologies access and construct knowledge through the body.

In Somatic practices, learning to access and direct attention is one of the central themes. One could say that this is akin

to becoming an 'expert user' in attention techniques. Ginsberg [20,21] offers examples that illustrate the value of attention skills. Other fields such as phenomenology [14] also share these goals and practices. At the simplest level, retraining the sensorimotor system, and re-enlivening sensori-motor pathways is a mechanism for retraining embodied habits and perceptions. An example includes slowing movement down as much as possible in order to increase awareness of the embodied state. This technique is practiced in Noh and Butoh traditions, as well as movement therapies that work to retrain poor sensorimotor habits that constrain the body. Slow motion enables the body to shift its attention to an immersive state in relation to its environment, where attention is intensified, and sensory details are sharpened.

Augusto Boal [4] terms these types of experiential exercise *de-specialization*. He states that in our every day lives "the senses suffer. And we start to feel very little of what we touch, to listen to very little of what we hear, and to see very little of what we look at. We feel, listen and see according to our specialty. The adaptation is [both] atrophy and hypertrophy. In order for the body to be able to send out and receive all possible messages, it has to be re-harmonized [through] exercises and games that focus on *de-specialization*." Boal's goals in theatre are to create imaginative, social and political agency. His work is premised on the notion that agency at the bodily level (agency of the self) enables agency at the social and political level. Many exercises in Somatics and performance focus on this idea of retraining attention in order to increase awareness and agency through the body, and can be applied to many levels of awareness that extend beyond the personal.

A Role for Somatics within HCI

In the performance domain, Dance Analysis and Somatics construct models directly from the *experience* of the moving body. Somatics is concerned with *lived experience* and includes practices such as Feldenkrais and Alexander technique. From the Somatics perspective, knowledge is constructed *through* experience, Hanna [22]; Johnson [28] and requires that experience be directed or focused through *awareness*. When sensory stimuli no longer results in a perceptual motor response, the body's sensorimotor system has reduced its ability to act. In Somatics this would be termed "somatic amnesia". However, when experience is specifically directed through the focus of attention, knowledge acquisition takes place which can be referred to as "Somatic learning", an activity expanding the range of what Hanna [22] terms volitional attention. While Csikszentmihaly [11] suggests that human experience operates within a limited field of attention, other movement systems within Somatics consider attention to be a generative attribute of awareness that can be augmented, increased through a process of somatic learning [22].

What Somatics Offers Felt-Life

Somatic Techniques and Experience Traditions share a common set of goals. Rudolf Laban's movement analysis systems [31, 46] and the work of Bartenieff [3] are examples of movement typologies based in experiential practices of dance [61, 62, 59] that model qualities and modes of movement. These typologies can be used in gestural recognition and modeling qualitative movement characteristics such as intentionality, interest, attention and body state. They present potential experience models for the classification of aspects of movement, and define a means to approach gestural and choreographic protocols. Participatory design, experience design, performance, theater, dance and somatics share a common focus in modeling or representing human experience. These domains also share the ability to articulate and explore engaging experience through movement, emotional response, sensorial qualities, and temporal/dynamic qualities of experience and of movement.

CASES + STRATEGIES FROM ART AND DESIGN

Experience is felt, is palpable, perceived and lived. How could these concepts be used within a design process that takes into account a framework that employs Somatics techniques? This would imply a design process that has the goal of cultivating our perception of attention, and can increase our skill with utilizing that attention. Somatics techniques apply their potential to increase the *resolution* of our attention and the *resolution* of our experience, adding value and increasing quality. Can user experience be designed to such a degree that experience itself becomes personalized bringing a degree of skill and refinement to the use of our own body states, refining the inseparability of mind from body. This would suggest that user-experience can shift its central focus from outer to inner and remain balanced between the two. And that user-experience can take the point of view of generating attention rather than competing for limited attention space of the user.

Three Cases are presented that apply first person methodologies and somatic principles in various ways that include active sensing. In Case One, the use of a series of design workshops is used to illustrate an exploratory approach to creating an interaction model through participants attention to their own lived experience. In Case Two, the physiological data of breath is used in order to create a heightened and empathic connection between a group of shared participants that wear networked skirts in order to actuate, display and share their breath. In Case Three, touch and tactile quality recognition is used in order to explore qualitative interaction where experience, intimacy and play are a central theme.

Case One: whisper[s]: wearable body architectures

This case illustrates the outcomes of a series of exploratory workshops³. These workshops were conducted prior to the

design of an interactive art exhibition. The goal was to find out how a group of people would pay attention to their own body state and share that with others in a space. A range of somatic techniques used within performance practice to train attention or awareness were explored. The workshops relied on improvisation, props, ritual space, and placebo objects. Very little digital technology was introduced at this stage in the design process. The central theme of the workshops was asking participants to employ simple acts of 'paying attention'. For example participants were asked to listen, notice, touch, move, feel. Participants were asked to imagine and visualize; focus on somatic attributes such as breath, heartbeat, stillness, and slow motion movement. One of the goals was to design experience that could be replicated, re-enacted, and re-played in the context of a public art installation using wearable computing technology. The design goal of the public art space was an environment that could be simultaneously intimate, playful, and social, while developing and sharing a level of awareness of our selves. A set of examples from three out of a total of five workshops conducted is described below.



Figure 2. Experience Modeling *connection and extension*

For each workshop participants were asked to write their experiences on a single card, each of which included two to three simple open ended questions.

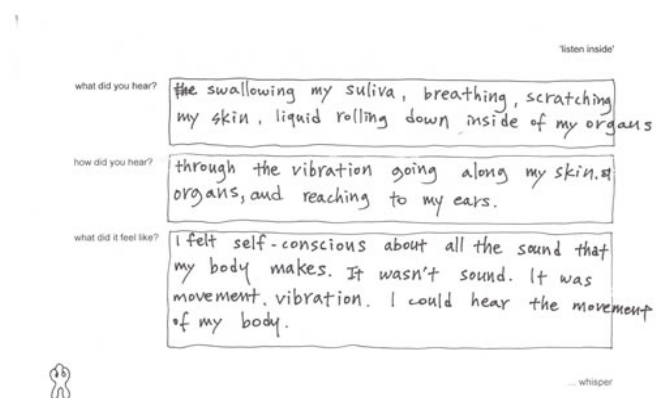


Figure 3. response card example

³ see full paper [59] Schiphorst, T., Andersen, K.

The <listen> workshop

One of the major themes of the series of workshops is the notion of ‘paying attention’ to one’s self. The design for the installation centered on measuring physiological data as a representation of oneself: data that we do not normally pay attention to in everyday life, but can easily access. The first series of experiences relate to how we perceive and deal with directing attention to our own body data. Participants were asked to find a place for themselves in the space. They were asked not to speak. Each participant was given a pair of earplugs and they were then left alone with themselves with no further instructions for about 15 minutes. After awhile the earplugs were collected and each participant was handed a card (see fig. 3). The card asked the questions: What did you hear? How did you hear? What did it feel like?

In the space of experience, this is the simplest of experiments. By depriving the body of its external hearing it can become aware of the internal sound otherwise made invisible by the louder external sounds. We are removed from our own ears, but not from our hearing. In performance, artists like Pauline Oliveros and Augusto Boal have created practices such as “deep listening”, and “listening to what we hear”, which probe and access these very same questions of experience. The responses to the very simple question on the cards: *What did you hear?* focus on access to this level or resolution of experience. Responses indicated the participants’ discovery of the internal soundscape.

‘Heartbeat; earplugs as they settle, breath, slapping sounds from others in the room; humming noise; myself; contact with my own body’

This seems to trigger strong emotions ranging from slight unease to feelings of fear or elation in the answers to the question: *What did it feel like?*

‘I felt self-consciousness about all the sound that body makes; it wasn’t sound; it was movement, vibration. I could hear the movement of my body’

‘Pain, shifting between past and present; fear / calm’

Some workshop participants were able to recognize that listening occurs not only through the ears, but also through the bones, the resonant cavities of vibration in the body, that the body is a metaphor for listening, and that, what is heard, is not only sound, but movement, vibration, feeling, and sensation.

The <between> workshop

<between> explored the ability to transfer invisible data to another person and the willingness to enter into an exchange of information that is otherwise private and unknown. In order for such a transfer to work, the participant needs to engage or invite trust not only to the other, but also to the ‘listening’ self.

This was an investigation into the invisible transfer of personal data between people.

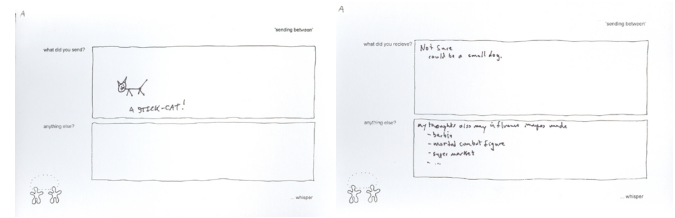


Figure 4. sending and receiving invisible signals

At the beginning of the workshop, the participants were asked to move in slow motion, as slowly as possible. They were then left to move very slowly for 10 minutes without speaking.

In Dance practices such as Butoh, this technique is utilized to enable the body to shift its attention to an immersive state in relation to its environment, what Csikszentmihalyi would term ‘flow’, where attention is intensified, and sensory details are sharpened. In neurophysiology and psychology [41] experimental studies show that the slowing or stopping of movement changes the conscious states we normally have and allows for observing the constant shifts of thought, sensation, or expands the ability to observe characteristics of basic experiencing [20].

Following the slow motion exercise, the workshop participants were asked to pair up, with one person selecting the role of *the sender*, and the other selecting the role of *the receiver*. The sender was asked to silently create an image in their mind for two minutes, and then send the image to the receiver, while the receiver was asked to simply pay attention to ‘listen’ for what image ‘came to mind’. At the end each participant was handed a card with the questions: What did you send? What did you receive?

What did you send? “A stick cat!”

What did you receive? “Not sure, could be a small dog”

The <extend> workshop

We wanted to continue to investigate issues of privacy and trust using physical objects that could mediate the interaction through physical gesture. <extend> augmented the invisible data with an amplification device. The participants were given ordinary medical stethoscopes and a small booklet with ten identical pages.

‘I felt like I was inside myself the pounding amplified my perception of myself, yet my breathing made me feel close’

By introducing the stethoscopes we gave access to another type of body data. More importantly, we introduced the possibility of sharing this data with someone else. The design of the stethoscope with a ‘listening’ end and a ‘probing’ end allows for the data to be shared by either probing someone in order to investigate their data, or giving someone the earpiece to offer them a particular sound. This

latter gesture of offering inverts the interaction model of probing or surveillance, to an interaction which invites and affords intimacy, trust, and peer connection.

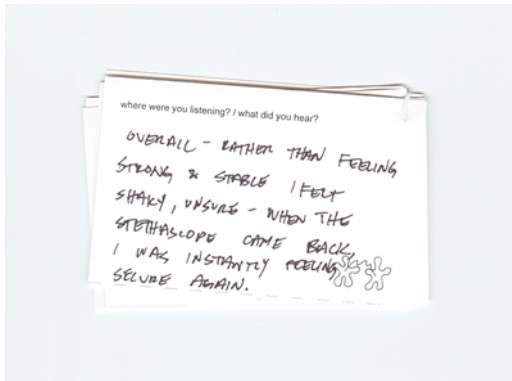


Figure 5. Response Card Sharing Physiological Data

The <phase>Workshop

By creating protocols that facilitate sharing and exchange there is a potential blurring of the boundaries between the participants as well as between what is inside and what is outside. The next exercise investigated this blur between inside and outside, as we asked participants to put on men's shirts. The shirts were given sticky Velcro patches to apply connection points anywhere they wished. The participants were encouraged to experiment with moving as each pair of shirts offered different possibilities for movement and control. The cards asked the questions: How did you extend yourself? How did you move?



Figure 6. Extension | Creating One Larger Body

How did you move?: *'Held hands with someone other than my husband; became silly; enjoyed the unusual and unknown; became aware of another's movement'*

How did you move?: *'I found myself thinking of our 'body' as a complete unit - it just had this other piece I wasn't controlling; the attached arm felt very unusual once I got complete control back'*

How did you move?: *'I was no longer just myself, I had to extend myself to become a part of a whole; as a whole we had to work together; when we failed it was almost disappointing because we were apart'*

Here we see several examples of body extension. It is interesting to see the disappointment when an appropriated body gets separated or the combined body fails to complete

a movement task. The workshops series as a whole contained a broad range of experience results that enabled us to construct an interaction model for an art installation. We continually returned to the artistic aim: that 'paying attention' to one's self enables a re-direction of attention with a greater access to optimal experience [11].

Case Two: exhale: (breath between bodies)

exhale: breath between bodies is an interactive art installation where group breath is shared between eight networked skirts. This example illustrates how our own body data can be used to create and share awareness in an intimate way in a social space. Each exhale skirt is sewn from lush vibrant raw silk in rich saturated colors. The skirts are lined with small vibrators that synchronize in correspondence with the participants' breath rhythm. Breath can be shared (given and received) through the use of RFID tags sewn into pockets in the side of the skirts. An LED array on the surface of the skirt illuminates the breath rhythm. Exhale creates a palpable interface where physical vibration created by small motors and the tiny movement of air created by small fans respond intensely and physically providing alternate 'physical displays' for the body [66].



Figure 7: exhale 'skirt trees' hanging in space

The exploration of breath in exhale is based on the notion of creating body states through somatic awareness. Shared breath creates empathic connections between participants and causes vibrations in the linings of the skirts, and light emissive fibres to respond to breathing patterns. This is an exploration of personal and group feeling states through attention to physiological data. Damasio [13] has studied the connection of 'feeling states' in the body and asserts that a given feeling state is associated with specific physiological patterns (such as breath rhythm) along with a set of processes including thought patterns and emotion. His research suggests that these 'feeling' body-states are an inter-connected set of feeling, thought, emotion and physiological functioning: each of these being present and affecting the other. He asserts that the induction of a body-state can be brought about through attention to *any* one of the inter-connected patterns: so that attention to physiological patterning (for example breath) can induce a body state, or conversely, attention to another associated patterns, such as the occurrence of certain thought patterns

can also induce body state. This inter-connectedness between physical data, and the state of the body creates a complex but coherent set of body-data and experience.



Figure 8 exhale skirt with LED array and RFID

Case Three: *soft(n)* tactile networks

(softⁿ) is an interactive public art-installation based on exploring emerging network behavior through interaction between a group of 8 to 12 soft networked objects. This example illustrates how specific movement taxonomies can be applied as a form of qualitative input recognition. Each soft object has a specially designed tactile surface that recognizes a range of 12 tactile qualities based on Laban's Effort Analysis. The Parameters that determine the tactile qualities are shown in Table 1. Implemented tactile qualities include jab, knock, touch, caress, glide, tap, pat and float. One can think of *(softⁿ)* as a counterpoint to, or a critique of, the hard: a survival strategy for interaction that allows misplaced action, mistake, forgiveness, a bad attitude, weakness, and stillness, giving in. *(softⁿ)* allows critique through the computational act of quality, where the quality of caress defines the interaction and response from each object. The objects have three states, inactive (sleeping), active (listening to other objects in the family) and inter-active (being touched or thrown about).



Figure 9: *soft(n)* tactile networked objects

The soft objects respond to tactile caress by actuating light, sound and vibration. Small tonal sounds, sighs and melodic 'dialogue' is shared between the objects when they are touched. They form an ecology of sound, vibration and

light. Each *(softⁿ)* touch pad is hand sewn using a specially constructed combination of conductive fibre, conductive foam and everyday needle and thread. This illustrates the ability to use domestic cottage industry approaches to 'hand-made' input devices that share algorithmic intelligence with other tactile heuristics normally applied to consumer input devices [58, 56]. The group of soft objects that are strewn about, and tumbled within, a public urban space, are networked to one another, and create a group-body, based on tactile input. The *(softⁿ)* objects communicate wirelessly to each other within their network.

To summarize: *(softⁿ)* includes the development and testing of an Interaction Model based on input heuristics of touch, based on Laban effort shape analysis, a system that was developed from within the knowledge base of Somatics.

Parameter:		Description
pressure	soft, hard	The intensity of the touch.
time	short, long	The length of time a gesture takes.
size	small, medium, big	The size of the part of the interaction object that touches the pad.
number	one, many	The distinction between one finger or object and many fingers.
speed	none, slow, fast	The speed of a touch-effort. This is the overall velocity of movement. This parameter is not used directly to distinguish efforts, but is used to determine space.
direction	none, left, right, up, down, and four diagonals	The direction of movement. This parameter is not directly used to distinguish efforts, but is used to determine space and path.
Secondary:		
space (speed)	stationary, travelling	A function of speed. If speed is zero then the gesture is stationary, otherwise it's traveling.
path (direction)	straight, wandering	If the speed is not zero, and there is only one direction registered, the gesture is straight.
disposition (pressure)	constant, varying	If the pressure maintains a single value after an initial acceleration the gesture is constant, otherwise it's varying.
pattern (gesture)	continuous, repetitive	If a gesture is unique in relation to the gesture immediately before and after, it is continuous. Any repeated action or gesture is classified as repetitive.

Table 1: Parameters derived from pressure pad data

SUMMARY

This paper has explored the notion of the effect of the "really really small" and how technology is an inseparable aspect of experience. The notion of palpable yet invisible interfaces and interactions is seen in the light of emerging explorations within human-computer interaction that explore experience, embodiment, subjectivity, and felt-life. The call to experience can be explored through valuing subjectivity and the foundational constituent knowledge of embodied approaches within interaction design. The concept of the really, really small marks a cognitive and creative shift from the visible to the invisible. This paper has offered the beginning of a framework from the field of *Somatics* particularly with regard to the body in everyday life. The design cases utilize various strategies borrowed from *Somatics* to design and create embodied interaction in the context of art and design.

CONCLUSION

One of the promises of the invisible computer is that by its very disappearance, we are left with ourselves in our world, and the opportunity to perceive ourselves more clearly in connection our own felt-life. Perhaps the invisible computer can make visible connections and interactions with ourselves that we were not able to perceive when the physical technology was 'in the way' obscuring our lines of sight and insight.

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PillowTalk: Can We Afford Intimacy?

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ABSTRACT

This paper describes the *move.me* interaction prototype developed in conjunction with V2_lab in Rotterdam. *move.me* proposes a scenario for social interaction and the notion of *social intimacy*. Interaction with sensory-enhanced, soft, pliable, tactile, throw-able cushions afford new approaches to pleasure, movement and play. A *somatics* approach to *touch* and *kinaesthesia* provides an underlying design framework. The technology developed for *move.me* uses the surface of the cushion as an intelligent tactile interface. Making use of a movement analysis system called Laban Effort-Shape, we have developed a model that provides a high-level interpretation of varying qualities of touch and motion trajectory. We describe the notion of *social intimacy*, and how we model it through techniques in somatics and performance practice. We describe the underlying concepts of *move.me* and its motivations. We illustrate the structural layers of interaction and related technical detail. Finally, we discuss the related body of work in the context of evaluating our approach and conclude with plans for future work.

Author Keywords

social intimacy, tactile interface, somatics, movement analysis, Laban effort-shape, tangible UIs, art/design installation, play, social interaction, user experience, ambient environment, choreography of interaction.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

A growing trend within tangible and embedded interaction is a desire to express emotional qualities through

interaction, accompanied by an interest in incorporating movement and human perceptual-motor abilities [18]. Within HCI, *intimacy* is among an emerging set of experiential values that also include curiosity, enjoyment, resonance, play and self-awareness [6]. Hummels, et al [18] describe this trend as a renewed ‘respect for the human as a whole’, and cite the shift in contextual focus of HCI from the work place to ‘quality of experience’ in our everyday lives. A direct reflection of this contextual refinement is the development of interactive technologies that mediate intimacy [14, 20, 28]. The expression of *intimacy* is vital in personal and social interaction. It is reflected in the persistent desire to create technologies that simulate touch, body contact, and ‘near-space’ interaction [20], and that communicate closeness, even at a distance [16]. Gibbs et al [14] have coined the term ‘phatic technologies’ to emphasize the qualitative importance of non-informational forms of exchange: interactive technologies that are less concerned with capturing and communicating information and more involved with establishing and maintaining social connection. Grivas [16] argues similarly that assigning aesthetic and emotional qualities to physical objects or locations is a key strategy for the achievement of intimate interactions. Intimacy is connected with physical togetherness and contingency, and that intimacy can be heightened by a ‘post-optimal’ approach to technology that values the evocative and poetic powers of electronic media over the urge for utility and efficiency. Gaver [13] reflects on intimacy and emotional communications systems by asserting that new forms of aesthetic pleasure can evoke a deeper and richer experience through increased use of unusual and sense-based materials and interactions, and less ‘explicit’ forms of information, encouraging imagination and expression of value and attitude.

We propose the notion of *social intimacy*, where the interplay between people and a set of networked objects in a social or public space can be used to create awareness between others, sensitivity and more vital connection between groups of people in a public space. As a part of the European ITEA Passepartout project (www.passepartout-project.org) we explore *intimate* ambient technologies in the context of home, and *social-intimacy* in urban social spaces, such as a lounge, café, or *speak-easy*. We have developed a set of small interactive throw pillows

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containing intelligent touch-sensing surfaces, in order to explore new ways to model the interactions and experiences of participants and artefacts within the environment, in the context of expressive non-verbal interaction. Key concepts investigated by *move.me* include intimacy, connectivity and play.

We apply ‘phatic’[14] approaches to technology, using networked cushions to explore awareness of connection and playful interaction. We use aesthetic properties of materials and their innate sensuality coupled with movement and pleasure to support *socially intimate* connectivity, including interactions of empathy, peripheral awareness, and engagement, as portrayed in Figure 1.



Figure 1. Interactive Pillow as Intimate Object – Paris ITEA demonstration Oct 2006

We propose ambient technology that requires the ability to detect and understand the user's activity, body state and identity [2]. Additionally, it has to understand the social signals displayed in user communication, as this is always part of a larger social interplay [15].

This article first describes the motivation for our choice of the pillow as an everyday intimate object. We then outline the underlying concepts of *move.me*. We illustrate an in-depth look at the structural layers that support the representation of context within *move.me* and related technical detail. Finally, this work is placed in the context of related bodies of work for evaluating our approach. We conclude with plans for future work.

THE PILLOW AS AN INTIMATE EVERYDAY OBJECT

The pillow is an example of an intimate everyday object. A pillow can express and extend a large dynamic range of qualities of affect. Our interaction can range from affection to ambivalence in a continuous cycle within our daily lives. Warhol's “Silver Floating Pillows” and Dunne's “The Pillow” [11] have contextualized the form of the pillow in both art and design. While Philips “photonic pillow” [23] is an extension of display of a ‘soft’ SMS, Dunne and Gaver describe “the Pillow” as a soft, subtle, gentle emitter of ambient data, beautiful and evocative, raising its issues and its content gently, one that has a certain *value fiction* that can contextualize information about our environment (in their case: the presence of electromagnetic radiation) through immediacy, intimacy and simple pleasure. The

pillow is familiar: it contains our memory, energetically and physically. Pillows have a rich and evocative metaphor space: they cushion us, bolster us when we are nervous, can be cherished, warm, close, and friendly. A pillow keeps secrets and shares intimate connections [25]. The term Pillow Talk and Pillow Book both reference this secret internal world of the body, the sensual or even erotic connotations that the pillow can suggest. Pillows are used as forms of urban or folk combat: the pillow fight, a physicalization of battle, physical play and expression of affect. They enable both the internalization as well as the externalization of movement, and ‘afford’ interaction that can play or slide between these varying scales. But a pillow is also a safe and humble object, it is held by a child for safety, for comfort, and to ‘bring a sense of home’ along for the ride.

Our exploration of the pillow as intimate technology embeds both digital technologies along side metaphors of intimacy to allow us to share, edit and communicate the evidence of our connection to reflect more subtle – or poetic – aspects of our identity and connection through patterns of touch, movement and being. We communicate embodied intimacy and play through a tactile interface embedded in the textiles and in the fabric of the cushions. In this way both the circuit design and the fabric and textile becomes an aesthetic component of the interactive object. [5]. This is also an extension of awareness technologies as discussed in Gaver's [13] reference to provocative awareness.

MOVE.ME – MOTIVATION AND SCENARIOS

Move.me is an ambient environment in which *embedded technologies* act as a “connective tissue” between users and devices within a contextualised space through domain-specific interaction strategies.

In *move.m* we developed a set of small interactive throw pillows, as portrayed in Figure 2. We utilize these pillows within two scenarios, a home scenario where a pillow is used by a single user in the context of digital entertainment, and in a café or lounge environment where the ambience is created by the dynamic social activity and interaction of people coming and going.



Figure 2. Pillow with actuators, touchpad, LED display and vibrator (photo courtesy of Jan Sprij).

The home scenario explores a child as the interactor with the pillow. In this scenario the media space is understood as an experience space, which the child can explore freely. Thresholds can be set for this space, with respect to levels

of excitement, as well as temporal aspects such as the reaction time for adaptations. The aim of this scenario is to explore a single user single object interaction and its possibilities to influence the overall environment.

The second *move.me* scenario is situated in a café/lounge environment, where participants are invited to re-mix a set of moving images projected in large scale on the walls within the café through physical interaction with a set of small interactive pillows. Figure 3 portrays a setting of the *move.me* environment, on the left, and an action performed with a pillow, on the right.



Figure 3: The *move.me* scenario setting.

The type of purpose-free social play in this scenario forms a kind of choreographic experiment in which the result of interaction with the pillow creates movement on at least three levels: 1) the movement of the participant as they interact with the pillows (touching, caressing, throwing, hitting, holding); 2) the movement of the pillows themselves as a result of the participants interaction; and 3) the movement of re-mixed images derived and rematerialized in direct response to the public intervention. The focus of this work lies on the representation of movement in an environment that is aware of users and objects but not necessarily knows much about them. This work integrates somatics [17] and gesture interaction [21] with textiles and interactive object design [25]. A detailed description of this environment can be found here [3].

SENSORS, ADAPTATION AND FEEDBACK IN *MOVE.ME*

The main idea behind *move.me* is to establish an environment, which constantly collects raw data from various modality-sensitive objects that is then communicated to a context engine. The context engine interprets the derived parameters to manipulate in turn the presentation of audio-visual material displayed in the environment as well as the overall ambience of the environment itself, e.g. by manipulating light and sound sources.

As a result we developed an interaction model that involves three parts:

- The user.
- The interface, which in our case is a conceptual unit containing the interactive pillow as input sensor and other devices, such as vibrator, fan, light-emissive fibre, light-emissive diode, earphones, screen, sound system, lamp, et cetera, as output sources.

- The context engine as a back end server.

With respect to its interaction part the model extends Don Norman's traditional execution-evaluation model [22] beyond the user's view of the interaction by including not only the interface but all the elements necessary to judge the general usability of the interactive system as a whole. This allows placing the *move.me* environment in different social contexts with an overlap on a particular task.

With respect to the contextual aspects of our interaction model we adopt strategies from case-based reasoning (CBR) [1], in particular those strategies which argue that tracing the history of actions [9] provides the means to improve a systems capability to adaptively interact with a user. We establish a set of raw data, on which we then elaborate based on user and environmental data (both together form our context) to perform contextualized adaptation. The adaptation as well as the context it was performed in are then stored and will be used in the ongoing process of ambient user adaptation for further refinement.

In the remaining part of this section we will outline the various modules of the *move.me* environment, namely:

- *Sensors*, which are the input sensors of the pillow.
- *Sensor evaluation module*, which instantiates the device drivers for every detected pillow. Its main task is to perform some statistical analysis (high-pass filtering and mean value calculations) in order to keep the overhead of processing low.
- *Context module* that consists of data structures describing the current context with respect to users, devices and the interactions between them.
- *Adaptation engine*, which uses data from the Context module to establish a mapping between detected actions and the appropriate environmental adaptation. It also conveys instructions about the source to be adapted and the means of adaptation to the Communicator.

We are aware that a number of the described action efforts as well as resulting adaptations could also and probably should be detected by other devices than the pillow. However, for the sake of clarity we explain the mechanisms through the pillow.

Pillow sensors and their evaluation

The objectives of the technical research in *move.me* are twofold. First, we want to explore smart fabric textiles in the context of flexible electronics and displays in order to build these into a wireless network, capable of making body data available. Second, we wish to develop heuristics of interaction based on touch, gesture, and movement to infer action efforts from users while utilising the device and to manipulate this raw data to enable a higher-level mapping of action efforts and presentation manipulation techniques.

Using raw data from smart fabric textiles allow qualitative recognition for two categories of movement: 1) touch on

the surface of the pillow, and 2) movement in three-dimensional space created by the ‘free-throwing’ of the pillow. We call our touch selection input “threads of recognition” because it refers to metaphors of input recognition in the context of smart textiles research [24].

Pressure is the essential type of data we process to extract a caress and its effort. We have identified a set of parameters that can be extracted or calculated from the information that the response area provides over time. These parameters are described in Table 1. At the moment we utilise the values for pressure, size, speed and direction as input parameters.

A pillow in *move.me* is the main medium for smart fabric textiles, and can be equipped with any of the sensors and actuators as displayed in Figure 4.

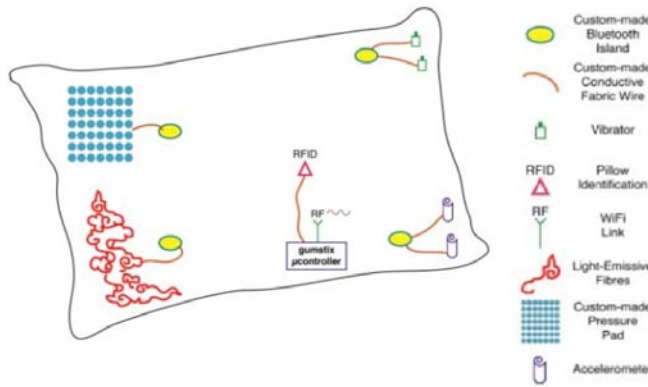


Figure 4: Pillow technology

The main sensors we apply are a touch-based interface for measuring pressure and accelerometers to measure motion. Fans, vibrators and light sources, either in the form of light emissive fibers or as a LED display, provide localized feedback.

The touch-pad itself is a simple grid (64 sensitive regions) of carbon-impregnated open cell polyethylene foam. This material has the characteristic that the electrical resistance of the foam drops as the density of the foam increases. We utilize this behaviour to identify a point of contact or applied pressure.

The processing unit is a small, lightweight, single-board computer, which connects to the accelerometers, and a sensor board card, which can measure up to 64 pressure sensors. The computer filters the incoming data and communicates at a rate of approximately 20 Hz to the server application, where the interpretation of the data is performed. When switched on, the pillow propagates its IP-address and port number on the network, which allows listening programs to detect and register the pillow and start receiving or sending messages.

For identifying users in the closer surroundings of the pillow each pillow contains an RFID reader/writer, allowing us to write our codes into programmable RFID-Tags, which are embedded within each pillow or worn by users of the environment as bracelets.

Parameter:		Description
pressure	soft, hard	The intensity of the touch.
time	short, long	The length of time a gesture takes.
size	small, medium, big	The size of the part of the interaction object that touches the pad.
number	one, many	The distinction between one finger or object and many fingers.
speed	none, slow, fast	The speed of a touch-effort. This is the overall velocity of movement. This parameter is not used directly to distinguish efforts, but is used to determine space.
direction	none, left, right, up, down, and four diagonals	The direction of movement. This parameter is not directly used to distinguish efforts, but is used to determine space and path.
Secondary:		
space (speed)	stationary, travelling	A function of speed. If speed is zero then the gesture is stationary, otherwise it's traveling.
path (direction)	straight, wandering	If the speed is not zero, and there is only one direction registered, the gesture is straight.
disposition (pressure)	constant, varying	If the pressure maintains a single value after an initial acceleration the gesture is constant, otherwise it's varying.
pattern (gesture)	continuous, repetitive	If a gesture is unique in relation to the gesture immediately before and after, it is continuous. Any repeated action or gesture is classified as repetitive.

Table 1: Parameters derived from pressure pad data

Emphasizing the sensual aesthetic of a pillow, covers are designed to encourage connection through feel in an associative and intuitive way. Pillow prototypes are portrayed in Figure 5.



Figure 5: Prototype pillows

Pillowcases are made of silk organza [24], a conductive fabric. In *move.me*, we use this material as cables that send data signals from the touchpad to the embedded processing unit. In that way we achieve that users, such as children, not only interact naturally with the pillow but also wish to do so, as the surfaces of textiles or light-immersive material asks for touch. Moreover, all the required hardware is lightweight and wrapped in soft material to avoid edgy sharpness that could destruct the intimate character of the pillow.

The pillow serves mainly as an affectionate transmitter that provides a basic analysis of the signals, e.g. calculating time and space variables, which are then sent out to the central system along with additional information, such as which other pillows or users are near to this pillow.

Once the data for pressure, size, speed and direction is received by the central system, the sensor evaluation module performs a first abstraction on the data. The way that incoming sensor data is analyzed depends on the context and the configuration of a pillow. For example, if the pillow contains a pad that allows measuring pressure as well as galvanic skin response (GSR) and an accelerometer

for computing movement, a different abstraction scheme is provided as output compared to a pillow that only contains a pressure pad. This means that the system handles every pillow individually, as it also does for users. Only at a later stage are the individual views combined to the global context view.

When analysing streams of data, in this case the input data for every taxel of the pad, it is desirable to keep a history of past events especially when we are looking for trends in the data [12]. However, storing the whole dataset and re-iterating over the last n samples whenever a new sample arrives quickly becomes inefficient as n grows. We, therefore, apply a method that keeps a history of past events without actually storing them but summarizing instead the entire set of (or the last n) past events in a few critical parameters.

For the detection of the pillow movement we analyse the data coming from a pillow's accelerometer. The basis of the recognition is a distinction between linear movements in three directions, clockwise and counter-clockwise circular movements, as well as rectangles and triangles described in space. The collected raw data is interpreted as vectors, and the input vector (the "raw" acceleration vector) is filtered and further processed to subtract the influence of gravity, and to yield "Position" and "Orientation" vectors. The "Motion" vector (i.e. total acceleration - gravity = acceleration caused by movement) is passed on to the neural network for the analysis of pillow motion (twirl, pan, tilt). The interpretation of the sensor data depends on the context in which it was collected.

Context in *move.me*

Context in *move.me* describes an area, namely a living room (home entertainment context) and the lounge (café context), in which users interact with the pillows.

The **Context Module** describes the current (present) status of the environment with respect to resident users, devices and the interactions between them. Users as well as devices become part of the Context Model once their RFID is detected. For each detected user or object a memory structure is established that reflects only those characteristics that are relevant for the current context. User characteristics are, for example, the user identifier, relevant thresholds, the current biometric status as well as related presentation devices. Device characteristics are, e.g. the device's sensor set, its affector setup, the device IP, activity state and location as well as preferences for particular users.

That we provide devices with a memory structure that is similar to that of human users is so that they themselves become proactive towards users. At the moment we only store very simple data, such as user id, action performed and its duration, but later on we wish to explore further in that direction.

The memory structures are rather static schema with which it would be difficult to observe the dynamics of the

environment. We introduced, therefore, the concept of a session, which monitors the interactions between a user and device or between devices. A session is a structure containing the ids of the two agents involved, the general start time of the session, the end time, the actions performed and resulting status reports (e.g. sensor values).

A session is instantiated by the Context Module once a device detects the user id and its sensors show some level of interaction. Sessions between devices are instantiated if a device in another session acts as a meta-device. Example: a child might hug a pillow (session A: child1 – pillow23) while it watches TV but actually operates through the pressure it performs on it the presentation of the program (session B: pillow23 – loudspeaker). Sessions are closed, depending on the device, either once the interaction stops or if the user leaves the context. In cases where more than one user is detected by a device the one using the device the longest is considered the prime user. If the prime user leaves the context then the next longest user in the list takes over. Once a session is terminated it will be stored in the History Model.

The **History Model** is our approach towards an individualized long-term memory of the interaction patterns for every user and device in a context. It is updated if a user or device exits the context or if a session has been terminated. The model contains, at the moment, two memory sets, namely **identification** and **session**. The identification set is always instantiated once a user enters a context. This set serves as a crosscheck source for the Adaptation engine to evaluate user behaviour (it might turn out that the user attends certain contexts, thus shows interest, but does not act in them – no sessions with this user id in the same time span). The session set describes every interaction the user or device was involved in. The data set stores the collected biometric data and the adaptation list contains the adaptations performed by the Adaptation engine based on the data in the same time frame. At the moment we keep track of sessions, and thus make them accessible to the Adaptation engine, in the form of a relational database. The outlined representation structures serve as sources for the Adaptation engine to determine if an adaptation is required and which type of adaptation needs to be performed.

Adaptation and Feedback

In *move.me* the Adaptation engine uses a finite state machine (FSM), where the session structure and descriptions of the Context module are used as to represent the states. Changes of these states are triggered through the input devices' touch pad and accelerometer. The transitions are based on the constraints set for the context as well as in the user models. Actions finally describe the adaptation that is to be performed at a given moment, either in the form of the adaptation of a pillow's actuators, such as vibrator, fan, or light-emissive diodes, or the performance of presentation devices in the environment, such as a change of the noise

level. Each context can be understood as a set of possible actions and moods that then again trigger certain adaptations. Thus, the organisation of rules in *move.me* is based on context scripts.

The Adaptation engine constantly evaluates the Context module for every identified user and device and reacts on changes only if they are outside the provided constraint set.

In *move.me* adaptation focuses on three major processes, namely stimulation, relaxation and representation. *Stimulation* describes the attempt to either engage a non-active user into an interaction with the environment or to increase a low-base activity. *Relaxation* tries to reduce the amount of activity or excitement. *Representation* aims to present the state of the environment and the user in a visible and audible form.

A typical situation for stimulation in the home scenario is, for example, if the child is in the living room but either does not interact with anything, i.e. simply sits on the sofa (the child is detected by the system but no session is established); or the child might hold the pillow but does that for a long time without changing neither effort nor gesture (there is a session instantiated but the changes of values are infrequent and generally low).

If the Adaptation engine cannot identify a session it tries to engage the child. The first step is to investigate which type of devices are available that are equipped with actuators that provide means to connect with the child (e.g. all types of global actuators, such as LEDs, emissive fibers, loudspeakers, etc.). Comparing the neighbourhood relations between these objects and the user the adaptation can activate the closest non-active pillow to start an interaction with the user. However, if any of the pillows already has a preference for the child, as represented in the pillow's user model, or the child has a preference for any of the pillows, this particular pillow will be instantiated to become active. In that way our system tries to utilise already established relations between objects and users. The start of an interaction can begin with already established pattern, such as the pillow shows known visual pattern that invite the child to hug the pillow. Once the contact is established the adaptation engine will use other established relations to stimulate further interest, e.g. switching on a TV or radio program.

A different type of stimulation is the detection of potential non-interest. Assuming the adaptation engine discovers over a period of time (a constraint determined by the context) a steady decrease of one of the threshold values, it might determine that the user is bored, and it may then activate both an icon on the LED matrix in the centre of the touch-pad, as well as causing a vibrator within the pillow to generate a shiver-like action. This pattern might also be used to instantiate a change of context, for example the change from TV mode into game mode.

The order of rules for the Adaptation engine is established based on the current state and the outcome of tracking the performance of the instantiated adaptation. In the example of the change between the state of watching TV and playing a game the adaptation engine would not launch the game if the child had not responded with acceptance of that change in time. In case the child ignored the suggested game, the Adaptation engine would try another strategy, e.g. instantiate a change in the environment, like increasing the volume to attract attention.

The dynamic interpretation of user actions and its efforts as well as pillow movement results in a change of visual and auditory patterns as well as task contexts, which in turn might stimulate new associations in users, resulting in a behaviour that might require that new adaptations be performed by the system. The result is a constant feedback loop where the data from a pillow triggers the interpretation mechanism, which directly affect the audio-visual outputs of the system and vice versa.

EVALUATION

We ran a small user study on the initial prototype of the system, consisting of a qualitative elicitation study, in the form of a one-day participatory workshop with 10 users, which was designed to explore user needs and system requirements. The test users were representatives of the target user group, 3 females and 7 males between the ages of 20 and 30. Aiming to gain an insight into interaction patterns, the workshop covered:

- A hands-on free exploration session with a medium-fidelity pillow prototype (the hardware as well as adaptation software for different modalities worked in real time). The free exploration sessions were conducted first from an individual starting point, and latter on a group basis.
- A "Wizard of Oz" simulation of the complete intended functionality of the system.

The participants' experiences with the pillow through the free exploration of the *move.me* system, and the discussion during the 'Wizard of Oz' sessions were both video taped for later analysis. A detailed evaluation of the workshop is described here [3]. The major findings of the workshop were:

- The current architecture is stable.
- Even though the adaptation of iconic messages on the LED display responded too slowly, causing in some users the impression that the icons were randomly generated, the initial exploration interaction pattern lead to the users' full engagement with the system.
- The way the gestures were performed by the users implied that they do not make a distinction between gestures based on the size of the area on the touch pad occupied by the gesture. For example a tap and a slap meant the same to them. A more important mean of distinction was, however, the number of repetition of

movements or the strength (or intensity) in which they were performed.

We are not only aware of the fact that the pillow is still a limited prototype (even if the current system is stable), but also that the test sample is rather small. That is the reason why, at the moment, we were only able to perform a qualitative evaluation of the system. This means that the findings should be taken as general guidelines, which will allow us to make educated decisions from a user centric point of view for further developments.

A presentation of the pillow functionality at the ITEA symposium in October 2006 showed that the adaptation based on stimulation, relaxation and representation is sufficiently sound to let users understand how the environment reacts to their actions. However, the performed user sessions are again too short to provide significant statistical data about the effectiveness of our suggested context representation. Regarding possible quantitative tests, we are aiming for a later workshop as the basis for fine-tuning the system before the public presentation of the installation in spring 2007 at the Dutch Electronic Arts Festival.

RELATED WORK

In our work we apply sensing and biofeedback technologies to establish a new way of interpreting human movements in real-time to enable expressive non-verbal interaction in the context of ambient, public, urban, social spaces. This section includes a summary of background and informing works.

There has been a great deal of general research in sensing and biofeedback in human-computer interaction [2, 8, 19, 20]. Although we use these technologies in different environments, this research has indicated that a number of well established sensory methods, such as pressure and GSR, obtain a window into the state of an individual.

Buxton et al [7] provides early descriptions of the unique characteristics of touch tablets relative to other input devices such as mice and trackballs. Chen et al [10] describe the use of a touch-sensitive tablet to control a dynamic particle simulation using finger strokes and whole-hand gestures, where the gestures are interpreted as a form of command language for direct manipulation. The fabrics used in our work differ, though, as they can be multiple-touch. In our work we go beyond direct manipulation by language to including the quality effort into the recognized gestures.

The Laban notation [21], which we use in the public, urban, and social space scenario of *move.me*, has often been used to interpret user movements, especially in interactive artistic settings. Badler [4] presents a digital representation of the specific Laban notation. Zhao [30] has applied Laban Movement Analysis (LMA) to studies of communication gestures. Within *move.me* we interpret gestures, or rather users' effort, for establishing communication rather than precise communication acts. Schiphorst et al [26] describe the use of kinematic models to represent movements.

Calvert et al [8] further describe the development of the composition tool into the product Life Forms, which uses Laban notation as the representation language. A computer-based graphical tool for working with the similar Benesh Movement Notation is described by Singh [27]. The current work was influenced by the choreographic approach to motion description and presentation of these studies.

Haptics and touch have been explored by many researchers. The University of Tsukuba has also developed a great number system that makes use of haptics such as finger/hand manipulation and locomotion [19]. Although these systems use different technologies, they have provided us with a motivation for the usage of touch.

With socio-ec(h)o [29] we share the notion of play. Just like *move.me*, socio-ec(h)o explores the design and implementation of a system for sensing and display. However, socio-ec(h)o bases its interaction models on existing serious game structures, where body movements and positions must be discovered by players in order to complete a level and in turn represent a learned game skill. In *move.me* the emphasis is more on the entertaining, purpose-free aspect of play than on the learning of skills.

CONCLUSION AND FUTURE WORK

We have described *move.me*, an ambient environment in which a set of small interactive throw pillows containing intelligent touch-sensing surfaces allow the exploration of new ways to model the environment, participants, artefacts, and their interactions, in the context of *social intimacy* through expressive non-verbal interaction.

The novel aspect of *move.me* is the approach to map efforts of actions to higher-level adaptation activities, which opens the mapping space between biometric data and its potential meaning. Though the first prototype shows promising results, we have to provide significant improvements with respect to adaptation response time as well as the range of adaptations to facilitate an experience-rich environment that reflects the broader motions of social interchange. We also have to fine-tune the relations between context, action and presentation modalities and the relationships between intimacy within the context of a one-to-one connection and within a group.

We consider *move.me* as a platform for the study of new forms of ambient-based interaction that integrate networked connectivity, in the context of *social intimacy*, and intend to explore this avenue further.

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Personalized Ambient Media Experience: *move.me* Case Study

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ABSTRACT

The *move.me* prototype illustrates a scenario for social interaction in which users can manipulate audio-visual sources presented on various screens through an interaction with a sensor-enhanced pillow. The technology developed for *move.me* uses the surface of a pillow as a tactile interface. We describe the underlying concepts of *move.me* and its motivations. We present a case study of the environment as the context of evaluating aspects of our approach and conclude with plans for future work.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces.

General terms: Ambient environment, ambient multimedia, interaction, social experience, user context, tactile interface.

Keywords: Guides, instructions, formatting

INTRODUCTION

The *move.me* project, a part of the European ITEA Passepartout project, explores the usage of ambient technologies in interactive digital television for home environments, as well as for public, urban, and social spaces, such as lounges at cafes, bars or cinemas. Key concepts explored by *move.me* include mobility, connectivity, invisibility, and intimacy. By applying context-aware technologies, we have developed a set of small interactive throw pillows containing intelligent touch-sensing surfaces, in order to explore new ways to model the environment, participants, artefacts, and their interactions, in the context of expressive non-verbal interaction within purpose-free social play.

In this paper we briefly describe the underlying technology of the pillows with a focus on the data collection for the context and user models. This paper reports on an evaluation workshop held in May 2006, where users tested the first pil-

low prototype with respect to its usability, and we investigated the feasibility of our research approach.

PILLOW – MOTIVATION AND TECHNOLOGY

The overall scenario for *move.me* is situated in a café/lounge environment. Participants are invited to re-mix a set of moving images projected in large scale on the walls within the café through the physical interaction with small interactive throw pillows.

In the *move.me* project we investigate the representation of movement, where the interaction with the pillow creates movement on at least three levels: 1) the movement of the participant as they interact with the pillows (touching, caressing, throwing, hitting, holding); 2) the movement of the pillows themselves as a result of the participants interaction; and 3) the movement of re-mixed images derived and rematerialized as direct response from the public intervention in an environment aware of users and objects.

We root our work in general research on sensing and bio-feedback in human-computer interaction [1, 5], which has indicated that a number of well established sensory methods, such as pressure and GSR, obtain a window into the state of an individual.

The affectionate quality of a pillow as a metaphor for intimacy is also used in other works, such as the interactive pillows by Ernevi [3, 2]. Both projects investigate interactive pillows as a means of enhancing long-distance communications. Though we share the notion of a sensual aesthetic of a pillow that encourages connection through feel in an associative and intuitive way, we do support a different vocabulary of expressiveness, based on motion.

Within *move.me*, we interpret users' touch effort, for establishing communication rather than precise communication acts. The work was based upon a somatic/choreographic approach to movement analysis and interpretation, described by Schiphorst et al [6]. It describes the use of qualitative kinesthetic models to represent movements.

Technology - hardware

In our approach we utilize raw data from smart fabric textiles, and apply a set of touch recognition heuristics to allow for a qualitative interpretation of the signal.

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We provide several variations of pillows, each distinguished by the set of sensors and actuators they offer. The main sensor we apply is a touch-based interface for measuring pressure. The touch-pad itself is a simple grid (64 sensitive regions) of carbon impregnated open cell polyethylene foam, which we utilize to identify a point of contact or applied pressure. The processing unit is a small, lightweight, gumstix computer and a sensor board card. The sensor board can measure up to 64 pressure sensors and has 4 software calibratable GSR inputs. The gumstix filters the incoming data and communicates it at a rate of ~20 Hz to the server application, where complex interpretation of the data is performed. The communication between a pillow and the server is utilizing the OpenSound Control (OSC) protocol. Fans, vibrators and light sources, either in form of light emissive fibers or as a LED display, provide localized feedback. A typical pillow is shown in Figure 1.



Figure 1: Pillow with actuators touchpad, LED display and vibrator (photos by courtesy of Jan Sprij)

Technology - software

The pillow itself only provides a basic analysis of signals, e.g. calculating pressure, size of touch area, speed of touch and direction as input parameters, which are then transmitted to the *move.me* central system along with information, such as which other pillows or users are near to this pillow. The central system contains a number of modules:

- Communicator module enables the flexible connection of all components. It also contains interfaces to convert data generated by the application to several communication protocols and vice versa. The communicator, for example, handles the control of underlying video mixing software.
- Sensor evaluation module instantiates the device drivers for every detected pillow. The main task is to perform some statistical analysis (some high-pass filtering and mean value calculations) in order to keep the overhead of processing load low.
- Representation Module consists of data structures that describe the current context with respect to users, devices and the interactions between them.
- Adaptation engine uses data from the Representation module to establish a mapping between detected caress and movement effort. It determines appropriate adaptation method and provides instructions for the source to be adapted and means of adaptation to Communicator.

The data structure used by these modules consists of context model, user model, and device model.

Context Model describes the current status of the environment with respect to users, devices and the interactions among them. Users as well as devices become part of the Context Model once their RFID is detected. Interactions between a user and device or between devices are monitored in sessions. The context model also contains a user, device model and history model.

Context User Model (CUM) and *Context Device Model* (CDM) are permanent stores correspondingly for user and device characteristics. Both CUM and CDM are created for each user and device when registered in a particular context and reflects only those characteristics that are relevant for the current context. User characteristics are, e.g. the user identifier, relevant thresholds, current biometric status. Device characteristics are, e.g. device's sensor set, affecter setup, IP, dynamic values like activity state and location).

History Model is an individualized long-term memory of the interaction patterns for every user and device in a context. It stores the contextualized events for each agent. Note, that we also provide devices with a memory so that they themselves become proactive towards users.

The central system is developed in Python (ver. 2.4) and runs on Ubuntu Linux and on Apple OSX 10.4 in combination with Fink. Neural networks handling are developed under Max/Mitter. Communicator is implemented as a Java application. A more detailed description of the technology is provided in [4].

EXPERIMENTAL SETING

To establish a safe ground for the development of the pillow and the interaction with it, we ran a user study on the initial prototype as a first step in our user-centered design.

A qualitative elicitation study took the form of a one-day participatory workshop with 10 users. It aimed at exploring user needs (experiences, aesthetics of objects, etc.) and system requirements (e.g. stability, network connectivity, etc.). We utilized a pillow with a 6x6 touchpad and a LED display. The underlying system could recognize touch based on size and speed; apply a set of 6 adaptation methods.

The test users were representatives of the target user group, namely young urban people in the age group between 20 and 30. Our test group was composed by 3 females and 7 males, all art students from the Piet Zwart Institute in Rotterdam. They participated in two separate sessions conducted in a lounge environment that we created in one of the cubicle houses in which the institute is situated.

To gain an insight on interaction patterns, we covered:

- A *hands-on free exploration session* with a medium-fidelity pillow prototype (the hardware as well as adaptation software for different modalities worked in real time). The free exploration sessions permitted each participant to interact with the pillow for around 15 minutes in whatever way they wished.
- A *first individual session* of roughly 15 minutes to fill in usability questionnaires. The questions applied compara-

tive scales for evaluating the understandability of the icons used as visual feedback on the pillow and how intuitive and natural the gesture/actions pairs were. Moreover, we also applied semantic differential scales to explore the users' connotative meaning about the pillow/movement space based on [8]. A detailed description of the results is provided in [7].

- A *second individual session* of roughly 15 minutes in form of an interview. The intention of this interview was to gain insight in the users' experience with an attitude towards the pillow as further fundament towards a complete system. Additionally we aimed at investigating requirements and aspects to focus on during further development and the future evaluation steps. The rest of the paper reports on results gathered in this part of the study.
- Finally we ran with all the users at the same time a "*Wizard of Oz*" 1.5 hours simulation of the complete intended functionality of the system (the VJing was performed by a professional as the mixing ability of the system was at the time of the experiment too rudimentary). The participants' experiences with the pillow through the free exploration of the *move.me* system, and the discussion during the 'Wizard of Oz' sessions were both video taped for later analysis.

DISCUSSION – SECOND INDIVIDUAL INTERVIEW

After half an hour of exploration of the pillow and a quarter of an hour session, in which participants individually evaluated particular communication aspects of the pillow, a second individual interview session was launched, where the participants were asked to evaluate the general concept of *move.me*. A verbal question and answer interview style was employed. The topics and related questions were predefined. The participants had roughly four minutes for each topic to describe their ideas about achievements, failures and potential additional wishes regarding the pillow in particular and the overall system in general. The topics covered in the interview were: purpose and functionality, interaction, networking/sensors, and actuator settings.

Purpose and functionality

One of the major findings of the workshop is that our initial approach towards invisibility and intimacy by providing the right aesthetics worked: all participants used the pillow as an object to rest, to support body parts, or to express affection through different caresses. All participants agreed that a pillow is a suitable way of collecting body data in a non-intrusive way. Functionality related to the typical use of the pillow was well accepted. However, a variety of additional functionalities resulted in distractions for the majority of participants (7). They would only accept additional functionality, such as the LED screen, which not only provided personalized information but could also be used as a remote control, an option liked by (8), with clear indications in different modalities according to the current usage context.

Expanding on these issues all participants emphasized that an environment as suggested by *move.me* should support practical tasks in the house and combine already automated de-

vices in or around the house (e.g. central heating, sunscreen, light-sources, audio-visual equipment).

Interaction. All 10 participants found the pillow a very pleasant and intuitive object to interact with. However, they would normally not look at a pillow while using it. Thus, the LED screen for additional information caused concerns as it forced the users to change their natural behavior ('I cannot lie on the pillow if I have to look at it to receive messages'). 3 participants perceived the active use of the pillow as unnatural vs only holding it or lying on it. Suggestions were made to integrate the feedback from the pillow into presentations of actuators that serve in the context of activities currently performed. For example, information about the user's current excitement level can be overlaid on the visual material the user is consuming. Another option is to use a vibrator to provide information, which allows the user to lie on the pillow and still receive feedback.

While exploring the pillow two main problems were indicated. First, the pillow appeared rather hard (gumstix box) and containing sharp pins (circuit board connector). Second, the feedback given by the LED's was difficult to understand if at all. The adaptation of iconic messages on the LED display responded too slowly, causing in some users the impression that the icons were randomly generated.

Networking/sensors. All participants experimented with only one pillow. This provoked desire in the majority to have other active pillows so that they can communicate with other people via them. Four users considered implicit and explicit communication (e.g. the exact relation between pillows, pillows in different locations). In that context most (8) participants indicated a desire to experiment more with our various memory models, an aspect not evaluated during this workshop. The necessity for such models was clear if an adjustable level of detail in the result presentation is present. With respect to the sensor capability of the touchpad – three users suggested that the pillow should be able to monitor brain-wave activity. In this way the pillow could assist, for example, in improving optimal sleep.

Actuator settings. For six participants the LED's on the pillow were too bright, which they found very distracting and uncomfortable. They suggested the brightness of the LED's to be adjustable (where they were equally happy with automatic, semi-automatic or manual adjustment).

Derived Social Indicators

During the interview the participants also provided feedback on social issues, e.g. trust, comfort, (dis)like, believe, willingness to invest time. The two most important social categories for all the participants were trust and comfort.

Trust was considered as a function of all the technical aspects that are mentioned above. Being confronted with novel technology, it is only natural for people to be suspicious and it takes time to establish a relation of trust. Another aspect of trust is the ability to receive feedback. If the system makes certain decisions the user must be able to understand the basis and purpose of this adaptation. Related to the aspect of

feedback is the aspect of control. Depending on the level of control (e.g. adjusting actuator settings to users liking) the level of trust can decrease or increase. No control from the user was unanimously rejected as an option. The level of control by the system was not clearly identifiable by the users, as that would require long time testing. Yet, a certain level of control was accepted.

Comfort. All users expected a high level of comfort while working with the pillow. Problems, such as poking out pins or hard objects in a pillow, are serious as they decrease the level of comfort. Wide ranges of sensors are at our disposal, some of which users are already more or less familiar with. Six participants felt highly uncomfortable when biosensor data, like GSR, body temperature or heartbeat, was monitored while others (5) felt less comfortable when monitored by camera's or motion detectors. Ideally, users should be able to choose the sensors of their liking to be used by the system. That is why we provide a set of different pillows (e.g. users that do not like monitoring of biometric data can choose pillows with gesture recognition only).

A lack of trust and comfort leads to *dislike* and *disbelieve* in the system resulting in a non-willingness to invest time with it. In particular *belief* is important for the bond between the user and the pillow and to achieve the balance between effort made and the reward gained.

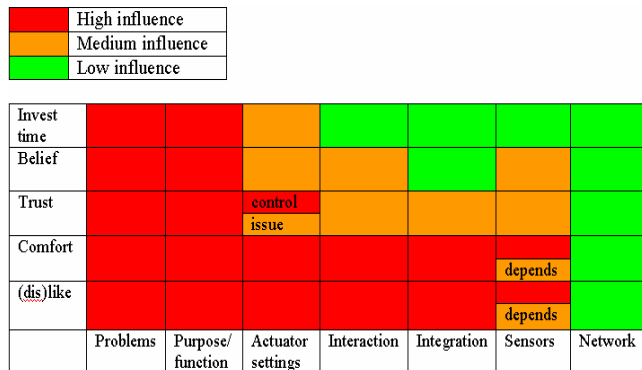


Figure 2: Hardware aspects - social indicators relation

Figure 2 describes the relationship between hardware aspects and social indicators we presented. It indicates the most important hardware aspects and social indicators as success factors. Further development of the pillow is focused on the 'high influence' aspects. We are aware that the pillow is still a limited prototype (even if the current system is stable) and also that the test sample is rather small. Our user-centered approach allows us to perform further studies in order to analyze and evaluate multiple aspects of the ambient environment and the system.

The findings from this experiment draw guidelines for further design and evaluation based on the relations in Figure 2

in to fine-tune the system before the public presentation during DEAF 2007.

CONCLUSIONS

In this paper we have described *move.me*, an experiment on personalized ambient media in the context of purpose-free social play. We described the current implementation and presented a first qualitative elicitation study applied on it.

The novel aspect of *move.me* is the approach to map movements to higher-level adaptation activities, which opens the mapping space between biometric data and its potential meaning. Though the first prototype shows promising results we have to provide significant improvements with respect to adaptation response time as well as the range of adaptations to facilitate an experience-rich environment that reflects the motions of the social interchange. We also have to fine-tune the relations between context, action and presentation modalities.

ACKNOWLEDGMENTS

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Affectionate Computing: Can We Fall in Love with a Machine?

I wanna hold your hand

It was dark. She could hear her heart beating softly against the pillow. I must still be alive, she thought.

Human beings need to connect: to themselves, each other, and their objects of affection in the world in which they live. We know that without touch, an infant will die, and without affection the human body's necessary neurophysiological development is deeply impaired. We also know that our technologies are becoming smaller and more powerful. So what does Maslow's hierarchy of needs have to do with Moore's law? Mobility, connectivity, invisibility, and intimacy aren't just keywords—they're becoming key content, and even key processes. What was the search key is becoming the sought-after object of our desire: our experience of ourselves through our technologies.

Current research in smart fabrics technologies includes the development of flexible circuits and flexible computing embedded within textiles and fabric polymers (see Figure 1). Within a handful of years the set-top box, portable computer, cell phone, game controller, and i-Pod will no longer be physical necessities. Form factor will become an imaginative choice, no longer a physical constraint.

Our technology will let us choose the shape, size, and function of our applications. Shape-shifting will no longer be science fiction; rather, it will be a feature set in wireless applications.

Can't buy me love

Her pillow was awake, too. It was soothed by the sound of her heart, but felt a little anxious, as it had been dreaming of one of its past lives.

How can we begin to conceptualize and prototype our applications of tomorrow? Our ability to design our futures requires some hand holding: bringing closer connection to the communication between art, science, and research in the technology industry. This hand holding can be uncomfortable at first, with a requisite period of sweaty palms, uncomfortable silences, and social faux pas. But hand holding can also invite affection, curiosity, and vulnerable data: which, if respected, can result in knowledge sharing and building.

This research domain extends embodied cognition, expanded perception, adaptive environments, and interactive systems. It considers these differing aspects as layers of architectures that embrace and include the body and its own data, affectionate computing, sensual interfaces, models for intention, smart materials, textiles, shape-shifting forms, and spaces that can move and transform.

I'm looking through you

Was it real, or was she imagining the familiar sound of a ring tone beneath (or was it inside) her head? She considered her pillow one of her better and most deeply trusted friends.

As our technologies become smaller and more invisible, as they embed themselves more deeply within our clothing and the objects of our affection, we're left looking through our technologies and into ourselves.

Ubiquity and wearability bring our technologies closer to the surface of our body, and sometimes even under our skin. Metaphorically we would say these technologies are drawing us clos-

Editor's Note

This article addresses new ways of computer interaction beyond the known mouse and button paradigm. The author explores haptics as a means to pay attention to the self, and using this sense to connect with others.

—Frank Nack

er to ourselves. Touchy subject? From our own bodies' skin, to the clothing that covers (and uncovers) it, to the buildings that our bodies move within and through, embedded technologies perforate¹ these protective layers and form a connective tissue within our ambient spaces.

Trends in bridging the interdisciplinary research methods evident in context-aware computing and computer-supported cooperative work (CSCW) are prototyping new ways to model the environment, its participants, their artifacts, and their interactions.

A growing number of research initiatives are exploring this domain. For example, there are ongoing projects at Simon Fraser University in the Whispers research group (<http://whisper.surrey.sfu.ca/>) and the Exhale project (<http://www.siggraph.org/s2005/main.php?f=conference&p=etech&s=etech15>), as well as the European Framework <Passepartout> project between Philips, Technische Universiteit Eindhoven (TU/e), Centrum voor Wiskunde en Informatica (CWI), and V2_lab in Holland.

I'm happy just to dance with you

Her pillow was listening to her thoughts. It could just tell she was second guessing herself again. Although this would have disappointed a lesser object of affection, her pillow just softened to it all ...

One of the domain strengths of the Whispers research group is performance practice: creative methodologies used in dance, theatre, and somatics. *Somatics* is a term coined by philosopher Thomas Hanna in 1976 and is defined as the "experience from within the lived body."

The moving body can contribute its tacit, experiential, and first-person phenomenological knowledge as both experience used within the design of user models, and experience of the environment itself.

The common ground that exists between human-computer interaction and performance practice are techniques and protocols that articulate models of experience. These first-person methodologies reveal an under-theorized area of practice. Models of interaction and the experience of the user/performer is a shared starting point. Our emphasis is on building knowledge *within* the experience of the body, an area well defined within performance and somatics. Paul Dourish² invites methodological modeling as a critical next step.

Listen, do you want to know a secret?

Not knowing why, she suddenly sighed, and



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Figure 1. Example of how sensors and conductive fabrics (soft cables) become constructive elements of garments.

began to gently weep, hugging her pillow even closer.

One of the major exploratory goals of experience modeling is the notion of paying attention to the self, and using this sense of self to connect to and exchange information or experiences with another. In our user modeling scenarios, we explore this ability to transfer this sense of self to another person or object. We use techniques for extending our bodily awareness through attention to breath and movement. We focus on our perception of our own physical data.

We can work it out

Her crazy pillow was in the mood for a fight, must have been the dream ... with playful glee, it flung itself across the room ... we'll see what tomorrow will bring ...

Using body area networks (BANs) as a platform allows flexible exploration and prototyping of wearable applications. In our case, Bluetooth islands are physically independent—we can remove them from clothing or accessories, move them to other locations on the body, or even move them to other locations in close proximity to the body (such as a pet, furniture, or accessories that are left in the home or in the car).

We have explored numerous smart fabric technologies including soft cables for flexible design

Beatles Song Titles

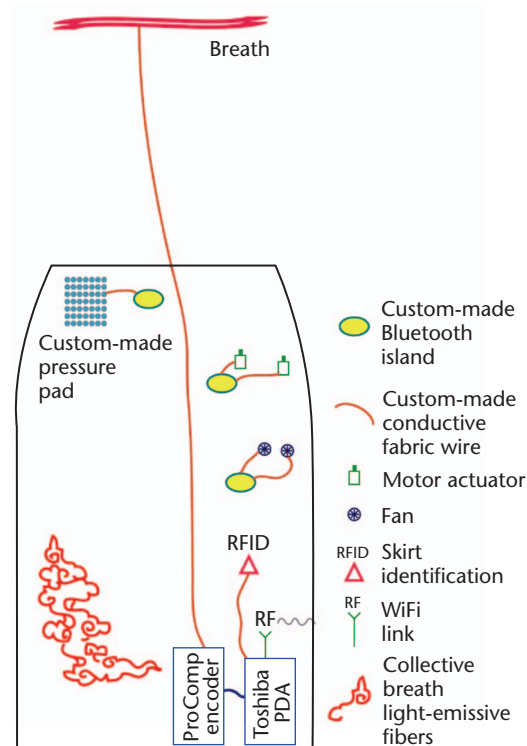
Just as psychology and physiology research modes of affection, popular culture expresses this through creating songs and lyrics. In this article, the author uses Beatles' songs as examples of phrases we use to tell stories that express affection.

Figure 2. Sensor and actuator electronics embedded within fabric enable explorations in garments as physically expressive devices.



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Figure 3. Architecture of a sensor-enabled skirt.



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and interaction (see Figures 1 and 2), and heuristics for gestural recognition that can be implemented in fabric technologies. The objective of this technical research is to identify current smart fabric textiles that are available in the context of flexible electronics and flexible displays. From

there, we can develop our own heuristics of interaction through touch³ and physiological input such as breath in order to embed this into a wireless network, capable of transferring data on the body, to other bodies in a public space.

Figure 3 illustrates one of our prototype architectures for a wearable garment network. Each garment (in this case, a set of eight skirts) in the network holds an embedded personal digital assistant and Smartphone (we're currently porting from Toshiba PDAs to Nokia Smartphones). Physiological data is transmitted via Bluetooth from Thought Technology's Procomp unit to the smart device in the skirt.

Small actuators such as cell phone motors, small fans, and tiny speakers embedded within the skirts' linings, respond in real time to the volume and rhythm of the breath. This creates a direct physical actuated response that is directly felt through the cell phone motor embedded in the waistband of the skirt. Small light-emissive fabric displays on the outside of the skirts also brighten and dim in response to the breath data. A person can transmit their body data from a tag in their skirt to another person's skirt through a touch mechanism using radio-frequency identification (RFID) tags embedded in the skirts. Participants can share physiological data through these mechanisms. The light emissive displays in the skirts are programmed to light and dim when two or more participants begin to breathe in concert with one another. Breath becomes an empathic input and response.

Oh, darling

She rolled out of bed, a little distressed, and stumbled through the dark, to retrieve her pillow on the other side of the room. "You're lucky I adore you," she muttered, as she fell into bed and drifted back into her dreams, the weight of her troubles falling effortlessly into the pillow ...

Clothing is expressive in what it reveals as well as what it hides. This acts as a mechanism for personal expression as well as a way to communicate with one another. In our ongoing exploration and design of garments embedded with wearable technologies, we explore the notion of intimacy that can be accessed and revealed through our own physiological data, the sharing of breath, and through the act of a touch or caress as interface to our own skin and the skin of our clothing.

At Simon Fraser University, we created these garments as sensuous textured skirts, with bands and sleeves made of silks and organza, natural

fibers in earthy and vibrant tones (see an up-close example in Figure 2 and the overall clothing line in Figure 4). These parts of our clothing speak to each other, so that we can speak to ourselves. "Clothing is like a language's lining [and] language and clothing are intimate technologies indeed."

With the incorporation of the exploration of adaptive user modeling, we can highlight certain aspects of our own interactions. System memory brings a reflective ability and the concept of where the environment can reflect upon its own combined behaviors. The system can represent the concept of intentional acts (constructed through navigational choices enacted through gestural interaction or biometric behaviors, such as certain breath patterns).

Another concept that we can explore is the notion of persistent memory of qualitatively meaningful events in the lives of the artifacts or devices themselves. In the context of wearable garments, our skirts, our scarves, or our accessories can develop past lives exhibiting human behaviors of both memory and forgetting—where past events or interactions affect their future behavior both positively and negatively.

A device could also develop stubbornness or a quality of languidness based on its previous experiences within the system. This supports folkloric ideas of animism in objects and artifacts around us. Sociologists have shown us that these notions of animism enable greater degrees of intimacy and meaning to be created between people and artifacts, as well as between people and one another. For example, UK designers Fiona Raby and Anthony Dunn⁴ have explored the notion of the placebo object, where objects were attributed with functions such as protection against electromagnetic fields, and where people developed close social bonds with these objects.

A specific example of this could include placing the object outside for light or fresh air, and then bringing it inside in the evenings for warmth and company. These more relational concepts about the nature of meaning that we attribute to our devices or artifacts are a rich and playful area for experience exploration in the context of interactive art.

There are many ways we can go about personifying our objects. In addition to some of the examples I've tried to show with the pillow in this article, our garments could also be affected by previous wearers or participants within the system. Artifacts such as accessories or devices (or even our pillows) could have moods, or be affected by our



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Figure 4. Various forms of sensor-enabled clothing modeled at Siggraph 2005 in Los Angeles.

moods. They could exhibit selective memory, and other remembering and forgetting strategies that model human behavior more closely than they model computer memory characteristics. These behaviors bring us back to our synonyms for expressivity: the mobile, animated, communicative, open, easier to read, meaningful, and representative mechanism that suggests a kind of animism, and other life-giving behaviors. **MM**

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Further Information

Can We Fall in Love with a Machine? is a new media art exhibition opening at the Wood Street Galleries in Pittsburgh in January 2006, curated by Murray Horne and Claudia Hart, and including interactive work by Thecla Schiphorst titled *Bodymaps*. For more information see <http://www.woodstreetgalleries.org/>.

Breath, skin and clothing: Using wearable technologies as an interface into ourselves

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Abstract

There is a common ground that exists between the first person methodologies of performance practice and the technology research of Human–Computer Interaction (HCI). Exploring this common ground, this essay describes movement research based in performance and somatics and then applied to the design of digital networked interfaces for wearable technologies. The research is based on a body of knowledge practices from performance/somatics that operate ‘from the inside out’, using the experience of the moving body to construct knowledge. Within both performance practice and HCI, there is a need to construct models of the user’s experience. One of the key questions this paper asks is: How can we bridge specific domain knowledge within performance practice to transform design strategies for our new technologies? The first section provides a theoretical context for bridging embodied practices from performance to HCI, and looks at (1) how performance methodologies can be used as a model for experience, (2) applying existing design concepts for creating gestural movement vocabularies in interaction, and (3) developing methods that bridge from experience to experience modeling. The second section provides a design context through the description of the development of the interactive wearable technology art piece entitled exhale, an installation that illustrates how first person methodologies of performance can be used to inform the design of digital interfaces/interactive clothing within an experiential environment.

Keywords

wearable technologies
digital network
interface
human–computer
interaction
embodied computing
contextual
performance
practices

Not only can we be aware of each part of our physical self, we can be aware with each part of our physical self. This leads to a very intimate, almost microscopic experience which is the self.

(Cohen 1994)

Clothing is peculiar in the sense that it conceals in its very conspicuousness and reveals what it appears to hide.

(Guedon 2002)

Theoretical context – bridging embodied practices from performance to HCI

I am interested in accounting for experience as a practice based function of accessing and constructing knowledge, as it is defined within performance practice. When I make the statement that experience accesses and constructs

knowledge, I am speaking specifically of the subset of knowledge that can be experienced by our body/mind, and that is constructed through experiential and embodied practice. I am gathering shared evidence within *human–computer interaction* (HCI), and performance (somatics) that supports this view of experience, where experience constructs a way of understanding, and of creating knowledge in practice, while framing this within the greater field of HCI as well as performance.

There is a common ground that exists between the domains of HCI and performance practice. I refer to this shared ground as first person methodologies: techniques and protocols that articulate models of experience. It is precisely the differing frames of reference between the domains that can reveal an under-theorized area of practice. The need to have models of interaction used to design the experience of the ‘user’/‘performer’ can be seen to be one such shared starting point that is framed through differing methodological strategies. How is interaction conceived, constructed and integrated within a design process? What are the underlying assumptions that differ between these domains?

Performance methodologies: A model for experience

I explore interaction as a space of lived experience and enactment, as something that is simultaneously inter-body and intra-body. Specifically, I explore human–computer interaction – defined by *human* experience in which action and meaning are inseparable – as a model for developing relational human–computer interaction systems.

Within the field of HCI, Dourish (2001) lays a strong argument for a foundation in HCI that validates the notion of an embodied interaction. The need to augment abstract reasoning and objective meaning with practical action and everyday experience is central to this approach. Dourish notes that his contribution is foundational, rather than methodological, which opens opportunities for methodological modelling and testing as a critical next step in the development of this area.

Suchman’s (1987) ethnographic research, which views all activity as situated and embodied, and her interest in purposeful, intentional activity, alongside Nardi’s (2001) work in constructing a ‘theory of practice’ within HCI based on the development of activity theory and intimacy between human and machine constructed through intense relational concentration, provide strong bridging links to our work.

Designing gestural movement vocabularies

What are the properties of a gestural movement vocabulary? In Activity Theory, Nardi (2001) illustrates the notion of a ‘function organ’ – a transforming bond with an artefact. A photograph depicts a child listening intently to the radio; the expression of intense concentration suggests the creation of a relation between body and object. In dance and theatre the gesture itself can also become a ‘function organ’, an artefact that creates or enacts a transforming bond between the participant and their own

movement. In this way, we think of the gesture *itself* as a function organ: an artefact that creates affordances for interaction.

The design of specific gestures that can become enactors is a notion common to theatre and dance practice. Richard Schechner (1985) uses the term *restoration of behaviour*, to describe gesture as 'material'. Restored behaviour is organized as sequences of events, scripted actions or scored movements. He refers to these as strips of behaviour, and states that a restored behaviour, although 'originating from a process, used in the process of rehearsal to make a new process, or performance, the strips of behaviour are not themselves process but things, items, *material*' (Schechner 1985: 35). This concept of gesture as source 'material' for designing interaction models is central to our work.

Augusto Boal states that 'bodily movement is a thought, and a thought expresses itself in corporeal form' (Boal 1992: 61). Boal's *arsenal of theatre* can be used to re-enact, or re-materialize the body state that accesses or indexes that thought or 'thought-unity'. Grotowski refers to an acting score as a script for designing *point of contact* or connection (Schechner and Hoffman 1997). In Interaction Design this is the equivalent of interaction schemas, which are navigated in order to construct the instantiation of the interactive experience. Grotowski speaks to the necessity of scripting gestural sequences in order to construct connection schema: 'What is an acting score? The acting score is the elements of contact. To take and give the reactions and impulses of contact. If you fix these, then you will have fixed all the context of your associations. Without a fixed score a work of mature art cannot exist' (Schechner and Hoffman 1997: 54, 55).

We suggest using gesture as a 'function organ', as a mechanism that can assist in defining properties for a scripted interaction score. These gestural function organs have the goal of paralleling processes to construct Grotowski's concept of mature art: works of 'mature interaction' (Schechner and Hoffman 1997: 55).

From experience to experience modelling

What do we mean by experience modelling? By bridging domains of performance practice with HCI, we are focusing on an area of enacted cognition: the *enactment* of descriptors, or schemas for movement. Previous research in the use of exploring experience/performance methods within the HCI community has occurred in the domain of user-centred and participatory design (Forlizzi and Ford 2000: 419–423). This has included: *experience prototyping* that fosters an 'empathetic' and 'embodiment' approach to user-centred and scenario-based design (Buchenau and Suri 2001: 424–433; Burns et al. 1994: 119, 120). Interval Research's exploration of *informance*: informative performance and *bodystorming*: physically situated brainstorming, *repping*: re-enacting everyday people's performances, and explorations of how low-tech solutions can create a design environment that focuses on the design question rather than the tools and techniques (Burns et al. 1994: 119, 120; Scaife et al. 1997: 343–350). Salvador and Howells (1998) shifted

the focus group methods to something they called Focus Troupe: a method of using drama to create common context for new product concept end-user evaluations. Simsarian (2003) has explored the use of role-play in extending the richness of the design process. In the *Faraway* project, Andersen, Jacobs, and Polazzi (2003) explored story telling and ‘suspension of disbelief’ within a context of game and play in a design context. In addition, exploring other subjective aspects of creative process, such as the use of creating ambiguity in design, has been described by Gaver, Beaver, and Benford (2003).

In the performance domain, dance analysis and somatics specifically construct systematic articulated movement models directly from the *experience* of the moving body. Somatics is defined as the *experience from within the lived body* and includes practices such as Feldenkrais and Alexander technique. From the somatics perspective, knowledge is constructed *through* experience (Hanna 1988; Johnson 1995) and requires that experience be directed or focused through *awareness*. Experience alone is not a pre-cursor to knowledge acquisition, since experience alone could result merely in conditioning, or in accessing conditioned responses. In somatics this would be termed ‘somatic amnesia’. However, when experience is specifically directed through the focus of attention, knowledge acquisition takes place which can be referred to as ‘Somatic learning’, an activity expanding the range of what Hanna terms ‘volitional attention’ (1979: 137–152). While Csikszentmihaly (1990) suggests that human experience operates within a limited field of attention, other movement systems within somatics consider attention to be a generative attribute of awareness that can be augmented, increased through a process of somatic learning (Hanna 1988).

Rudolf Laban’s movement analysis systems (Laban 1974; Newlove 1993), and the work of other researchers such as Bartenieff (1980) and Blom and Chaplin (1982), are examples of gestural typologies based in experiential practices of dance (Schiphorst 1997: 79–98; Schiphorst et al. 1990: 167–174), which model a range of qualities and modes of movement. These typologies can be used for gestural mapping and modelling qualitative movement characteristics such as intentionality, interest, attention and body state. They present potential experience models for the classification of aspects of movement, and define a means to approach gestural and choreographic protocols.

Participatory design, experience design, performance, theatre, dance and somatics share a common focus in modelling or representing human experience. These domains also share the ability to articulate and explore engaging experience through movement, emotional response, sensorial qualities and temporal/dynamic qualities of experience and of movement.

A design context example – *exhale*

In this second section, I use an example of an interactive installation, *exhale*, that has been designed based on principles outlined above. In *exhale*, the experience of breath, interaction through movement and touch,

and the experience of 'wearing' one's own physiological data was a design intention.

Exhale is an interactive art installation based on designing and fabricating 'a-wearable' body networks for public, social space. The term 'a-wearable' is used to refer to a synthesis of 'wearing' clothing that uses attention to afford 'awareness' of the self. In *exhale* networked group breath is used as an interface for interaction. The rhythm of breath is a mechanism for sharing our bodies' affective non-verbal data. This occurs through responses in the linings of skirts worn by the participants. Networked breath is used to create output patterns through small fans, vibrators and speakers that are embedded in the lining of these sensually evocative skirts. This response enables a hidden and 'inner' one-to-one communication between bodies in the installation, so that one body's breathing can directly affect another body's skirt. At the same time, collective group-breath is made visible on the *exterior* layers of fabric on the skirts by using a specialized fabric printing technique that enables certain fibres to 'light up' in a continuous cycle according to collective breath rhythm. Breath bands wrapped around the chest measure the ebb and flow of the breath cycle. As clothing, and as a type of costuming, the skirts of *exhale* cross our gendered modes of 'wear-ability', and are able to 'contain' both inner and outer senses of self. *Exhale* interaction enables an expression of collective group empathy through the use of breath. This artwork integrates somatics and gestural interaction with textiles and garment design, developing new communication metaphors for wearable technologies and wireless networks. *Exhale* premiered at the Emerging Technologies exhibition in Los Angeles at SIG-GRAPH (August 2005).

This description is organized into the following components: experience, artistic concept, interaction and technical description. Together, these sections address various aspects of creation, production and working method:

1. how the public will **experience** the installation as they approach, enter and interact within it;
2. what is the **artistic concept** that supports that experience, and unifies the concept of *breath* as a starting point, and the concept of *wearing ourselves* through garments, clothing or costume;
3. how the **interaction** enables *group breath* to be expressed through the garments, and how interaction utilizes modes of self-to-self, self-to-other and self-to group communication;
4. how the piece is **technically designed** and constructed in order to support the artistic concept and participant experience.

***Exhale* experience scenario**

Participants walk towards the darkened space, becoming aware of eight textured and sensual garments: skirts made of silks, and organza, natural fibres in earthy and vibrant tones, hanging from cables stretched from ceiling to floor. The visual image is a small forest of 'skirt trees': skirts suspended at

various heights in space, connected to vertical cables dropping in plumb lines to the earth. A light positioned at the base of each skirt illuminates it upward from below, highlighting and bringing light to its materiality (Figure 1).

Guides assist the participant in 'dressing': putting on the skirt and wrapping the breath sensor around the rib cage, a process that occurs behind a draped area. Once outside the dressing area, a Polaroid image of that participant is taken by the guide and placed in a small bag that is also attached to the vertical cable. These small 'purses' have see-through front pouches that enable the image of the wearer to be left in the space, as a memory of the skirt, and as a mechanism to bring the skirt back to its home, once the participant's experience is complete.

As a participant moves through the space, consciously shifting their own breathing cycle, they create three kinds of interactions: the interactions of self-to-self, self-to-other and self-to-group: wirelessly communicating and creating a shared breath state. And as the lining of each skirt 'breathes' with the participants, the small fans and vibrators respond to the breath beneath the lining unseen to others; the small speaker within the skirt marks the sounds of the breath data creating a body network that tickles and caresses and whispers from within. Collective group breath acts like moving dimmers, slowing lighting up, and then dimming fibres on the outside of the skirts, following the pattern of matched breath patterns. These fibres only light up when participants breathe in the same pattern as one another.

Initially, the guide shows the participant how to actuate the small vibrators and fans in the lining of the skirt based on their own breath: the interaction of self-to-self. Once the participant experiences and understands his or her own relationship to self-data, the guide invites them to share their data with other participants in the space. Sharing data occurs through



Figure 1: Exhale uses a 'forest of skirt trees' suspended floor to ceiling by cables.

touch sensitive conductive fabric strips sewn within the side linings of the skirts: the interaction of self-to-other. Participants can stroke or caress another skirt creating a shared data space between skirts. Multiple participants can create shared connections through touch. Once contact with another participant is made, the actuators within the skirt lining move in relation to the connected participants. Participants navigate the sharing of their own data through caress. Therefore, a participant's experience, based on the actuators sewn within the linings of the skirts, can move from their own data, to another's data, to a group of data. When any two participants breathe using the same breath pattern, the 'light fibres' sewn onto the outside of the skirts light up in the same pattern as the breath: the interaction of self-to-group. When all participants breathe in the same cycle, the breath fibres slowly ebb and flow with the group breath within the installation.

Artistic concept – breath, skin and clothing

The artistic concept of *exhale* is in its most essential form: 'to wear our breath', as a mechanism for redirecting our attention to our own body states, individually, and between bodies in a space, creating a group ecology through its breath. In *exhale* the breath is contained within the body, and also is *worn* on the body, shared through the garments and the garments response in a group-body, a group-breath. This cycle of inside and outside forms the modes of representation selected for this wearable art installation.

:: breath ::

. . . the work with breathing starts with sensing the inner atmosphere of our organism—the basic [. . .] stance we take to ourselves and the world.

(Lewis 1997: 45)

So it all ends, in wordlessness. . . Yet, something forms within the world of my tears, shaped by the world that caused it; something takes shape within this uttered breath that builds an image of breath.

(Goyen 1999: 41)

Breath reflects a state of rhythm and intention *as we wear ourselves*. This concept of breath as a starting point, as a marker for representation, and as an *input* to be mapped through navigation, selection and interaction allows us to use breath as a metaphor for synchronizing and coordinating: that is, giving and receiving data. Breath is a source of information, as well as a pattern in which to communicate that information. Our bodies' respiratory system is connected to most of the body's sensory nerves; so that any sudden or chronic stimulation coming through any of the senses can have an immediate impact on the force or speed of our breath, or can stop it altogether. Intense beauty, for example can 'take our breath away'; fear 'stops us in our tracks'; deep contentment is often accompanied by fuller, more languid and more rhythmically even and connected breathing.

We can – within limits – intentionally hold our breath, lengthen or reduce our inhalation and exhalation, breathe more deeply, and so on.

When we do so, the nerve impulses generated in the central cortex as a result of our intention bypass the respiratory center and travel down the same path used for voluntary muscle controls. Breathing is both autonomous and conscious, and can move between these two physical control systems of the body. The process of exhaling is a process of release and letting go: 70% of the body's waste products are eliminated through the lungs through the respiration cycle.

Breathing in concert with another is a physical way to synchronize with another's body state, enabling a sharing of internal state, represented through multiple physiological signals, and synchronized through attention. At times of physical duress such as death, illness, distress, and also states of intimacy, human bodies instinctually connect with another through synchronizing breath, either consciously or unconsciously. This can be seen in the work of mid-wives and labour-coaches during birthing; sports coaches during high performance physical training; in meditation techniques that calm and quiet the body; in the work of pain therapists that use attention to re-direct the body's proprioceptive state. Instinctively small children will synchronize breath to give or receive information with a parent or loved one, often in the form of feeling tone or 'feeling state' information.

Neurophysiologist António Damásio has studied the connection of 'feeling states' in the body and asserts that a given feeling state is associated with specific physiological patterns (such as breath rhythm) along with a set of processes including thought patterns and emotion (Damásio 2003: 112-33). His research suggests that these 'feeling' body-states are an inter-connected set of feeling, thought, emotion and physiological functioning: each of these being present and affecting the other. He asserts that the induction of a body-state can be brought about through attention to *any* one of the inter-connected patterns: so that attention to physiological patterning (for example breath) can induce a body state, or conversely, attention to another associated patterns, such as the occurrence of certain thought patterns can also induce the body state. This inter-connectedness between physical data, and the state of the body creates a complex but coherent set of body-data.

What does this mean in the context of this art-work? Using Damásio's notion of body-state allows us to start from a physiological pattern of the body, such as breath, as an access point to contacting and sharing state data between bodies. We synchronize breath in order to align communication non-verbally. Synchronizing breath enables a tuning of the natural and proprioceptive systems of the body, as breath is both autonomous and consciously controlled. Poetically, breath has been attributed to notions of life-force, or the presence of life in non-organic objects. In William Goyen's novel, *The House of Breath*, memories of a house from childhood are attributed with breath, and the notion of intention, thought and breathing as being one and the same:

Through the mist that lay between us it seemed that the house was built of the most fragile web of breath and I had blown it – and that with my breath I could blow it all away.

(Goyen 1999: 181)

The beauty of this poeticism is that it is also echoed in concepts occurring in fields as diverse as neuroscience (Damásio's neuro-physiological assertions of body-state and body-maps), and Yogic teachings of Pranayama and the Science of Breath, where breath, thought and intention are also seen to form a coherent union.

:: wearing ourselves ::

Another important artistic concept in *exhale* is the concept of *wearing ourselves*. In *exhale* we literally wear ourselves through our breath. The breath-band adorns the rib-cage, creating a physical holding and wrapping, a sensual and safe and felt textured cut of fabric, as it simultaneously captures our breath, our data. We reveal our breath through the properties of the cloth itself in the form

of the skirts, our breath is revealed as it shimmers in light and dims with each exhale on the fibres of the fabric. Our clothing expresses properties of adornment, revealing, concealing, sensuality, pleasure, intimacy and containment (Figure 2).

One of the artistic goals is to develop an interface for expressive non-verbal interaction in the context of a wearable or ubiquitous environment. Ubiquity and wear-ability bring our technologies closer to the surface of our body, and sometimes even under our skin. Metaphorically we would say these technologies are drawing [us] closer to ourselves. And while they draw closer, they also allow us to move. Mobile technologies recognize that people move and are moving; and mobility sustains movement, allowing people to move themselves with their environments, and within their environments.

Our colloquial language uses phrases such as 'she wears herself well', 'he wore a smile', and the almost cliché and well-rendered phrase 'I am wearing my heart on my sleeve'. These phrases point to ways in which the body has its own tendency to *reveal* inner states, intimate and personal aspects of the self, often affective, feeling states, through the concept of *wearing the self*. To wear the self is the body's way of communicating its own knowledge and being. In *exhale*, we ask the question: how can the body itself contribute its tacit, experiential and first-person phenomenological knowledge as both experience used within the design of wearable interaction, and experience of the environment itself? We explore the use of smart fabrics and interactive textiles, which integrate flexible electronics



Figure 2: Exhale breathband measures breath, while RFID tag enables breath exchange.

and flexible displays as an interface in wearable computing garments that express *ways of wearing the self*.

***Exhale* interaction**

Interaction within *exhale* is comprised of three interaction modes: (1) self-to-self, (2) self-to-other and (3) self-to-group interaction. The interaction mode determines which participant's breath data is actuating responses inside the lining of any given skirt. Participants are able to choose, to select and to switch interaction modes. Interaction modes are selected through *touching* or *caressing* specially designed fabric panels that are sewn into the skirts. These fabric panels recognize qualitative aspects of the touch gesture and direct the breath data to the actuators within the participant's own skirt, or to another participant's skirt. The third category of interaction: self-to-group is created when participants are breathing in concert with one another, and is not selected through touch.

:: input ::

Breath is used as the *input* interaction in all three modes. Breath is measured using a breath band which is wrapped around the chest area, around the clothing, and which measures the contraction and expansion of the rib cage. These images (Figure 3) illustrate some initial prototype tests with conductive fabric; however, they do not reflect the final breath band design. Prototyping fabric swatches, such as those show here, allows the testing of functionality alongside the potential experience of the texture and 'feeling' of the fabric, the result of the experience, and the technological configurations necessary to create the whole set of interactions.

:: output ::

The *output* or response to breath data depends upon the interaction mode. When the participant first puts on the skirt they are in self-to-self interaction

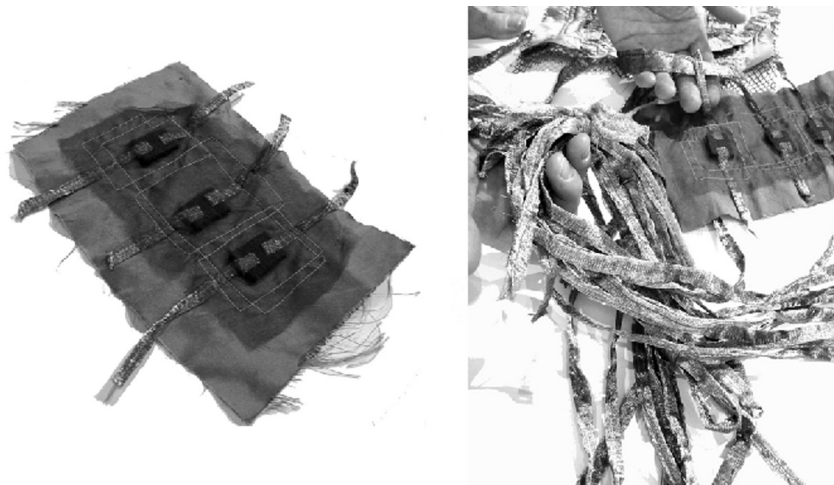


Figure 3: Prototyping conductive fabric for touch and as passive conductor.

mode. In this mode the ebb and flow of their breath data creates responses in the linings of their own skirts. Each skirt has small *vibrators, fans and speakers built into the linings*. As the participant breathes, the data patterns (speed and intensity) of the vibrators and the fans ebb and flow in response to the participant's breath rhythm.

A second kind of output is used with the self-to-group interaction mode, also called collective breath interaction. This mode is enacted when participants within the installation breathe in the same tempo pattern as one another. When this occurs, the output for group interaction is the display of collective breath on specially designed fibres on the surface of the skirt fabric. These fibres are imprinted with a



Figure 4: LED array embedded within fabric to display continuous breath data.

specially designed nano-inkjet technology, which creates a conductive and light emissive surface that can display variable light levels depending upon the ebb and flow of the breath data that is used to control the pattern of the light (Figure 4).

:: selecting modes through touch ::

The interaction modes of self-to-self and self-to-other are selected through touch on custom designed touch RFID pads embedded into the fabric of the skirts (see Figure 2). These touch pads recognize qualitative aspects of movement. A softer caress selects data from another skirt and outputs it inside the lining of the participant who is 'pulling' the breath toward them. A harder directed 'pushing' caress sends the data from the participant's skirt to the partner's lining. Participants can reselect their own breath data by caressing their own skirt. These touch pads are specially designed using heuristics described in the technical section below.

Exhale technical description

In order to implement our higher-level goal of developing expressive non-verbal interaction that brings awareness to the body's states in the context of a wearable or ubiquitous environment, we ask two questions: how can we model the environment, its participants, their artefacts and their interactions to enable the goal of expressive non-verbal interaction in the context of a wearable environment? And how can the moving body itself contribute its tacit, experiential and first-person phenomenological knowledge as both experience used within the design of the model, and

experience of the environment itself? The first question moves from the outside inward, and the second moves from the inside out; the first we answer through our technical research goals, and the second, through our artistic inquiry and creation.

The objectives of the technical research in *exhale* is to identify current smart fabric textiles that are available in the context of flexible electronics and flexible displays and to develop our own heuristics of interaction through touch and breath in order to build this into a wireless network, capable of transferring data on the body, to other bodies in a public space. We call our touch selection input 'threads of recognition' because it refers to metaphors of input recognition in the context of smart textiles research. We are working on developing a wearable platform based on a body area network that utilizes Bluetooth on the body, in combination with custom made hardware, running on a Toshiba PDA platform.

An *exhale* skirt is a custom-made garment with electronics embedded within it to form a sensor and communication system that can exchange physiological signals and responses with another *exhale* skirt.

Each skirt has a small portable computer, or PDA, that coordinates and interprets the data communication. Along with the PDA, there are several very small computers that control embedded transducers – fans and vibrating motors – and that are mounted on individual circuit boards, called 'islands'. These 'islands' interact with the PDA via a Personal Area Network, or PAN, constructed using Bluetooth technology.

Connections that cannot be made wirelessly are made using conductive fabric 'wires' which are composed of a transparent directionally conductive fabric contained in a non-conductive fabric or sewn directly into the skirt to form portions of the skirt itself. There is also a pressure-sensitive pad area, constructed of the conductive fabric wires, connected to one of the Bluetooth 'islands', to provide touch-based gesture data. The PDA has two specialized devices attached to it as well: an encoder that converts the analogue electrical signals from a breath sensor into digital format, and an RFID sensor that is used to identify nearby skirts via small disks sewn into each skirt. The breath sensor is an adjustable, stretchable band worn about the chest that generates an electrical signal on each exhalation and inhalation. This signal is conveyed to the PDA via the encoder, where it is analyzed and then transmitted to a central system, along with information on which *exhale* skirts are near to this skirt as well as any gestures reported from the pressure-sensitive pad.

The central system routes the analyzed signals to other *exhale* skirts, based on the 'neighbourhood' information that has been gathered. At the same time, the breath signals from groups of skirts are gathered together and analyzed; this collective breath is then sent back to the skirts within the group, and displayed on each skirt as a pattern of light using special light-emissive fibres controlled by the PDA. The PDAs also activate their fans and vibrating motors, using their Bluetooth 'islands', when the gesture or breath data matches their criteria.

The central system converts the data obtained from the skirts – the physiological data, the RFID data and the pressure pad data – into a visible

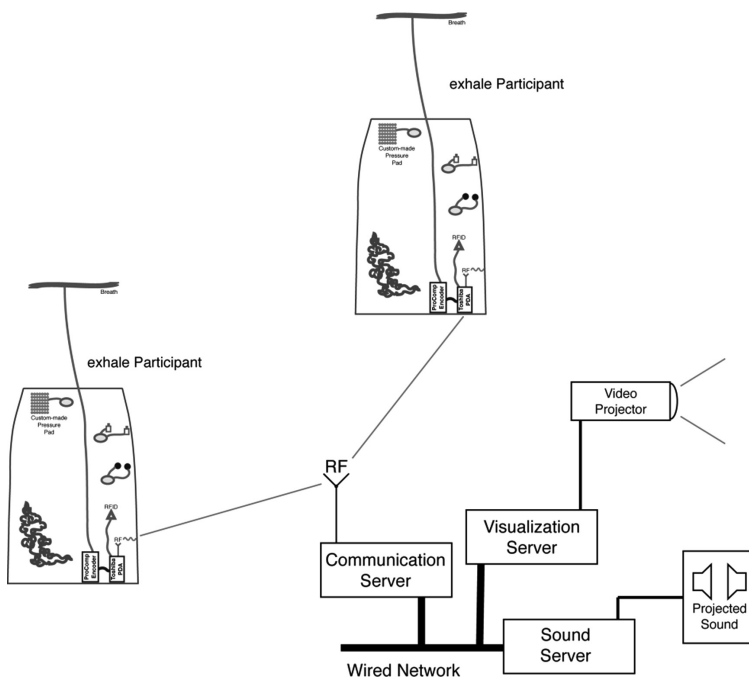


Figure 5: (a) Networked interaction in exhale. (b) Optional (made available by author): Technical implementation of body area network (BAN) in an exhale skirt.

and audible representation of the state of the installation space and its participants. A video projection system and multiple speakers are used to convey this representation to the participants within the space (Figure 5).

Conclusion

This essay illustrates how we can augment experience design with first person performance methodologies found in theatre, dance and somatics. *Exhale* is an example in designing and testing experience models based in this strategy. The differing frames of reference between the domains of HCI and performance practice reveal an under-theorized area of practice, which can be explored through experience modelling. Embodied interaction is a reflective process that is simultaneously inter-body and intra-body. In addition, this essay has provided a case-study for a model of designing embodied interaction by applying the use of gesture as a 'function organ', as a mechanism that can assist in defining properties for an interaction score that Grotowski describes as scripts, or *points of contact*. The experience with the *exhale* installation illustrates that participants can learn to shift their own threshold of attention, awareness and body-state through the interaction affordances created within movement and embedded within the garment. They participate in becoming expert users of their own physiological data, and in playfully engaging with an emerging co-operative and physically and emotionally negotiated body state and collective system state. Social

navigation is created through the perceived data flow (through the interaction with RFID tags in exchanging breath) and represented through the actual data flow (through the server). As such the installation is also its own experience workshop, and is a starting point to continue to explore methodologies of experience modelling.

As an installation, *exhale* was an initial exploration of modelling experience through a variety of gestural protocols that led to the design of an interaction language facilitated by wearable garments. This work is a starting point to mapping more complex data relationships to body state and intention. The *exhale* installation illustrates that participants can become playfully engaged in simple feedback loops of 'attending to' their breath, and sharing that data with others in the space. *Exhale* also points to next steps in research: exploring mapping and 'meaning' in data patterns across participants body state, extending types of physiological data (brain waves, GSR, temperature), types of output actuators (vibration, local sound, local motor memory), as well as building an intelligent model of interaction which includes memory, resonance and meaning in the devices themselves. This kind of work that integrates performance practices as a design strategy in wearable garments and technologies continues to model experience through deepening first person methodologies. And as the Digital Cultures Lab at Nottingham exemplified, such methodologies and communities of practice also require cross-cultural workshop spaces that can enable and iterate the practice itself through shared experience and reflection with other artists and practitioners.

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exhale: (breath between bodies)

ARTIST STATEMENT

The artistic concept of the piece exhale is in its most essential form: “to wear our breath,” as a mechanism for redirecting our attention to our own body states, individually and between bodies in a space, creating a group ecology through its breath. In exhale, the breath is contained within the body, and also is worn on the body, shared through the garments and the garments response in a group-body, a group-breath. This cycle of inside and outside forms the modes of representation selected for this wearable art installation.

exhale is a whisper[s] research group project based on designing and fabricating “a-wearable” body networks for public spaces. The rhythm of networked group breath is used as an interface for interaction and a mechanism for sharing our bodies’ affective non-verbal data. We use the networked breath of the participants within the system to actuate the responses of small fans, vibrators, and speakers that are embedded in the lining of sensually evocative skirts worn close to the body. This work integrates gestural interaction with fashion, developing new communication metaphors for wearable technologies network design.

Art and Science

This work embodies the confluence of artistic design and expression with software and hardware technology. The whisper[s] research group combines backgrounds in fabric and garment design, choreography, and complex software systems, including both hardware and software architectures. The resulting work was influenced by their practices with modeling experience studies, networked micro-controllers, and real-time systems. It applies tools from choreography, such as Laban Effort/Shape Analysis, along with linguistic and statistical analysis, to investigate the physiological data that the work utilizes. The garments employ conductive fabric, shaped equally by the needs of the electronic elements and the design aesthetics. Placement and organization of the sensors and transducers is guided by body ergonomics, bio-energy systems, and interface design. Movement analysis is used to frame gestural interaction, creating playful, intimate connections between participants.

Vision

In this work, garments are a step in a progression to systems that transparently exchange and express internal body state and intention via participant-mediated communication, mixing physiology-derived information with gestures and other non-verbal mechanisms. Concepts of device “listening” and biofeedback enable what we term subtle machine learning. The garments provide an environment in which we can augment verbal and visual modes of communication, where the quality of a gesture can replace many words, and can be exchanged with their affects as well as their effects through out-of-band pathways.

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Experience

Participants walk towards the darkened space, becoming aware of eight textured and sensual garments: skirts made of silks and organza, natural fibers in earthy and vibrant tones, hanging from cables stretched from ceiling to floor. The visual image is a small forest of “skirt trees”: skirts suspended at various heights in space, connected to vertical cables dropping in plumb lines to the earth. A light positioned at the base of each skirt illuminates it upward from below, highlighting and bringing light to its materiality. Guides assist the participant in putting on the skirt and wrapping the breath sensor around the rib cage. As participants move through the space, consciously shifting their own breathing cycles, they create the interactions of self to self, self to other, and self to group: wirelessly communicating and creating a shared breath state. And as the lining of each skirt “breathes” with the participants, the small fans and vibrators respond to the breath beneath the lining unseen to others; the small speaker within the skirt marks the sounds of the breath data, creating a body network that tickles and caresses and whispers from within.

Innovation

The core technical innovation of exhale: (breath between bodies) is integration of non-verbal models of network communication in a playful multi-modal environment, using layers of directionally conductive fabric to provide both electronic pathways within the garment systems and a sensual tactile experience for participants. Connections between participants are realized through specialized electronics and embodied through acts of physical contact, designed using gestural models for interaction.

The fabric that forms the conductive layers within the garment has electrical behavior due to its construction as a combination of very fine silver or gold wire with traditional materials such as silk. This conductive fabric is used as a replacement for conventional wiring, which is much heavier and less flexible. It is also used to form simple touch or pressure sensors, via contact between layers, and identification patches, using isolated fabric regions that include devices that have unique electronic signatures. Touch zones on the garment (or another garment) can make contact with these isolated regions, and the signature can be “read” to establish self-to-self, self-to-other, and self-to-group connections.

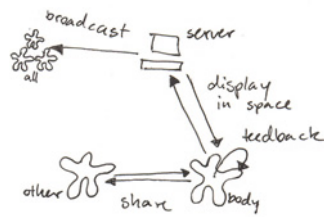
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exhale: (breath between bodies)
Art installation

(aRt&D)



soft, softer and softly:

[whispering] between the lines



soft, softer and softly: [whispering] between the lines

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CONCEPTUAL FRAMING

This paper describes some trajectories of the artistic research and development for the whisper project, an art research project that was developed in collaboration with v2 lab from 2002 to 2003. The concept of *softly* developing art research through embodiment strategies and techniques is borrowed from first person methodologies as defined within somatics. In this essay we look at the role of r+d, the research and devising process within our art research.

Our project name, whisper, is an acronym for **w**earable | **h**andheld | **i**ntimate | **s**ensory | **p**ersonal | **e**xpectant | **r**esponse | **s**ystem. The research of *whisper* is based on wearable body architectures, extrapolated as small wearable devices, embedded within garments, worn close to skin: proximity creating resonance, contact and communication, body as carrier to device, device as devising the body.

The whispers research group is a collective made of dancers, choreographers, software engineers, hardware engineers, interaction designers, fashion designers, media artists, sound designers, and computer scientists based in the Interactivity Lab at the School of Interactive Arts and Technology at Simon Fraser University. With a research team of over a dozen individuals, one size does not fit all. whispers builds art research through techniques of body. But what does this mean? Does this 'work'? As we ask these questions through our work ... softly, softer, whispering, shouting, weeping, dissolving, re-emerging our

strategies, technologies and techniques, re-constructing our selves and each other, we make and re-make our work, our aRt+d.

How? Our art research re-appropriates usefulness, user and usability, re-inventing usefulness in terms of relationship to the self. One can perhaps even refer to this as a form of hyper-subjectivity “a process of de-hypnotizing.... this depends upon avoiding external suggestion and becoming independent of anything which is not internal.” [1] A hyper-subjectivity that may produce engineering outcomes, but that shares methodological strategies with first person techniques of physical practice.

In our own art research we create and *name* outcomes that include delicate hardware, biodegradable software, softer firmware, tough love, bio-kinesiology for textiles, energy work for circuits, and ‘circuit-training’ for dancers. Within this collection of essays, the headings of embodiment, interface and technique distinguish trajectories of art research. And although the whisper research deals very much with art as interface, it does so through developing techniques of *body* interface, creating a synthesis of art research that weaves body, interface and technique as a threaded research question.

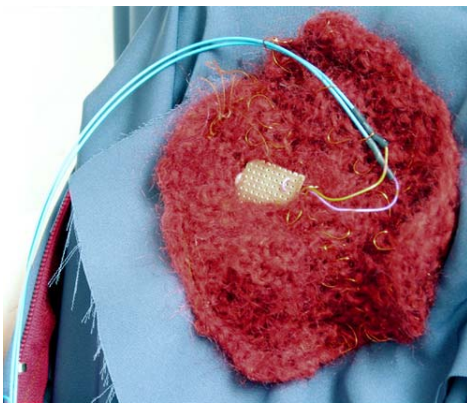
The title of this essay *soft, softer and softly: whispering between the lines*, refers to methods of embodiment that extend through the body, softening the edges between our selves, each other, our methodology, and our materials: hardware, software, textiles, objectiles, and the sensual smudging, messing and pleasure, exotic and abject that exists between the lines. *Soft, softer and softly* also refers to drawing attention, and paying attention to ourselves within our processes, observing ourselves observing, in hyper-reflexivity.

We also explicitly reference building somatic practices between the ‘lines’ of software code, as well as between the lines of our own rhetoric. We call these somatic practices *first person methodologies*. Somatics is a term applied to a physically based research discipline, named and developed during the twentieth century in Europe and America by Thomas Hanna [5]. Somatics studies the living body as perceived from within first-person perception, from within its experience of itself. And the soma as internally perceived incorporates a viewpoint that includes immediate proprioception.

First person methodologies as defined and used within performance practice and somatics share a common set of features. They exist as a set of rigorous, definable physical processes or techniques that can be *learned*, and produce *repeatable* results. They are based on the direction of *attention* in order to affect, alter or produce *body state*. It is possible to retrain perception utilizing directed attention that is produced through the application of directed movement, gesture or action, through *intention* in the body. First person methodologies *access* and *construct knowledge* through the body. They are simultaneously epistemological

and ontological, creating *knowing* through *being*.

Our research methods attempt to subvert and destabilize traditional software and hardware engineering, as well as traditional physical engineering, the bodies of technology. This destabilization loosens, and softens, releases previous boundary conditions, problematizing technical processes (body, code, method, memory). In order to design our circuits, living as they do alongside the electromagnetic energy of the body, traditional electrical engineering employs techniques that 'retro-fit' our selves. Are we retro-fitting our bodies into our technologies, or reverse engineering the self to map the 'shortening circuit'? Is there a radical re-invention of engineering that can create a longer exhale in the design life cycle?



In order to bridge this perspective within our research, we have created a curiosity cabinet of methodologies for the creation of physical, technological, kinesthetic & affective vocabularies.

METHODOLOGICAL FRAMING

Our methodological framing is something we call experience modeling. We were interested in creating gestural protocols for the interaction model used in our wearable body architectures. Since we were interested in using data 'of the body' to model or map the space of body state, we used physiological data of the body as data source.

One of our methodological approaches was to create experience *workshops* as a way to imagine communication protocols between bodies. In other words, we designed our hardware and software networks by exploring experience itself, utilizing the workshop as a model for the hardware, software and network architectures.

A series of user-experience workshops were designed with the goal of developing an interaction model for the network. These workshops modeled levels of intimacy, social navigation and play, using performance methods to create gestural protocols, or movement responses between participants.

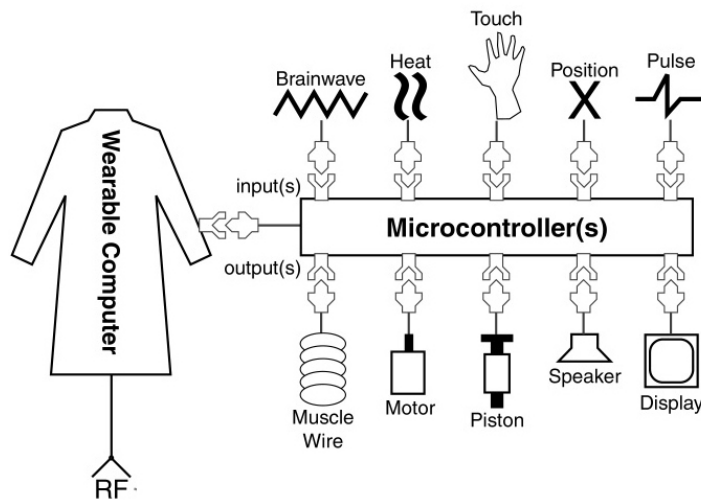
Participants generated movement vocabularies by negotiating permission and control of their own physiological data, their own 'body state'. Gesture was utilized as an expressive indicator of intentionality, extension of body image, permission, control, exchange and play.

We gathered data from the workshops through video, gestural analysis, and experimental feedback in the form of small hand-drawn cards which participants could draw or 'journal' on. These feedback mechanisms let us imagine how we could create an interaction model, wearable garment design, and body-to-body network protocol that would eventually be used in the public art installation, and also how performance methodologies could contribute to the research and devising of interaction.

TECHNOLOGICAL FRAMING

Keywords

gestural protocols, performance methods, choreography, wearable computing, intentionality, improvisation, first person methodologies, physiological computing, play, experience prototyping, public art, informance design, bodystorming, somatics, experience design, social navigation



Our work in designing and testing experience models borrows across methodologies from the performance practices of Theater [4], Dance [2,3], and the field of Somatics [5], expanding work in the area of computationally centered design techniques as well as the rhetoric of user-centered design, experience design, and participatory design. Our premise is that performance, as a practice-based research domain, contains a longstanding history of constructing experience models. Computational interface strategies omit the bodily

experiences of participants. We explore embodied cognition as a reflective process that is simultaneously inter-body and intra-body.

Technical Interaction :: Gestural Movement Vocabulary

Our interaction model required that participants exchange their body-state, or physiological data between themselves, and their garments. In order to design circuit connectivity for networked participation we needed to explore how gesture could enact bodily connectivity.



What are the properties of a gestural movement vocabulary? In Activity Theory, Nardi [6] illustrates the notion of a “function organ” – a transforming bond with an artifact. A photograph depicts a child listening intently to the radio, the expression of intense concentration suggests the creation of a relation between body and object. In dance and theatre the gesture itself can also become a “function organ”, an artifact that creates or enacts a transforming bond between the participant and their own movement. In this way, we think of the gesture *itself* as a function organ: an artifact that creates affordances for interaction.

The design of specific gestures that can become enactors is a notion common to theatre and dance practice. We follow with examples from performance practice that support this notion. Richard Schechner [7] uses the term *Restoration of Behavior*, to describe gesture as “material”. Restored Behavior is organized as sequences of events, scripted actions, or scored movements. He refers to these as strips of behavior, and states that a restored behavior, although “originating from a process, used in the process of rehearsal to make a new process, or performance, the strips of behavior are not themselves process but things, items, *material*”. This concept of gesture as source ‘material’ for designing interaction models is central to our work explicated in this paper.

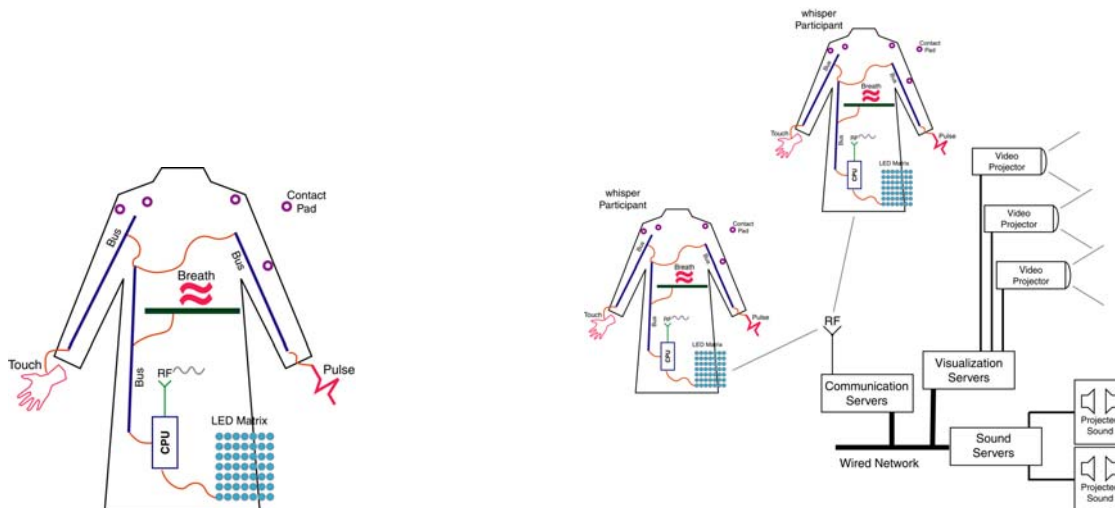
Augusto Boal [4] in *Games for Actors and Non-Actors*, states that “bodily movement *is* a thought, and a thought expresses itself in corporeal form”. Boal’s *arsenal of theatre* can be used to re-enact, or re-materialize the body state that accesses or indexes that thought, or “thought-unity”. Grotowski refers to an acting score as a script for designing *point of contact* or connection [8]. In Interaction Design this is the equivalent of interaction schemas, which are navigated in order to construct the instantiation of the interactive experience.

Grotowski speaks to the necessity of scripting gestural sequences in order to construct connection schema: “what is an acting score? The acting score is the elements of contact. To take and give the reactions and impulses of contact. If you fix these, then you will have fixed all the context of your associations. Without a fixed score a work of mature art cannot exist” [8].

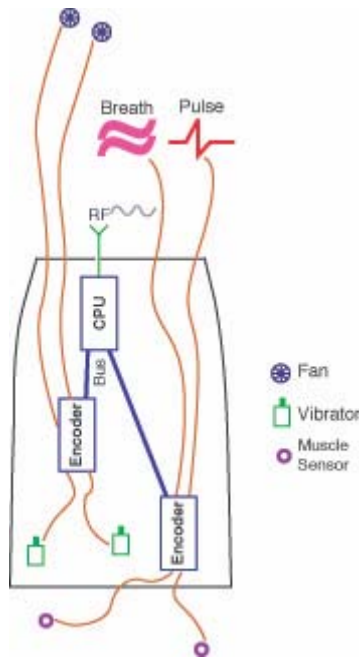
We suggest using gesture as a “function organ”, as a mechanism that can assist in defining properties for a scripted interaction score. These gestural function organs have the goal of paralleling processes to construct Grotowski’s concept of mature art: works of “mature interaction”.

CIRCUIT TRAINING FOR DANCERS – Addendum

In the spirit of our embodied research we have created artifacts of these processes which have been exhibited at the DEAF festival 2003, Future Physical Respond, Cambridge 2003, e-culture fair in Amsterdam October 2003, [Ciber@rts](#) Bilbao, April 2004, Siggraph Cyber Fashion Show, Los Angeles 2004, New Forms Festival Vancouver 2004, and Siggraph Emerging Technologies Exhibition, Los Angeles, 2005.



Our first technical prototype - developed in very close collaboration with v2_lab - involved compact networked microcontroller systems that were linked via Bluetooth communication to a network of servers; the wearable systems integrated real-time breath and heart rate data as well as instantaneous tactile connectivity information to synthesize visual and sonic responses that were derived from the dynamic aggregate data streams.



The second generation platform, <between bodies>, incorporates commercial, off-the-shelf, PDA technology with integrated WiFi communication as well as custom electronics that interfaces to Thought Technology's biofeedback/psychophysiology monitoring devices, which provide EMG [ElectroMyoGraphy: muscle contraction] , breath rate, heart rate and GSR [Galvanic Skin Response: skin resistance] physiological signals from directly attached sensors. The PDA is also connected to multiple transducers to generate localized feedback to the wearer in the form of air motion (with miniature fans) as well as tactile and sonic feedback.

We continue to explore a set of embodied practices within our research. These continue to develop our research questions, our (aRt&D) forward soft, softer, and softly through

Emanating relationship

whisper device states are learned and emerge from living on a specific body, and begin to represent that body; *whisper* devices remember past lives and these past lives influence their behavior.

Body as system

whisper devices are held close to the body. Our bodies have secrets, contain multiple intelligences, conceal information in unlikely places, surrender things to one another, learn, habituate and unlearn by applying directed attention. So do the devices of *whisper*. Any one of our bodies is a 'we'. When our bodies are together they can operate as an 'I'. So can the devices in *whisper*.

Future memory

whisper builds and represents and builds 'future memory'. The past is incomplete and the whispers can revisit and reconstruct past views as time progresses. The past is not replaced, it is augmented and restructured as the system perception grows. And the rediscovery of the past propagates into the future and the system's anticipated behaviors.

Cultural study of telepathy and mapping

whisper is an incursion into the cultural study of telepathy: impressions are transferred invisibly, mediated both through body and technology. Telepathy is the ultimate wireless network. we create wearables for the telepathically impaired. *whisper* excavates the invisible, is a search for lost things.

Special thanks to v2-lab, Anne Nigten, Stock, Marjolein Berger, Alex Adriaansens and all the warm bodies that supported this research.

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Threads of Recognition: Using Touch as Input with Directionally Conductive Fabric

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Abstract

In this paper, we describe the design of a touch input system utilizing directionally conductive fabric for use as “smart fabric” in wearable computing garments. Our development is based on utilizing the fabric surface as a tactile interface. We have defined a set of qualitative gestures using heuristic algorithms. This model provides high-level interpretations for the tactile quality of the caress, which is used to derive parameters for the interaction model. The user (or wearer) uses this fabric as interface to select interaction modes that direct data between networked garments in a wearable art installation.

The fabric is composed of highly conductive fibers alternating with insulating materials, such that current can flow “along the grain” but not across. This design allows the fabric to become a passive conductor replacing conventional cables, and more significantly, an active device such as a touch sensor surface. The fabric is integrated into garments (in this example, a set of networked skirts), and is used to provide a source of tactile input.

The garment is used to explore the interpersonal exchange of physiological data, controlled and selected by the individual wearing the garment, using gestures sensed by the fabric, and contact between garments, as initiated by the wearer. These connections form the basis of ongoing studies of the dynamics of person-person and person-group interactions.

Categories & Subject Descriptors: J.5 [ARTS AND HUMANITIES]: *Performing Arts*; B.4.2 [Input/Output Devices]: *Tactile input*

General Terms: Design, Experimentation, Human Factors

Keywords: Tactile UIs, Input and Interaction Technologies, User Experience Design, Tangible UIs, gestural analysis, tactile input, Laban Effort-Shape analysis, whole hand input.

INTRODUCTION

The input system is based on the blending of two primary techniques: Laban Effort-Shape Analysis and a generalized input library, called the Gestural Interface Toolkit. The Laban Effort-Shape Analysis provides a movement-based theoretical basis for the development and description of the system, while the toolkit supplies an abstraction layer for the realization of the system in hardware and software.

Effort-Shape Analysis is a system and a language for observing and describing effort qualities of movement, originally described by Rudolph Laban [8]. Effort/Shape Analysis describes: 1) movement qualities and dynamics defined as Weight, Space, Time and Flow, and 2) Shape qualities which are defined as interactions with the environment: Directional and Shaping. Our work extrapolates primarily Efforts. Effort quality is defined as a continuum between polarities — Weight varies between strength and lightness, Space varies between direct and indirect/flexible, Time varies between sudden and sustained and Flow varies between bound and free.

Combinations of the main qualities are described as “qualities” of Effort. There are eight Basic Effort Actions, corresponding to the eight possible combinations of Space, Time and Weight. Figure 1 shows these qualities organized as the vertices of a cube, superimposed on the Effort components.

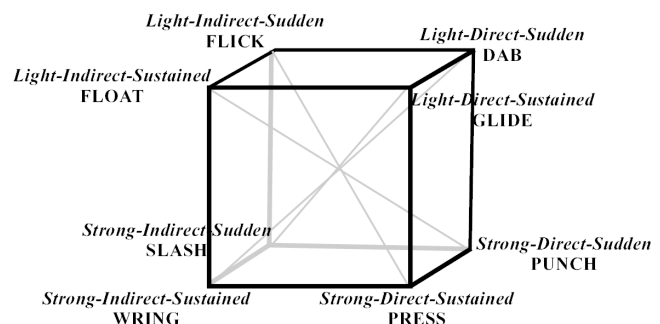


Figure 1. Effort Qualities and Actions

The Gestural Interface Toolkit (GIT) is an Application Programming Interface (API) for developing responsive wearable applications that require access to tactile input [19]. It incorporates gestural interpretation based on heuristic algorithms that represent Laban Effort Analysis.

The objective of the toolkit is to provide uniform and consistent handling of several classes of tactile input.

The toolkit is parameter driven for tactile data [11]; in this application a two-dimensional model of signal sources from the fabric is used, in combination with thresholds and filters tuned for the range of the discrete attributes of Laban Effort qualities.

PRIOR WORK

The Laban movement notation is described in Laban [8]. Badler [1] presents a digital representation of the specific notation, Labanotation. Singh [18] describes a computer-based graphical tool for working with the similar Benesh Movement Notation.

Zhao [21] has applied Laban Movement Analysis (LMA) to studies of communication gestures. In this work, we focus on interpretation of the gestures as control actions for selecting communication pathways, as opposed to the gestures expressing the communication.

Schiphorst et al [13,14] describes the use of kinematic models to represent movements and Calvert et al [4] describes the further development of the composition tool into the product Life Forms, which uses Laban notation as the representation language. The current work was influenced by the choreographic approach to motion description and presentation of these studies.

Buxton et al [2] provides early descriptions of the unique characteristics of touch tablets relative to other input devices such as mice and trackballs. In particular they explore multiple-touch and pressure-sensitive tablets. The fabric used in our work can be multiple-touch, although our initial focus has been on single-touch gestures, as well as a more symbolic, high-level, treatment of the data.

Chen et al [5][6] describe the use of a touch-sensitive tablet to control a dynamic particle simulation using finger strokes and whole-hand gestures, where the gestures are interpreted as a form of command language for direct manipulation. In this work, we extend the concept of a direct manipulation language to incorporate some emotional expression in the observed gestures.

IMPLEMENTATION – HARDWARE

Our exploration with conductive fabric is based on the following needs from our prior work:

- 1) The conventional cables for the electronics used with sensors and personal digital assistants (PDAs) in our first prototype garments were too bulky and too rigid, so that the natural movement of the wearers became constrained and awkward, due to concern with the physical interconnects, such as cables and attachment points.
- 2) The interaction model that we wished to explore required a more robust connection mechanism between garments than we had experienced with

earlier prototypes; it focuses on affective and expressive non-verbal communication based on touch, gesture, and movement, integrating these missing modes of communication into computer-assisted human-human networked systems as well as human-computer interfaces. Mechanical connections (such as fabric snaps) were hard to connect and required significant visual attention from the garment wearer to work; we want to connect more by feel, based on more associative and intuitive, touch-based gestures.

The implementation of our touch-based interface uses directionally conductive fabric, silk organza [12], forming layers of a garment. The prototype garment is a skirt that has integrated embedded cables that use the conductive fabric (as shown in Figure 2) to power transducers and to route data signals from sensors to a small wearable computer. The transducers are clusters of vibrator motors and fans embedded in the skirt lining to provide localized feedback for the wearer of the garment. Thanks to the physical characteristics of the fabric (nearly transparent and very lightweight), the cabling can be easily adjusted to accommodate different garment configurations, activities or wearers.



Figure 2. Conductive Fabric Strip

Connections can be made directly to the fabric, with a high degree of isolation between signals. This can be accomplished without interfering with the flexibility or appearance of the conductive fabric. Large pockets in the garment are used to house the wearable computer, the power supplies and the associated electronics.



Figure 3. The Garments

In addition, the conductive fabric is easily added to the garment to form response areas [7]. The fabric is layered with non-conductive fabric to form a simple grid that can be interrogated with a small amount of electronics [13] to identify a point of contact or applied pressure [17]. The information obtained from the fabric is sent to a small, lightweight, wearable computer, which communicates wirelessly with a central server. The server integrates the information from the garments with physiological data (such as heart and breath rates), gathered using a commercially available medical-grade sensor system that utilizes low-noise electronics and very reliable biosensors.



Figure 4. *Sensor Electronics*

IMPLEMENTATION – SOFTWARE

Early versions of the garment used a very ad hoc approach to touch and contact recognition, primarily due to limitations imposed by the hardware architecture. The software model has been refocused to emphasize the dynamics of connection and contact, which are key to our studies of non-verbal interpersonal communication.

For this, earlier work [16] on adapting Laban Effort-Shape Analysis to recognizing gestures on a touch-sensitive tablet were adapted to the problem of identifying similar gestures on a response area. Some simplifications were necessary, as the fabric doesn't provide fine variation in detectable pressure. It does, however, have good isolation between the conductive fibers, so that determining the bounds of the contact region is both easier and repeatable. It is assumed that, at any given moment, there is only one touch-effort intended by the user [10]. For example, the wearer is not tapping with one finger and jabbing with another.

Data from the response area is input into an image-processing environment, with some filtering performed using the wearable computer. The image is then processed as a visual representation, to extract parameters that we have identified as representing physical values that can be extracted or calculated from the information that the response area provides over time. These parameters are described in Table 1.

To simplify the decision process used to determine what quality of touch is used, we take a fuzzy approach and use some techniques borrowed from Laban. The rationale for this is that parameters generally aren't represented linguistically by gradations of numbers, but are described in more dualistic terms such as "soft" or "hard. By

categorizing each parameter into two or three qualitative values, the number of possible touch-efforts is reduced to a manageable quantity, which is more representative of the actual types of touches that we have identified. These values are then quantized to provide a standard representation that can be further analyzed and mapped to gestures, such as "stroke", "pat" or "touch". These gestures are combined with inter-garment connection information to generate a model of the actions being requested by the garment wearer — she can indicate which physiological signals she wishes to share or observe, and how the signals are to be mapped to the feedback devices on the garment.

Parameter:		Description
pressure	soft-hard	The intensity of the touch.
time	short-long	The length of time a gesture takes.
size	small-medium-big	The size of the affected region in the response area.
number	one-many	The distinction between one finger or object and many fingers.
speed	none, slow-fast	The speed of a touch-effort. This is the overall velocity of movement.
direction	none, left, right, up, down, and diagonals	The direction of movement.
Secondary:		
space (speed)	stationary-traveling	A function of speed. If speed is zero then the gesture is stationary.
path (direction)	straight-wandering	If the speed is not zero, and there is only one direction registered, the gesture is straight.
disposition (pressure)	constant-varying	If the pressure maintains a single value after an initial acceleration the gesture is constant.
pattern (gesture)	continuous-repetitive	If a gesture is unique in relation to the gesture immediately before and after, it is continuous.

Table 1. *Parameters That Can be Extracted or Derived*

At the same time, the connection information provides a representation of the groupings of the garments into clusters; each cluster can, at the discretion of the participants, provide aggregated physiological signals that can be used to modify aspects of the environment, in the form of visual imagery projected on suspended reflective sheets.

RESULTS

The response areas on the garments allow us to explore a touch-based interaction model that supports wearer-controlled sharing of physiological data from multiple sensors as self-to-self, self-to-other and self-to-group communication. The use of lightweight electronics and a wireless network allow the garment wearer essentially unrestricted movement within the installation. The response

areas can be adjusted for each wearer, so that differences in “reach” or applied pressure can be accommodated.

The vibrator motors and fans that are embedded in the skirt lining provide sensual, non-verbal representations of the recognized gestures and allow the wearers to experience the contact and sharing aspects of the system, which is our primary exploratory focus.

FUTURE WORK

We are interested in applying the parameterized model of effort qualities to expressing and inferring meaning from caress and other forms of touch, such as holding and hugging [8]. The current system uses a single fabric insertion area as a response area, which limits the range of movements that can be expressed. By incorporating multiple response areas, it should be possible to create multiple active regions on the body, so that interpersonal touch can be represented and qualified [19]. Alternatively, the same fabric could be used to form an active area within a device or object, by embedding it within the floors and/or walls of a room, or by applying it to surfaces such as furniture.

Wearable computers in the form of PDA's provide localized processing; we are porting the platform to the cell-phone Symbian environment. This will enable peer-to-peer exchange of interpretation of gestures and the formation of ad-hoc communities, which will provide opportunities for higher-level analysis and exploration of other applications where quality, intention and meaning, rather than quantitative position-based interaction is required [3]. Moving to a more decentralized organization, where servers in multiple locations exchange gesture information through the internet, will also allow us to explore how gesture exchange might work when there is no visual contact between participants, let alone direct touch.

This work raises some interesting questions: Can we integrate such visceral information with conventional communication mechanisms, in such a way that the sensual nature of a gesture is not lost? How does one store, access, communicate and elicit such communications, as we do with a telephone call? Can we e-mail a hug?

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Artist Round Tables

Researching the Future: (CAiiA-STAR and the Planetary Collegium)

Taking the Planetary Collegium as their starting point, members of the round table address research issues as they relate to the development of practice and theory in the context of collaborative criticism and inquiry across a wide field of knowledge and experience. The Collegium network is worldwide, in terms of its meeting and conference locations, the cultural identity of its members, and its ambition to develop nodes based on and complementary to its unique procedures and methodologies.

The Collegium emerges from 10 years of experience with CAiiA-STAR in gathering doctoral and post-doctoral researchers of high calibre whose work transcends orthodox subject boundaries, and whose practices are at the leading edge of their fields. We are living in a time of crisis for universities, museums and corporations, a time in which old cultural and academic structures need to be replaced by research organisms fitted to our telematic, post-biological society. The Collegium combines the physical, face-to-face transdisciplinary association of individuals with the nomadic, trans-cultural requirements of a networking community. The panelists, all members of the Collegium at various stages in its development, present their personal visions of the direction future research might take and the structures needed to support it.

ROY ASCOTT (CHAIR)
University of Plymouth

DONNA COX
University of Illinois at Urbana-Champaign

MARGARET DOLINSKY
Indiana University

DIANE GROMALA
Georgia Institute of Technology

MARCOS NOVAK
University of California,
Santa Barbara

MIROSLAW ROGALA

THECLA SCHIPHORST
Simon Fraser University

DIANA SLATTERY
Rensselaer Polytechnic Institute

VICTORIA VESNA
University of California,
Los Angeles

Ars Electronica: 25 Years of the Digital Avant-Garde

Celebrating 25 years of Ars Electronica. The panel provides not just interesting historical information, but also comprehensive insight into new directions of digital art.

ROY ASCOTT (CHAIR)
University of Plymouth

MICHAEL NAIMARK
New York University

CHRISTINE SCHÖPF
GERFRIED STOCKER
Ars Electronica

BARBARA ROBERTSON

KAREL DUDESEK
Ravensbourne College of Design

Since its invention in 1979, Ars Electronica has maintained its strong focus on the crossovers between art and technology. With each annual edition of its Festival for Art, Technology and Society, Ars Electronica has become more and more an international meeting point for the ever-growing community of people interested in digital art, its practise, and its theories. The festival advanced from an insiders' event for pioneers and early adopters to the major event of the international digital art circus.

Ars Electronica also developed a strong influence on the local level and became a major driving force in Linz, Austria's process of transformation from a city based on the aging steel industry to a new economy of innovative technologies and industries, and it became an icon for Linz's new identity as a modern cultural city.

Ars Electronica established a unique dialogue between artists and scientists to explore the possibilities of digital technology and to encourage critical awareness of its cultural and social impact. Emerging technologies, new artistic practises, and advanced theories have very often found their first large public presentation at the annual Ars Electronica Festival.

In 1987, Prix Ars Electronica was introduced as the first international art competition dedicated exclusively to digital arts. It was the logical next step for Ars Electronica and an immediate success, not least because of its significant prize money and its high profile among jurors and award winners. Over the past 17 years, about 30,000 works have been submitted to this annual competition, and prizes totalling \$US1.7 million have been presented to artists. The Prix contributed essentially to the building of Ars Electronica's large international reputation and its network of partners, friends, and collaborators.

With the opening of the Ars Electronica Center in 1996, Ars Electronica's field of operation was significantly redirected toward the general public and development of new forms of collaboration among art, science, and the general population. The Center resembles a prototype for a fully interactive museum and acts as a successful educational walk-in centre for a broad spectrum of audiences. It features frequently changing exhibits of outstanding media art works and innovative research projects from artists and media laboratories all over the world.

The Ars Electronica Futurelab, also founded in 1996, is an internationally acclaimed model for interdisciplinary collaboration among artists, designers, engineers, and researchers from the academic and commercial communities.

High-profile artists-in-residence projects as well as top-level research projects with large corporations provide a very inspiring and challenging foundation for any type of creative work in new technologies.

The panel provides not only interesting historical information, but also a comprehensive insight into new directions for digital art.

Synaesthesia

This panel discusses synesthesia, which typically involves sensory crossover among the basic senses (vision, hearing, taste, smell, and touch) within the normal range of sensation.

ROY ASCOTT (CHAIR)

University of Plymouth

DONNA COX

University of Illinois at Urbana-Champaign

MARGARET DOLINSKY

Indiana University

DIANE GROMALA

Georgia Institute of Technology

MARCOS NOVAK

University of California, Santa Barbara

MIROSLAW ROGALA

THECLA SCHIPHORST

Simon Fraser University

VICTORIA VESNA

University of California, Los Angeles

Synaesthesia Abstracts

DONNA COX

Baking Images with the Taste of Color

Visualization and digital-image generation requires control of red, green, and blue color specification in quantitative numbers. Cox's first love in making digital images is in the process of cooking with color, as a synaesthetic experience. As an artist, she practiced painting and color photography. In 1983, she discovered digital imaging and numerical control of perceptual color. By 1985, Cox developed an Interactive Computer-Assisted RGB Editor (ICARE) that enabled color control using trigonometric sinusoidal functions. She will discuss the link between her synaesthetic taste of color as a physical experience and the digital bake-offs in large collaborative visualization projects over the past 21 years.

Cox collaborates to make data-driven digital animations from sensed observations and simulations. She has played multiple roles in these collaborations, but most of the projects involved her control or influence on the design of color. While she has collaborated with scientists and developed new methods for color design, she primarily and intuitively experienced color by taste. Her "tasteful" embrace of color has led to innovative color solutions for scientific visualization. She describes several projects that include the "grid" virtual technology and other advanced technologies used to create animations for museum displays, PBS Nova television shows, and other large-scale colorful projects. Cox discusses how the "taste of color" affects her palettes and how this approach reveals itself in striking contrast to many of her scientific colleagues.

Her collaborations include the 1997 Academy Award-nominated IMAX movie "Cosmic Voyage," for which she was associate producer/art director for scientific visualization. In this Round Table, she also shows astrophysical visualizations and decisions she made in producing "Unfolding Universe" for the Discovery Channel. Under her direction, the NCSA Experimental Technologies Group recently completed a tornado project for Nova, "In Search of the Super Twisters," which she will explain in her exploration of the relationship among technology, visualization, displays, and synaesthesia.

DIANE GROMALA

Riots of Sensation

A medically defined, idiopathic aberration. A keyboard that produces a different taste for each note. A cyberpunk ideal. An LSD trip. An

artistic method to expand consciousness. The man who tasted shapes. Each could be an instance of synaesthesia, defined as "the transposition of sensory images or sensory attributes from one modality to another." Synaesthesia has proven to be a provocative concern of Western artists and scientists alike, arguably from the era of Isaac Newton and John Locke, prominently in the late 19th century, and certainly in contemporary times.

Although synaesthesia still is not well understood and suffers from mild associations with moderate deviance, its importance can be inferred by the prominence of the scientists, artists, and philosophers who have historically grappled with it, and by its cyclical recurrence as an object of intense scrutiny. Interest in this phenomenon curiously seems to resurface during times of technological change, such as our own. Yet the ways of defining, understanding, and contextualizing synaesthesia have traditionally divided artists and scientists. This paper argues that the shared interest in emerging forms of technology among certain artists and scientists, through a phenomenological approach, promises to be far more productive than the usual feel-good interdisciplinary enterprises suggest.

The paper briefly outlines the major assumptions upon which most contemporary and historical accounts of synaesthesia rest as seriously problematic, pointing to examples familiar to the SIGGRAPH community. For example, the notion that we have five distinct senses has given way to the identification of other senses, and a reconsideration of their distinction (the so-called "binding problem" in consciousness studies). Though this has been an outgrowth of research in much larger realms, the focus here is on the work of artists, cognitive and computer scientists, and experiences encountered in work with technology, such as proprioception in virtual reality.

The paper then posits a reconsideration of synaesthesia, by describing continually fluctuating perceptual fields, thresholds, and liminal states that arise from stimuli, both internal and external. It will focus on the potentials and possibilities that emerging technologies hold for users to "remap" sensation, drawing on the overlapping findings of scientific research and artistic practices.

MARGARET DOLINSKY

Synaesthesia in Your Toolbox

In reality, synaesthetic percepts have been found for a wide variety of intermodal combinations. Senses are not discreet and often work in unison, one triggering the other. For example, a trained pianist feels sound through her fingers. She is kinesthetically aware of finger

positions, tactilely sensitive to the keys and auditorially attentive to the sound. As she plays the piano, the tactile becomes sound as one sense predicates another.

When we are confronted by a novel sensation, we rely on our senses to correlate it to previous percepts and learn how to incorporate it within our base knowledge. The senses act as meta-knowledge that can be extended and developed. Perhaps synaesthesia has different levels of definition. Perhaps synaesthesia is not uncommon; perhaps the senses are not discreet but instead one modality often invokes another.

In virtual reality, participants see images moving past them, which triggers a sensation of motion. Participants can perceive height, move into empty space, and sense themselves falling. The visual can become kinesthetically effective enough to cause a range of physical sensations from dizziness to motion sickness.

Philosopher Andy Clark posits that humans have not entered a post-biological era but, rather, have always been natural born cyborgs using tools as extensions of the body. From the early adaptation of tools to create cave paintings to the recent ingestion of nanobots to capture corpus video, we have incorporated foreign objects with our biological mainframe to heighten our senses and awareness. A case in point: the artist uses the paintbrush as an extension of her body, feeling the sensuousness of the camel-hair tip as it caresses the canvas, leaving a moist trail of color in its wake. The flow of the hand, brush, and paint connect the action, image, and body physically, mentally, and sensorially into one place, one moment, and one being. This process, termed “flow” by psychologist Mihalyi Csikszentmihalyi, is an action that is summarized by a “total involvement with life.” Psychologists believe that this process is just one of the methods that we use for gathering information, the very essence of our survival.

MIROSLAW ROGALA

I Wanted To Keep Touching the Words

Dynamic mapping involves changing (v)user behaviour and implies that a new narrative structure is needed to inform any (v)user, be it single or multiple. Dynamic mapping confronts (v)users not only with complexity, but also with the responsibilities that the freedom to navigate complex structures brings with it. In “Divided We Speak,” through repeated engagement, the audience becomes comfortable with the range of freedoms they are offered. Because of the problems that have arisen in the interpretation of the movements and gestures of multiple participants in the same shared space, the spatial grammar of experience and behaviour need to be redefined. Mapping horizontal movement in the space becomes a mode of interpretation. Thus, both hand and body movements dynamically create new art forms. As participants exclaimed: “It is really amazing that you can actually touch the sound!” And another stated: “I wanted to keep touching the words.” The process of dynamic mapping interactions requires exploration and decisions to be made by the (v)user. The (v)user’s confrontation with power and control are determinants for expanding the aesthetic experience.

THECLA SCHIPHORST

Between Bodies, Between Senses: Practicing [Holding] the A-Wearable Self

The body synaesthetic is a simultaneous act of movement and stillness. The ability of the body to hold multiple states and multiple sensory domains is codified as daily practice in performance and somatics. Dance and theatre provide models for knowledge acquisition, information design, networked connectivity, remote sensing, and wearable technologies. In my own work with wearable technologies, the notion of LANs (local area networks) is extended to include: BANs, body area networks, SANs, skin [subtle] area networks, and MANs, meridian area networks.

VICTORIA VESNA

NanoMandala: Feeling is Believing

This paper discusses the significance of considering the ideas of a Mandala – a cosmic diagram and ritualistic symbol of the universe, used in Hinduism and Buddhism – when working with science on the molecular scale. Using an interactive installation that was created in collaboration with nano-scientist James Gimzewski and a group of Tibetan Buddhist monks from the Gaden Lhopa Khangtsen monastery in India who built a seven-foot-diameter sand mandala, I will approach this uneasy subject of the invisible made tangible by the metaphysical.

With the invention of the scanning tunneling microscope (that should really be called a tactoscope), using “touch” to feel the molecular surfaces, scientists are able for the first time ever, to access this realm in a “tangible” way and prove the complexity of “nothingness.” Manipulation of individual molecules bears some resemblance to the methods monks use to laboriously create sand images particle by particle, and what is considered here in particular is the process. Eastern and Western cultures use these bottom-up building practices with very different perceptions and purposes, and the merging of the two could result in some interesting research. A Mandala can be translated from Sanskrit as “whole,” “circle,” or “zero.” It consists of a series of concentric forms, suggestive of passages between different dimensions, the macrocosm and the microcosm, from the largest structural processes as well as the smallest. It is the planet earth, the atom that composes the material essence of our being, and the galaxy of which the earth is but an atom. By approaching the molecular worlds with this in mind, rather than the usual idea of working with nano as something very small, there is an amazing potential for discovery and expansion of our perception of our worlds.

MARCUS NOVAK

TransSense: General Synaesthesia

Synaesthesia normally occurs when input to one sensory modality registers across another sensory modality. Typically, this has involved sensory crossover among the basic senses (vision, hearing, taste, smell, and touch) within the normal range of sensation. However, several continuing developments are expanding not only the range of the senses, but also their kind, and even their scale. Numerous avenues of research, including studies of neural plasticity in the cerebral cortex, sensory substitution, prosthetics, robotics, and others, point to the expansion of the sensorium to a condition of generalized synaesthesia, in which all available sensory modalities, biological or technological, can be, to varying extents, mapped into one another.



FOUR KEY DISCOVERIES

Merce Cunningham Dance Company at Fifty

A discussion with Carolyn Brown, Merce Cunningham, Laura Kuhn, Joseph V. Melillo, Thecla Schiphorst, and David Vaughan

The following discussion was held at the Brooklyn Academy of Music on October 18, 2003. The panel, moderated by Joseph V. Melillo and organized by BAM's Education and Humanities department, was held to observe the Merce Cunningham Dance Company's fiftieth season and the world premiere of *Fluid Canvas* and *Split Sides*, performances created in collaboration with the rock groups Radiohead and Sigur Rós. Cunningham also incorporated new computerized choreography software into the chance-based performance.

JOSEPH V. MELILLO In Merce Cunningham's own words, "there have been four events that have led to large discoveries in my work." Today, at the company's fifty-year milestone, we have assembled a distinguished panel of artistic collaborators, critics, historians, and dancers to consider the past and present evolution of these Cunningham discoveries.

This discussion is titled "Four Key Discoveries" because Merce once said that the company's work can be considered through the prism of these ideas: (1) the separation of music and dance as influenced by John Cage; (2) the use of chance operations in choreography; (3) the possibilities of film and video; and (4) experimentation with computer technology. Merce, would you give us your point of view about this statement?

MERCE CUNNINGHAM Yes. First, the music: John Cage didn't like the idea of one art sup-

porting another or one art depending on another. He liked the idea of independence and wondered if there were another way we could work separately to produce a work of music and dance. The first things we made were short solos, and it was difficult for me to do, not having the music as support in the traditional way. But at the same time there was marvelous excitement in this way of working, so I pursued it. In one of those first solos, we had a given time structure within which the dance might take place—I think it was five minutes. I remember so clearly the first day when we were rehearsing with John and I made a large, strong movement—there was no sound but just about three seconds later came this ravishing sound, and it was very clear that this was a different way to act: not being dependent on the music but being equal to it. You could be free and precise at the same time. As we have continued to work this way with music and composers, it's always struck me how

Carolyn Brown,
Laura Kuhn, and
Merce Cunningham.
Photo: Elena Olivo

precise the dances become on their own terms: it's both being free and at the same time working together.

The second discovery was chance operations. That began in the 1950s. A scientific institute called the Institute of Random Numbers had declared that using random numbers was just as useful as logic. The *I Ching*, the Chinese book of changes, had been published—that showed that chance was a way of working which opened up possibilities in dance that I might otherwise have thought impossible. I would try them, and sometimes they were impossible, but they always showed me something else that I hadn't thought of: ways of getting from one thing to another, kinds of rhythm, use of space. So I abandoned the idea of frontal staging focus; we could now face anyplace, any direction. One direction is equally as valid as any other. *Split Sides*, the piece we're doing here tonight, is a chance operation from the beginning. Every night we have the possibility of changing the order of music, set, costumes, and lighting design.

Tonight, before the curtain, we will cast the dice, first to see if it comes up odd or even: Even means we start the program with section A, odd means section B. A has come up now for three nights, but I can't tell you what this one will be and equally so with all the parts: which set, costumes, and lighting design to use for each section.

I made the third discovery when I worked with Charles Atlas on films in the 1970s, and later with Elliot Kaplan, who filmed a number of dances. I never had any connection with the camera, but then Charlie showed me its principles. The first thing that struck me was that the space I was looking at wasn't at all like the stage, so you didn't have to think that way. The camera can change its relationship to what the dancer or dancers are doing. Television in particular has a quickness and clarity in the cam-

era's movement, which I began to investigate in classes.

The last discovery, computer technology, I made with Thecla Schiphorst, with whom I've worked for ten years on LifeForms. I'm going to let her talk about that, but I should say that it has opened my eyes to things about movement which I wouldn't have seen otherwise. I'm grateful to her, as I am for all of these things, because each one has showed me something that I might have thought impossible in movement. But each has somehow given me a new way to work in the dances that I make.

LAURA KUHN I think I have the most fun topic because of the collaboration with Radiohead and Sigur Rós this season. I don't know what the effect has been outside the company, but within that world it's been a little controversial, and it's fun to think about the effect of that collaboration.

Merce and John Cage were artistic partners for most of their adult lives, and John Cage was the first music director of Merce Cunningham Dance Company, formed in 1953, and he remained in that capacity until approximately 1990. As the music director, it was Cage's job to find composers to work with a company distinguished by a total separation of music from movement—there is no relationship. Until the first performance the dancers themselves don't actually hear the music that will be performed with the dances.

If you read the roster of composers and performing musicians who worked with the company since its inception, it reads like a *Who's Who* of modern music. Merce Cunningham and the Kronos Quartet may be tied for commissions of new American music. Like Merce, Cage was always interested in finding something new, such as his early embrace of electronic music. There were, however, certain tacit musical decisions over the past fifty years.

Rarely, if ever, could you hear an intelligible spoken voice, though in a few instances musicians have come and used text, and it's created a slightly disruptive sensory competition. Also, as a rule, Merce has introduced new composers to his audience; what's interesting about the event tonight is that it's nearly the reverse. Virtually nobody in the Merce Cunningham world knew who Radiohead or Sigur Rós was. The two bands were encouraged to do something different—without the commercial music world's confines—and they did. Another thing the Cunningham collaborations tend to shy away from in music is a fixed beat. Rock music, on the other hand, normally has a rigid, fixed beat. But tonight there is no drummer. In fact, Radiohead made a unilateral decision not to have percussion, which I thought was extremely interesting.

But the other thing I find curious about this performance is the correspondences. This was especially striking on Tuesday night, which was the only live performance with the musicians playing in the pit. Especially in the Sigur Rós collaboration, there were a number of correspondences between sound and movement. If the dancers did a quick step, the music got jittery, because the musicians were watching the dancers. The band clearly did not know that this is taboo, so they felt free to try to dance with them, musically speaking.

CAROLYN BROWN Fortunately or unfortunately, in 1966 I wrote an article called "On Chance." I did a lot of research and tried to find out what this work was all about, prompted by two critical pieces by a writer who wrote both for a Chicago paper and for *Dance News*. In them she said, "The dancers did their favorite movements." There was a huge misunderstanding—people thought the dancers were just up on the stage making up their own steps. (Though how they could look at these dances and imagine that we were up there making up our own steps is beyond me.) So I wrote an outraged letter to *Dance News* and then proceeded to write a longer article for *Ballet Review*. I gave it to Merce before submitting it to the editor; he read this long article and then looked up at me with eyebrows raised and said, "So serious!"

And it was. I wanted to point out a lot of important precedents. Chance in performance didn't start with John, it goes back to Dada in the early twentieth century, poets and artists like Duchamp—who actually did one of the first musical chance pieces—who took words and shuffled them for compositions, and who cut up drawings and threw them up in the air and repasted them on paper as they fell.

In a way chance dance is like any other form, because Merce has done a meticulous study, and then he teaches it to us so we don't have to go through the same process. Once he has taught the choreography, it stays as it is.



Merce Cunningham
Dance Company in
Split Sides, Brooklyn
Academy of Music,
2003. Photo:
Jack Vartoogian



Split Sides. Photo:
Jack Vartoogian

The unusual element is not so much chance as indeterminacy, in which something unpredictable can happen. This is not about improvisation — among many other things, Merce is a master of structure and timing. We once did a piece called *Story* in which we had a little freedom on stage, and it drove Merce crazy when we took too much time on stage. There's a wonderful story about Merce going out on stage during a performance, picking a dancer up, and carrying her off. What is indeterminate is not the dance itself but the components of a performance. A piece like *Rune* is indeterminate — it had five sections which could take place in any order. But once the order was decided (by chance), it was set and didn't change. I think it's important that people understand that. Henri Bergson once said, famously, that "disorder is simply the order we are not looking for." And to me, this is what Merce does on stage.

DAVID VAUGHAN As Merce said, he's worked with two filmmakers: Charles Atlas and Elliot Kaplan. Charles Atlas first came into the company as a stage manager, and he happened to be a budding filmmaker at the time. He had a Super-8 camera, and at first he made short clips of Merce's joints in movement, in close-up, moving in different ways. Sometimes these were used as decor in performance events, though I don't think I ever saw any of those. Then in 1972 Charlie asked Merce which dance in the repertory he would most like to see filmed, and Merce said *Walker on Time*. He shot the pieces in two parts: one in Berkeley, California, and the second in Paris, which was actually Carolyn's last performance, in 1972.

So in a way Charlie was moving toward actually collaborating with Merce, and in 1974 they made their first piece together. It was called *Westbeth* after the name of the building where our studio is. The technical materials

available were primitive. But the result was the beginning of an exploration of what you could do with film. Over the next few years, Charlie and Merce made several pieces together, video dances and then film dances. And in a way each one explored a different aspect of the camera, ending up with a kind of grammar of the dance on film. Interestingly, they were subsequently transferred to the stage, reversing how people usually work—making film or video versions of existing dances. But Merce transferred them back to the stage, and of course that meant they had to be changed quite a bit.

Charlie made his last piece, *Coast Zone*, with Merce in 1983. And then Elliot Kaplan, who'd been Charlie's assistant, took over and became the filmmaker-in-residence. I might add that one reason Merce wanted to collaborate with a filmmaker was that he had seen the way other people's dances were chopped up on film; he thought it was necessary to find out more about technology and the camera so he could have more control over the way they were seen. Many people making film or video versions of their dances at that time wanted to make it look as much like the stage as possible. But Merce realized that there's no point in doing that. Instead, people always come in from one side or the other, from behind the camera, or else the camera shifts a bit and they are found in place. Since it's clear from looking at the films that everything has to be planned in advance, I once asked Merce how chance comes into the video process. And he said, "Well, it's partly because the camera never quite does what you want it to do, so you have to do something else."

THECLA SCHIPHORST I'm going to share with you some of the work that Merce has been doing with the computer tool for choreography now known as LifeForms, although it has had a

number of names over the years. It started with the name Compose and was renamed LifeForms, and actually now there's a version of it called DanceForms. It's now used specifically to create and explore movement. What's really interesting about chance is that it affords a mechanism by which we can let go of habit. Each of these four discoveries offers another, new way of working.

Merce and I actually started working together in 1989 at Simon Fraser University. Some Italian producers had invited us to work together using the software. Although the commission fell through, Merce has continued to explore the computer since then. In the beginning Merce was just working with shapes, which found their way into the dances. He used those movements in the classroom, and these movements found their way into the dances. So even more than has been acknowledged in the press or in interviews, this has become a part of the exploration questioning movement.

Interestingly enough, in 1967 there was an article in *Dance* magazine about Michael Knowles's work. Knowles was a researcher at Bell Labs, and Merce was aware of his work and actually commented on it in a way that really speaks to the sense of what technology could do for movement at that time. In 1968 Merce said: "There have been some slight experiments that I know made in this direction, and this situation makes me think immediately that a dancer could be on a screen. Imagine stick figures, the screen is a notation, the shapes move in depth and in space and can be moved in time and space." This is a description of the LifeForms software we started working with in 1990.

This experiment with technology is in many ways an extension of Merce's use of chance. Merce used found objects such as test phrases which the computer programmers had

left on Merce's computer. Those test phrases either found their way into his dances or he reconstructed them by exploring the relationship between time and space. With a figure doing a simple walking phrase, Merce would actually explore the relationship in time and space, looking at how he could change first the legs, then modify the arms totally separately, and then see how the spine could be modified. Of course what was created was a very complex, very difficult walk, not something that was natural in any sense. So the dancers not only had to learn these movements, but they also had to relearn how to use their bodies to perform and understand what this movement was. They shared in this questioning of what movement is. On the computer, the body is represented by joints, and the program is about the complex ways you can put together so many kinds of joints. Even though the movement may appear to be physically impossible, its sheer complexity has really shifted both the choreography and the way the dancers have to understand movement.

CUNNINGHAM: With LifeForms, as with my other processes, it's a continual balance of making and looking. I have it in my G4 and carry it on tour. In the beginning I worked on this enormous machine. Thecla came and very carefully showed me how to do things the first time we worked together, and then she went away. And then I tried things and everything crashed. I thought, "Well, it doesn't matter, I don't know anything so it's not a mistake." Eventually I started again, playing with the possibilities, and when I showed Thecla what I'd done she said, "How'd you do *that*?" I couldn't explain it.

I like to produce movement that seems out of range, to enlarge the range and add things to what we think of as dance. I think one of the things that has happened with the

dancers and not just the technology is the use of arms, for example. I was working with LifeForms, using chance means to arrange the arms in a way which I'd never seen before. So I tried them in a minimal way and saw they were possible, so I began to use the arms in a much more complex way. With the computer—so far—I take the movement to the dancers. I want to do it the other way, but so far I can't think of a way to do it. I have my own personal difficulties with moving now, so most of the demonstration is talking—and dancers don't like that, they want to *see* it.

Here's a simple example of my work with the software: let's say that I always do a certain movement, 1-2-3, 1-2-3. One is a hop, two is falling down, and three is a jump. Applying chance principles means tossing the dice: maybe the order comes up as fall, hop, and run. You might think that's not possible to do, but when you go ahead and try it, you find out that you can do it. It gives you a different physical continuity, a different physical coordination. Now imagine two people dancing together—in fact, one of the duets in this evening's performance comes out of the computer. The movements were put into the computer by chance, and the order of the duet comes from applying chance to a single sequence of events for this person and then for the other person. When it comes together, you have not only the chance continuity of these events but also the sequences in relation to each other. Now these are not simply figures on the screen; these are people who move around and who don't want to run into each other. So it can give you limitations, but the limitations keep changing almost beyond what you think is possible.

I will ask two dancers to try something based on the computer results, and the two of them do it together and all of a sudden something happens that we hadn't even ever thought



of. And I'll say, "Oh, keep it!" Because it's something that we hadn't experienced before. I don't mean to say it's easy—it's constant work. More times than not, though, you find a way.

From the beginning—like the other discoveries, such as separating music and movement—the software has constantly brought up other possibilities. I've always felt that there is a limit to the structural activity of the human body: once we stood up on two legs, we were caught and have to work that way. But there is

always some other way to do it. Not that I'm going to find it or anybody else is, but there always is something else to discover. That's been the history of movement; dance is another way someone has found to deal with the question of what movement can be. The computer has opened it up to me. It has broadened what I think of as possible in dance.

Split Sides. Photo:
Jack Vartoogian

Between Bodies: using Experience Modeling to Create Gestural Protocols for Physiological Data Transfer

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ABSTRACT

In this paper, we describe the use of experience modeling to create gestural protocols for physiological data transfer. This design method has been applied to the development of a wearable computing public art installation called *whisper*.

A series of user-experience workshops were designed with the goal of developing an interaction model for the public installation. These workshops modeled intimacy, social navigation and playful exchange, using performance methods to create gestural protocols.

Workshop participants generated movement vocabularies by negotiating permission and control of their own physiological data. Gesture was utilized as an expressive indicator of intentionality, extension of body image, permission, control, exchange and play.

We illustrate through video, gestural analysis, and experimental feedback, how the workshops provided an experience model for the interaction, wearable garment design, and body-to-body network protocol used in the public art installation, and how performance methodologies can contribute to the area of interaction design.

Author Keywords

gestural protocols, performance methods, choreography, wearable computing, intentionality, improvisation, first person methodologies, physiological computing, play, experience prototyping, public art, informance design, bodystorming, somatics, experience design, social navigation

ACM Classification Keywords

H.5.2. User Interfaces, User-Centered Design, Prototyping

1. INTRODUCTION

The title *Between Bodies* is a metaphor that provides our framework for experience modeling. Our work in designing and testing experience models borrows methodology from the performance practices of Theater [4], Dance [3], and the field of Somatics [12], expanding work in the area of user-centered design, experience design, and participatory design. Our premise is that

performance, as a practice-based research domain, contains a longstanding history of constructing experience models. Many participatory design perspectives omit the bodily experiences of participants. Performance-based experience methodologies can contribute to exploring our bodies' physical responses in the growing area of interface design for ubiquitous, wearable and affective computing. We explore embodied cognition and interaction as a reflective process that is simultaneously inter-body and intra-body. This research provides a case-study for a model of designing embodied interaction.

1.1 Artistic Aim

One of the major themes of the installation *whisper* is the notion of 'paying attention' to one's self, and using this sense of self to connect to, and exchange with another. This requires an ability to transfer this 'sense of self' to another person. Designing expressive interactions that afford intimacy, privacy, affect as well as connection are the goals of interaction. How can a system create a willingness, a trust, the 'suspension of disbelief' needed to enter into an exchange of information that is otherwise private and 'unknown'? To explore these questions of access to experience we turned to performance methodologies. For example, techniques for extending our bodily awareness through attention to breath and movement are common to performance methodologies found in theatre and dance. Techniques in these domains build both intra-body and inter-body knowledge by focusing on our *perception* of our own physical data. This includes having access to, and agency over our own breathing, our own heart, our own thoughts, and our own body state. In the installation this is afforded through the use of measuring physiological data as a representation of one's self, and in effecting how this data is displayed, exchanged, and shared.

1.2 The Outcome: A Wearable Public Installation

We developed an interaction model for the public art installation through a series of experience workshops outlined in this paper. *whisper* is a real-time interactive public art piece, based on small wearable physiological sensors, micro-controllers, and wireless network transmission, embedded in evocative and playful garments worn by the participants. *whisper* is an acronym for [wearable, handheld, intimate, sensory, physiological, expressive, response system]. Focusing on body state represented through participants' breath and heart rate, *whisper* aims to monitor physical data patterns of the body, mapping heart and breath physiological data onto linked and networked devices worn within a specially designed garment. *whisper* collects breath and heart rate data from the bodies of participants, and through visualisation and sonification techniques, enables participants to interact, interconnect, and interpret their own and other participants internal data in playful and responsive ways.

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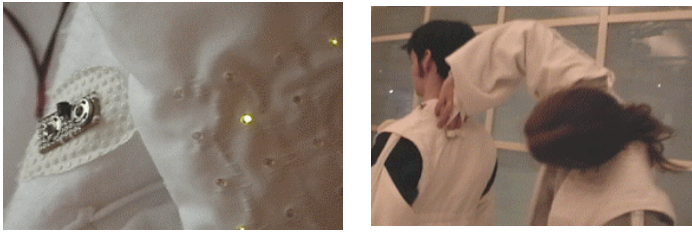


Figure 1. *whisper* garment and gestural interaction DEAF03 Festival

The wearable installation is the outcome and testing ground for an experience modeling methodology described here. *whisper* has been exhibited at DEAF03, the Dutch Electronic Arts Festival, in the public lobby of the Schouwburg Theatre, in Rotterdam in February and March 2003, at Future Physical's Respond festival, in Cambridge, UK in March and April 2003, and at the e-culture fair at the Amsterdam Paradiso in October 2003. Up to six participants are able to listen to and affect their own body-state represented by their physiological data (breath and heart-rate). They are also able to connect to and exchange their physiological data with other participants in the interaction space through gestural interactions which enable connecting, listening, exchanging, giving and receiving.

2. BACKGROUND

During our design workshops, gesture was utilized as an expressive indicator of intentionality and body state. We modeled our workshop methods on performance techniques that provide a link between embodied interaction, activity theory, user-centered and participatory design, and situated cognition. Within HCI, gesture/movement design analysis is an under-theorized area, and a need exists to explore richer methods to create gestural interaction. Our work attempts to bridge this gap, and specific examples are described throughout the paper.

2.1 Workshopping Experience through Gesture

The workshops were modeled using a range of performance techniques such as improvisation, props, phantom partners, prosthetic devices, ritual space, and placebo objects. We used attention modeling that incorporated listening, sending attention and touching; imagining and visualization; focus on somatic attributes such as breath, heartbeat, stillness, slow motion movement; journaling using hand-writing and drawing; social navigation using gesture and touch to express permission, trust, exchange, and feeling; and costumes and props to express physical extension, connection and group identity. The goal of the workshops was to model experience that could be replicated, re-enacted, and re-played in the context of a public art installation using wearable computing technology. The design goal of the public art space was that it could be simultaneously intimate, playful, and social, while developing a level of awareness of our selves.

We illustrate our process through video, gestural analysis, and experimental feedback. Gestural protocols created and imagined by the workshop participants during playful engagement became the basis for: body to body network protocol; the wearable garment design, including the selection of connection points, placement of wearable computers, sensors, wiring paths, and visual display systems; and for the mechanisms of gestural connection, intention and data sharing that was used in the public art installation.

2.2 Performance Methodologies as Experience Models

There is a common ground that exists between the domains of HCI and performance practice. We refer to this shared ground as first person methodologies: techniques and protocols that articulate models of experience. We posit that it is precisely the differing frames of reference between the domains that can reveal an under-theorized area of practice. For example, the need to have models of interaction and the experience of the 'user'/'performer' can be seen to be one such shared starting point that is framed through differing methodological strategies. How are these models of interaction conceived, constructed, and integrated within a design process? What are the underlying assumptions that differ between these domains?

We explore interaction as a space of lived experience and enactment, as something that is simultaneously *between bodies* and *within-bodies*. Specifically, human-computer interaction, as it is defined by *human* experience in which action and meaning are inseparable. We explore human interaction as a model for developing relational human computer interaction systems.

One of our contributions to this shared domain of developing models of experience, is that in our work, the 'bridge' is being built from the side of performance practices, rather than from the side of HCI. This brings with it new vocabularies, techniques, with an emphasis on building knowledge *within* the experience of the body, an area well defined within Performance and Somatics.

Dourish [9] lays a strong argument for a foundation in HCI that validates the notion of an embodied interaction. The need to augment abstract reasoning and objective meaning with practical action and everyday experience is central to this approach. Dourish notes that his contribution is foundational, rather than methodological, which opens opportunities for methodological modeling and testing as a critical next step in the development of this area.

Suchman's [28] ethnographic research, which views all activity as situated and embodied, and her interest in purposeful, intentional activity, alongside Nardi's [18] work in constructing a "theory of practice" within HCI based on the development of activity theory and intimacy between human and machine constructed through intense relational concentration, provide strong bridging links to our work.

2.3 Gestural Movement Vocabulary

What are the properties of a gestural movement vocabulary? In Activity Theory, Nardi [18] illustrates the notion of a "function organ" – a transforming bond with an artifact. A photograph depicts a child listening intently to the radio, the expression of intense concentration suggests the creation of a relation between body and object. In dance and theatre the gesture itself can also become a "function organ", an artifact that creates or enacts a transforming bond between the participant and their own movement. In this way, we think of the gesture *itself* as a function organ: an artifact that creates affordances for interaction.

The design of specific gestures that can become enactors is a notion common to theatre and dance practice. We follow with examples from performance practice that support this notion. Richard Schechner [22] uses the term *Restoration of Behavior*, to describe gesture as "material". Restored Behavior is organized as sequences of events, scripted actions, or scored movements. He refers to these as strips of behavior, and states that a restored behavior, although "originating from a process, used in the process of rehearsal to make a new process, or performance, the strips of

behavior are not themselves process but things, items, *material*". This concept of gesture as source 'material' for designing interaction models is central to our work explicated in this paper.

Augusto Boal [4] in *Games for Actors and Non-Actors*, states that "bodily movement is a thought, and a thought expresses itself in corporeal form". Boal's *arsenal of theatre* can be used to re-enact, or re-materialize the body state that accesses or indexes that thought, or "thought-unity". Grotowski refers to an acting score as a script for designing *point of contact* or connection [23]. In Interaction Design this is the equivalent of interaction schemas, which are navigated in order to construct the instantiation of the interactive experience. Grotowski speaks to the necessity of scripting gestural sequences in order to construct connection schema: "what is an acting score? The acting score is the elements of contact. To take and give the reactions and impulses of contact. If you fix these, then you will have fixed all the context of your associations. Without a fixed score a work of mature art cannot exist" [23].

We suggest using gesture as a "function organ", as a mechanism that can assist in defining properties for a scripted interaction score. These gestural function organs have the goal of paralleling processes to construct Grotowski's concept of mature art: works of "mature interaction".

3. PRIOR WORK IN DESIGNING EXPERIENCE

What do we mean by experience modeling? By bridging domains of performance practice with interaction design and HCI, we are focusing on an area of enacted cognition: the *enactment* of descriptors, or schemas for movement.

3.1 From Experience To Experience modelling

Previous research in the use of exploring experience/ performance methods within the HCI community has occurred in the domain of user-centered and participatory design [10][14]. This has included: *experience prototyping* that fosters an 'empathetic' and 'embodiment' approach to user-centered and scenario-based design [5]; Interval Research's exploration of *informance*: informative performance and *bodystorming*: physically situated brainstorming, *repping*: re-enacting everyday people's performances, and explorations of how Low-tech solutions can create a design environment that focuses on the design question rather than the tools and techniques [6][21]. Salvador and Howells [20] shifted the focus group methods to something they called Focus Troupe: a method of using drama to create common context for new product concept end-user evaluations. Simsarian [26] has explored the use of role-play in extending the richness of the design process. In the *Faraway* project, Andersen, Jacobs, and Polazzi [1] explored story telling and 'suspension of disbelief' within a context of game and play in a design context.

3.2 Building Experience within Performance Practices

In order to provide a context for the techniques we use in our workshops, we introduce an overview of some of the work that has been explored in the performance domain related to constructing models of experience. This discussion is by no means complete, but suggests a range of models that can be borrowed in order to define experience methodologies. For example, Dance Analysis and Somatics specifically construct systematic articulated movement models directly from the *experience* of the moving body. We are interested in applying these models in our work with interactive systems.

Somatics is a term coined by Thomas Hanna in 1976 [12] to label a field that was beginning to develop mind/body integration disciplines using the body as experienced from within. Somatics can be defined as the *experience from within the lived body*, and is an example of first-person methodologies. It includes practices such as Laban Effort-Shape Analysis, Feldenkrais and Alexander technique. From the Somatics perspective, knowledge is constructed *through* the experience of the body [12][13], and requires that experience be directed or focused through *awareness*. Somatics differentiates between conditioning and learning. In these terms, experience alone is not a pre-cursor to knowledge acquisition, since experience alone could result merely in conditioning, or in accessing conditioned responses. In Somatics this would be termed "somatic amnesia". However, when experience is specifically directed through the focus of attention, knowledge acquisition takes place which can be referred to as "somatic learning", an activity expanding the range of what Hanna [12] terms volitional attention. In our workshops, we specifically using methods to direct and access attention, (what we termed earlier as *attention modeling*). Attention modeling enables us to create affordances to access specific body states that increase awareness. In our workshops, we were interested in creating repeatable, enactable, embodied states that could be used in interaction design. While Csikszentmihalyi [7] suggests that human experience operates within a limited field of attention, other movement systems within Somatics consider attention to be a *generative* attribute of awareness that can be augmented, increased through a process of somatic learning [12], or conversely, limited or atrophied through a process of somatic amnesia.

Rudolf Laban's movement analysis systems [15][19], and the work of other researchers such as Bartenieff [2] and Blom and Chaplin [3], are examples of physical methods to create gestural typologies based in experiential practices of dance [24][25]. These systems model a range of qualities and modes of movement. Laban and Bartenieff's work creates a systematic description of qualitative change in movement. Blom and Chaplin create a set of exercises that explore choreographic techniques for movement generation. We use aspects of these typologies for gestural mapping and modeling qualitative movement characteristics such as intentionality, interest, attention and body state. They present experience models for the classification of aspects of movement, and define a means to approach gestural and choreographic protocols.

Participatory design, experience design, performance, theater, dance and somatics share a common focus in modeling or representing human experience. These domains also share the ability to articulate and explore engaging experience through movement, emotional response, sensorial qualities, and temporal/dynamic qualities of experience and of movement.

4. EXPERIENCE WORKSHOP DESIGN

To develop an interaction model for our installation, a series of workshops were designed. The workshops modeled participant experience of non-verbal expressive gesture that shared and communicated physiological data. At the beginning of our workshop process we included four categories of physiological data: breath, heart rate, galvanic skin response (GSR) and brain signals. The workshop exploration utilized choreographic methodologies in order to create gestural movement vocabularies.



Figure 2. Experience Modeling *connection* and *extension*

In the context of this work, workshops are a formal, scripted experience in which a specific physical experiential concept is explored, tested and documented for the purpose of developing an interaction model. The term workshop is borrowed from its performance context, where a script or form is ‘acted out’, ‘acted through’, and explored with the intention of testing, developing and iterating a theatrical model. This theatrical model also becomes the foundation for the interaction | technological model: the model that provides a basis for the development of the interaction through the technology. As with the theatrical model, the interaction | technological model, includes a set of experience concepts such as intention, gesture, direction of focus or attention, relationship, rhythm, body-state, and use of, and attitude to space. This model creates a formal container for experience that includes a physical as well as technological description, and is a process that enables an evaluation, assessment and analysis of the formal relational elements that operate successfully or unsuccessfully in the construction of that experience.

4.1 Workshop Design: First come First Play

We made use of a series of workshops in order to investigate and prototype the representation of experience for the forthcoming installation. The workshops were designed in the following manner: Each workshop had up to 12 participants with a maximum duration of about 45 minutes. Participants were students and employees at Simon Fraser University and participation in the workshops was assigned on a *first come first play* basis. Invitations were e-mailed to the University School community each week, with a simple subject line such as “invitation to listen”, where <listen> is the title of the workshop. Contextual or conceptual information was purposefully left out of the e-mail exchange and workshop formats, creating an affective, metaphorical, yet ambiguous framework [11] for the invitations. The workshops took place once a week over 5 weeks. Each workshop was divided into two components or exercises that encompassed an overall theme represented by the name of the workshop. Each exercise was based on clearly stated tasks represented by the theme. For example, the exercises in the <listen> workshop were *listen inside* and *listen outside*.

The facilitation of the workshop followed a designed script, and attention was paid to using everyday non-specialized language.

The themes/names of the workshops were *listen*, *between*, *mutate*, *extend* and *phase*. After each segment of a workshop the participant was asked to write their experiences on a single card which included two to three simple open ended questions. Participants were given time to write, note or draw their experiences in long-hand written “journaling” form. The workshops were conducted in a ‘blank’ circular space delineated with ‘theater black’ curtains. The workshops were videotaped and photographed throughout.

Figure 3. response card example

In the following section we describe a selection of workshop experiences.

4. 1. 1. workshop <listen>

themes: listening/awareness/body-data/self to self

One of the major themes of *whisper* is the notion of ‘paying attention’ to one’s self. As the installation centers on measuring physiological data as a representation of one’s own self, data that we are not normally aware of in our day to day life, the first series of experiences and experience questions relate to how we perceive and deal with shifting attention to our own data, to having access to, and agency over our own heart beat, our own breathing, our own thoughts, our own body.

This experience was initially prototyped in the workshop exercise called <listen>. The participants were asked to walk around until they found a place for themselves in the space. They were asked not to speak. A facilitator then gave each of them a pair of earplugs and they were then left alone with themselves with no further instructions for about 15 minutes. At the end the earplugs were collected and each participant was handed a card (see fig. 3). The card asked the questions: What did you hear? How did you hear? What did it feel like?

In the space of experience, this is the simplest of experiments. By depriving the body of its external hearing we become aware of the internal sound that is otherwise drowned out by the louder external sounds. We are removed from our own ears, but not from our hearing. In performance, artists like Pauline Oliveros and Augusto Boal have created practices such as “deep listening”, and “listening to what we hear”, which probe and access these very same questions of experience. The responses to the question on the cards: What did you hear? focus on this. Responses indicated the participants’ discovery of the internal soundscape.

‘Heartbeat; earplugs as they settle, breath, slapping sounds from others in the room; humming noise; myself; contact with my own body’

This seems to trigger strong emotions ranging from slight unease to feelings of fear or elation in the answers to the question: What did it feel like?

'I felt self-consciousness about all the sound that body makes; it wasn't sound; it was movement, vibration. I could hear the movement of my body'

'Pain, shifting between past and present; fear / calm'

'Normal, I'm alive; Invigorating - breath going in and out with "normal" rhythm, and changing properties'

Some workshop participants were able to shift their internal awareness to recognize that listening occurs not only through the ears, but also through the bones, the resonant cavities of vibration in the body, that the body is a metaphor for listening, and that, what is heard, is not only sound, but movement, vibration, feeling, and sensation.

4.1.2. workshop <between>

themes: awareness/attention/sending/receiving/self to other

The ability to transfer data to another person and the willingness to enter into an exchange of information that is otherwise private and 'unknown' is the other main theme for whisper. In order for such a transfer to work, the participant needs to engage or invite trust not only to the other, but also to the 'listening' self.

In order to investigate the invisible transfer of personal data, and the trust of the self, we created a workshop experience we called <between>.

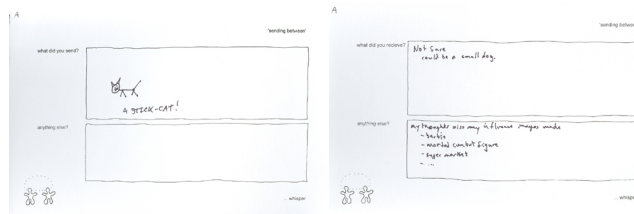


Figure 4. sending and receiving invisible signals

At the beginning of the workshop, the participants were asked to find a space for themselves and begin to move in slow motion, as slowly as possible. They were then left to move very slowly for 10 minutes without speaking.

In Dance practices such as Butoh, this technique is utilized to enable the body to shift its attention to an immersive state in relation to its environment, what Csikszentmihalyi would term 'flow', where attention is intensified, and sensory details are sharpened.

The workshop participants were then asked to pair up, with one person selecting the role of *the sender*, and the other selecting the role of *the receiver*. The sender was asked to silently create an image for two minutes, and then send the image to the receiver, while the receiver was asked to simply pay attention to 'listen' for what image 'came to mind'. At the end each participant was handed a card with the questions: What did you send? What did you receive?

What did you send? *"A stick cat!"*

What did you receive? *"Not sure, could be a small dog"*

4.1.3. workshop <extend>

themes: transfer/sharing/play/self to other

As stated in the previous workshop, transferring private, internal and personal data to another person requires a willingness to enter into a private exchange of information. The participant needs to invite trust with the other, and also engage in a level of agency as to whom, and where, this exchange takes place.

We wanted to continue to investigate these issues of privacy and trust using physical objects that could mediate the interaction through physical gesture. We created a workshop experience we called <extend>, which augmented the invisible data with a non-digital amplification device. The participants were given ordinary medical stethoscopes and a small booklet with ten identical pages. On each page there was space to write or draw and each page had the questions: Where you listening? What did you hear?

'I felt like I was inside myself the pounding amplified my perception of myself, yet my breathing made me feel close'

'My friend stood up and tried to hear my heart, it was hard, I heard my heart, I heard low voice'

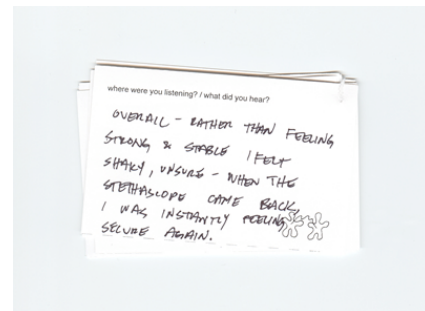


Figure 5. Response Card Sharing Physiological Data

By introducing the stethoscopes we gave access to another type of body data. More importantly, we introduced the possibility of sharing this data with someone else. The design of the stethoscope with a 'listening' end and a 'probing' end allows for the data to be shared by either probing someone in order to investigate their data, or giving someone the earpiece to offer them a particular sound. The latter gesture of offering inverts the interaction model of probing or surveillance, to an interaction which invites and affords intimacy, trust, and peer connection.

4.1.4. workshop <mutate>

themes: permission/control/exchange/touch/islands/snaps

By introducing the possibilities for sharing we immediately encounter notions of permission, surveillance and thresholds of privacy. The following workshop introduced Galvanic Skin Response [GSR] data, and investigated thresholds of boundary, agency, and control.

In the first exercise of the workshop the participants were given white men's shirts that were attached by simple sewing [basting] into pairs at various locations such as the seam of the sleeves, the back shoulder seam, and the seam at the cuffs. Each shirt pair set had a unique contact seam; no two pairs were connected identically.



Figure 6. Exploring Transfer | Play | self to other

The participants were instructed to put on the shirts and button them up. This is a difficult task that requires the pairs to cooperate, both physically and socially, but it also dictates a close proximity between the participants. A series of movement related tasks followed. As in each workshop experience, following the experience, participants were given cards to fill out. An example of the challenges in allowing this proximity is present in an answer to the question: How did you change?

'I wouldn't have gotten that close/intimate under normal circumstances'

In the second half of the workshop the participants were grouped again in pairs and given primitive boards that measure GSR. The boards were constructed in such a way that one of the participants is wearing the sensors [simple metal points of two fingers] and the other has the output [a red LED] pinned on the shirt and connected to the board with a long wire. As the GSR goes up or down the red light brightens or dims. The participants were also given small booklets asking the question: What did you feel?

'As an observer, a recorder, an instigator, responsible'

Here we see an example of one type of response to this particular sharing situation. The first responder classifies him/her self as the passive observer of the other, but since the output of the GSR is closely related to emotional excitement this observer, also feels involved and responsible. By taking responsibility for the output you also take responsibility for the object of your observation.

'I do not know, Dennis is not showing me my output, I will attempt to limit my input to nil, to avoid detection'

This is an example of another group of responses. The observed party feels exposed by the observer not allowing access to the output data and as a consequence the observed participant will deliberately try and influence the result. In this way the observed party changes the rules of engagement and turns what was a probing of emotional personal data into a game.



Figure 7. Extension | Creating One Larger Body

4.1.5. workshop <phase>

themes: extension/body image/creating one larger body

By creating gestural protocols that facilitate sharing and exchange there is a potential blurring of the boundaries between the participants as well as between what is inside and what is outside.

The next exercise is investigating this blur, as we asked participants to put on men's shirts again. This time the shirts were given sticky Velcro patches to apply connection points anywhere they wished. The participants were then encouraged to experiment with moving as each pair of shirts have different possibilities for movement and control. The cards asked the questions: How did you extend yourself? How did you move?

How did you move?: *'Held hands with someone other than my husband; became silly; enjoyed the unusual and unknown; became aware of another's movement'*

How did you move?: *'I found myself thinking of our 'body' as a complete unit - it just had this other piece I wasn't controlling; the attached arm felt very unusual once I got complete control back'*

How did you move?: *'I was no longer just myself, I had to extend myself to become a part of a whole; as a whole we had to work together; when we failed it was almost disappointing because we were apart'*

Here we see several examples of body extension. It is interesting to see the apparent disappointment when the appropriated body gets separated or the combined body fails to complete a movement task.

4.2. Workshop Results: Experience to Gestural Protocol

During our design workshops, gesture was utilized as an expressive indicator of intentionality, body state, extension of body image, permission, control, exchange and play. The workshops were modeled using a broad range of performance techniques. Improvisation was used in all five workshops, improvising both movement and stillness. Stethoscopes, ear-plugs, blindfolds, heart monitors, GSR sensors were used as props. Men's White Shirts became phantom partners, prosthetic devices and placebo objects. The simple 'black box' curtained circle became a ritual space. We modeled the use of physical attention that incorporated listening, 'sending' invisible messages, and touching to connect one's self to another. We used imagining and visualization to explore movement vocabulary. We focused on somatic attributes such as breath, stillness, and slow motion movement. Journaling in both hand-writing and drawing was used as a method of documenting, archiving and expressing. The workshop participants integrated social navigation using gesture to express permission, trust, exchange, and feeling. And the white shirts as costumes along with various props, modeled and expressed physical extension, connection and group identity. The design of the stethoscope with a 'listening' end and a 'probing' end allowed some participants to invert the normalized medical surveillance 'probing' model of listening in favour of giving someone their earpiece to offer them a particular sound.

The workshops contained a broad range of experience results that enabled us to construct gestural protocols within the installation. We continually came back to the main theme found within the workshops, and the artistic aim of the installation: that 'paying attention' to one's self enables a re-direction of attention with a greater access to optimal experience [7]. The workshops responses illustrated that the body can become a metaphor for listening, and that what is heard, is not only sound, but movement, vibration, feeling, sensation, and the self. We discovered that some workshop participants were able to shift their internal awareness to recognize that listening occurs not only through the ears, but also through the bones, the resonant cavities of vibration in the body.

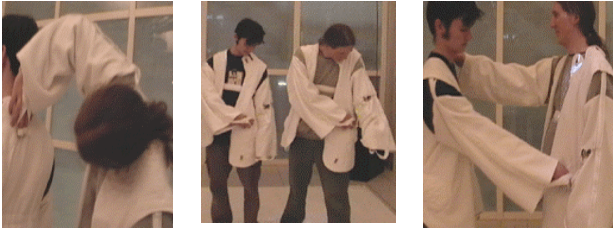


Figure 8. Gestural Interaction in the Installation

In Theatre and Dance practices such as Noh and Butoh, the slow motion technique used in the <between> workshop enables the body to shift its attention to an immersive state in relation to its environment, where attention is intensified, and sensory details are sharpened.

Augusto Boal [4] terms these types of experiential exercise *de-specialization*. He states that in our every day lives “the senses suffer. And we start to feel very little of what we touch, to listen to very little of what we hear, and to see very little of what we look at. We feel, listen and see according to our specialty. The adaptation is [both] atrophy and hypertrophy. In order for the body to be able to send out and receive all possible messages, it has to be re-harmonized [through] exercises and games that focus on *de-specialization*.” Our workshop series are related in form and function to Boal’s *arsenal of theater series of listening to what we hear*, exercises of the 4th series: *rhythm of respiration*, and 5th series: *internal rhythms*.

The workshops met their goal of modeling experience that could be replicated, re-enacted, and re-played in the context of a public art installation using wearable computing technology, where the public art space was simultaneously intimate, playful, and social. As a consequence we selected a subset of successful gestural interactions to be specifically modeled within the installation.

5. DESIGN CONSEQUENCES

The workshops were the basis of the concept design, interaction model, and development of the *whisper* installation. The workshops made it possible to probe and investigate the underlying interaction issues early on in the hardware and software development process. A significant design outcome from this process was the importance for each body to physically control access to their privacy, and allow shared play of their own body data. This was enacted in the installation by the Gestural Protocols discovered during the workshops, where costumes or white shirts expressed physical connection and extension of the body through ‘sticky’ connection points.

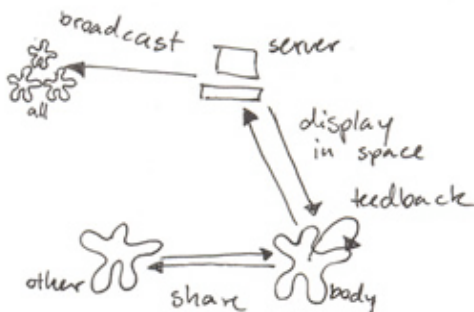


Figure 9. State Spaces: Self to Self | Self to Other

In the workshops these connections were ‘sewn’ together, or explored through Velcro fabric swatches that enables participants to play with connection placement. These connection points were engaged through ‘feel’ or ‘touch’ rather than through a visual symbol or natural language interface.

As a consequence of this workshop exploration we designed a tactile interface to the wearable garment. This consists of a set of wired clothing snaps attached to the right hand fingers of the participant and a series of tactile ‘islands’ placed in various positions on the wearable device. These islands are small id chips wired up to matching sets of snaps. By touching the snaps of an island with the finger-snaps the participant can choose and mix between the different sets of body data coming from his or her own body. In order to access data you have to negotiate physical and social interaction of touching someone.

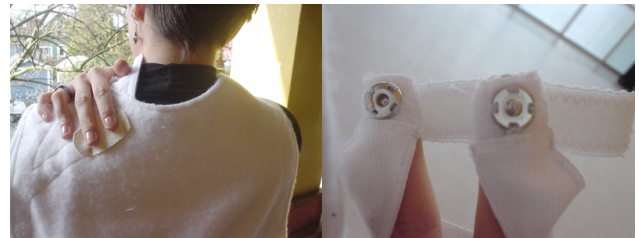


Figure 10. Garment Design | Snaps | Connection

The islands are made from different textures to allow the participants to navigate the data through touch and feel.

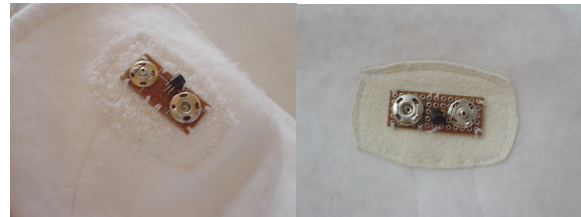


Figure 11. Snap Islands “Textural” Recognition

6. CONCLUSIONS

Our work in designing and testing experience models has illustrated that we can augment experience design with first person performance methodologies found in Theatre, Dance and Somatics. The differing frames of reference between the domains of HCI and performance practice reveal an under-theorized area of practice, which can be explored through experience modeling. We have explored embodied interaction as a reflective process that is simultaneously inter-body and intra-body. In addition, we have provided a case-study for a model of designing embodied interaction. We have applied the use of gesture as a “function organ” [18], as a mechanism that can assist in defining properties for an interaction score that Grotowski [23] describes as scripts, or *points of contact*. The experience with the installation illustrates that participants can learn to shift their own threshold of attention, awareness and body-state through the interaction affordances created within the gestures and embedded within the garment. They participate in “becoming expert” users of their own physiological data, and in playfully engaging with an emerging co-operative and physically and emotionally negotiated body state and collective system state. Social navigation is created through

the participants' perceived internal body data flow [through the fingers, or connection snaps] and represented through the actual data flow [through the server]. As such the installation is also its own experience workshop, and is a starting point to continue to explore methodologies of experience modelling.

7. FUTURE WORK

As an installation, *whisper* was an initial exploration of modeling experience through gestural protocols that led to the design of an interaction language facilitated by wearable garments. The *whisper* hardware remained relatively low level due to bandwidth and memory constraints, physiological data patterns were explored directly through server-side visualization, without the development of context aware intelligent devices. Mapping more complex data relationships to body state and intention were not explored or modeled in this work. *whisper* illustrated that participants could become playfully engaged even in simple feedback loops of "attending to" their heart rate and breath, and sharing that data with other in the space. *whisper* also pointed to next steps in research: exploring mapping and 'meaning' in data patterns across participants body state, extending types of physiological data [brain waves, GSR, temperature], types of output actuators [vibration, local sound, local motor memory], as well as building an intelligent model of interaction which includes memory, resonance and meaning in the devices themselves. Perhaps most importantly, we are interested in continuing explore workshops that model experience by bridging first person methodologies used in performance practice with those of interaction design.

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Cross-Dressing And Border Crossing: Exploring Experience Methods Across Disciplines

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Abstract

As designers of interactive systems (spaces, process and products for people), we find ourselves stretching the limits of methodological structures that enable us to explore, build, communicate, and prototype experience. This workshop aims to investigate divergent disciplines that each contains rich knowledge and rigorous methodologies for addressing human experience in interactive systems.

Categories & Subject Descriptors: H.5.2 [Information Interfaces and Presentation]: User Interfaces — Theory and methods; H.53 [Information Interfaces and Presentation]: Group and Organization Interfaces — Theory and models; [H.1.2 [Information Systems]: User/Machine Systems — Human factors.

General Terms: Design, Human factors, Theory

Keywords: experience design, interaction design, interdisciplinary methods, prototyping.

INTRODUCTION

As designers of interactive systems (spaces, process and products for people), we find ourselves stretching the limits of methodological structures that enable us to explore, build, communicate, and prototype experience. We argue that designing experience requires a ‘re-dressing’ of methodological practice, and that HCI can benefit from drawing on methodological frameworks that traditionally fall outside of its purview. Domains such as performance, theatre, dance, architecture, conceptual design, industrial design, and visual art each contain rich knowledge and rigorous methodologies for constructing experience. Each of these domains defines experience, experience qualities and attributes, and defines affordances for enacting [and re-enacting] experience as a fundamental methodological tool in the respective discipline.

We invite participants from multiple disciplines across and within HCI, including kinesiology, performance, visual art, architecture, anthropology, organizational research, computing science, visualization and engineering. Participants are expected to be practitioners exploring unique methodological frameworks for designing technologically mediated experiences that live in technologically mediated

environments. Participants will be expected to share, explore their methodologies for constructing and designing experience. Our fundamental assumption is that experience matters. We assume that an understanding, exploration and sharing of experience design is central to HCI. Building experience is an interdisciplinary practice, we invite participants to share and explore the diverse practices that contribute to the evolution of methodologies for designing experience.

GOALS OF THE WORKSHOP

The focus of this workshop is to cross boundaries, assume other roles in order to experiment methodologically and to establish a new common knowledgebase aimed at design and human experience. We see this as a step toward establishing a community of practice within HCI. We propose the following key issues as points of departure and exploration during the workshop:

- In today’s HCI landscape, experience is felt, defined and modeled across multiple media and disciplinary domains, and environments. This provides a scope challenge that requires creative solutions derived by a diverse community of practice.
- Members of this community can engage each other in a cross-disciplinary dialogue around the task of creating positive “user experiences”.
- In doing so each practitioner sits at the experience design table with a slightly different set of assumptions, knowledge, methodology and context around what it means to consider user experience.
- The considerations related to user experience in each discipline are unique and valuable in their own right. It is important to recognize this and embrace alternate perspectives.

THE WORKSHOP ACTIVITIES

The workshop will be divided into three main parts with the key goals of finding a more common language around problem setting, hybridizing practices for the development of criteria for new methods, and reflecting on the cross-disciplinary practices of each team.

Part 1. Problem setting: Organizers and participants will present and review several of the experience scenarios. Activity and discussions will center on developing a set of shared analysis and language for defining and problem

setting interaction experiences. In addition to discussions, organizers expect group activities in the form of role-playing, re-enactments and re-articulations as a form of analysis.

Part 2. Practice and play: Teams will brainstorm and “prototype” new methods that could address the understanding of the problem articulations that emerged in part 1. The activities will shift from structured “brainstorming” to open ended development of a method within a condensed period of time. The activity will end with a “swapping” of methods to be used by another team to address the problem situations from part 1.

Part 3. Reflection and mirror-gazing: A key goal of the workshop is to identify criteria for new methods while also identifying the rich and diverse set of practices that can be pulled in within HCI in order to respond to experience interaction situations. Teams will be asked to discuss and report out on three key items: criteria for methods, identification of the intertwining of practices within their methods and methods from other teams, identify key disciplinary and non-disciplinary connections within the teams and in other teams. The workshop in plenary will discuss the reports as a possible group report that identifies issues of methods, cross-disciplinary knowledge sets, and key relationships and connections that could form the basis of a community of practice centered on human experience.

RELATED LITERATURE

Terry Winograd was among the first to identify a design practice whose outcome and focus was a qualitative process rather than a “thing” or an object [14]. He labeled this new practice as “interaction design”. Winograd identified the need to focus on the perceptual and psychological aspects ‘of human experience by rooting interaction design equally in graphic design, psychology, communication, linguistics and computing science. A key genesis point in the evolution of “experience” as a design concept is the work in the 1930s of the industrial designer Henry Dreyfuss [3]. Dreyfuss’ work in ergonomics lead to the publication of the “Measure of Man”, an extensive database of human measurement to facilitate the design of products tailored to a ‘standardized’ human body. In the late 1960’s ergonomics split into the related science and kinesiology based field of human factors, the political and social movements in Scandinavia that became known as participatory design [4, 8], and the cognitive science and design methodology of user-centered design [11]. Design experience was seen in surprisingly different lights, one functional the other social and political. Enabling the audience experience was also a key goal of theorists and practitioners of the fields of performance and theater, namely the Russian, Vsevolod Meyerhold [1], and later the work of theorist and theater director Jerzy Grotowski [6]. This tradition directly informed the concepts of interactive design from the early work of Norman Bel Geddes [9] to today’s interactive technology experiences and

environments [2, 10]. In the field of computing science, particularly in the field of HCI (Human Computing Interaction), experience design is viewed as an extension of user-centered design methods [7, 13]. This approach has a particular focus on the “User Experience” aspect of design, in particular, quantifying the interactive experience as a means to determining standards for interface and interaction design. On a methodological note, some of the framework of this workshop is indebted to the work Donald Schön and Henrik Gednryd [5, 12]

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FlowField: Investigating the Semantics of Caress

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1. Introduction

We have created a new interactive experience piece called FlowField. Participants touch and caress a multi-point touchpad, the MTC Express, in a CAVE (CAVE Automatic Virtual Environment), directly controlling a flowing particle field. Collisions in the particle field emit musical sounds providing a new type of musical interface that uses a dynamic flow process for its underlying musical structure. The particle flow field circles around the participant in a cylindrical path. Obstructions formed by whole hand input disturb the flow field like a hand in water. The interaction has very low latency and a fast frame rate, providing a visceral, dynamic experience. In FlowField, participants explore interaction through caress, suggesting reconnection with a sense of play, and experiencing a world through touch.

2. Interaction Experience

The FlowField installation allows participants to immerse themselves in a virtual flow field of particles (Fig. 1) displayed on a four-screen CAVE. By using hands and fingers on the MTC Express, users can interact directly with the flow by introducing obstructions in the path of the particles (Fig. 2). The effect is not unlike placing one's fingers into a stream, experimenting with blocking the flow of water. The experience is complemented by a dynamic soundscape caused by the particles striking the obstructions. The combination of sound and visual sensations brings the interaction activity to life, ebbing and flowing in intensity with the particle flow, as directed by you.

By applying one's hands and fingers onto the MTC Express in different ways, interesting flow patterns can be developed that are aesthetically pleasing. Multiple touchpads can be used to enable a group of users to interact with the same flow field, creating an interplay of particle and sound between users, who can work with, independently, or against each other to generate complex interference patterns, all while immersed in the swirl of activity.

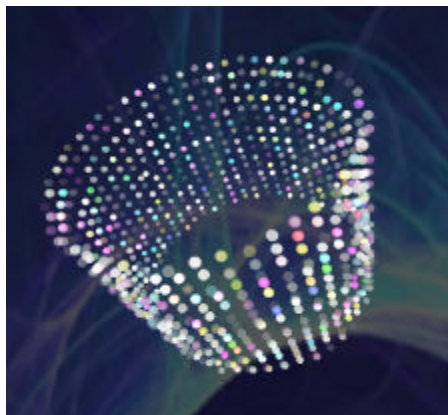


Figure 1: Cylindrical particle field. In virtual space, users are standing inside the cylinder while the particles revolve around them.

3. Motivation

The human sense of touch is as well developed as our senses of sight and hearing. Yet, while there are plenty of devices that deliver and receive visual and auditory information, the same cannot be said for the tactile sense. Even with very complex and compelling virtual reality display systems such as the CAVE, there is often little means of providing tactile input. The FlowField system instead uses the pressure-sensitive, multi-point MTC Express, developed by Tactex Controls, Inc. to give users a new form of tactile input.

Another purpose of this work is to explore the semantics of gesture and its application in interactive systems. In particular, the nature of the touchpad allows us to study interactions between the hand and a solid surface. The important property of this type of interaction is the inherent repeatability of gestures when performed on a fixed surface. This is in contrast to unconstrained gesturing, such as sign language, which can be recognized using glove-based devices or video capture.

4. Related Work

FlowField exhibits several attributes necessary for a compelling interactive installation, including instantaneous response, implemented with low latency and fast sample and rendering rates, and a balance between visual and musical quality [Fels et al. 1997; Fels and Mase 1999]. Furthermore, having a direct relation between action and result and a reflection of self in the stimulus (hand shape seen in obstructions) is an innovation.

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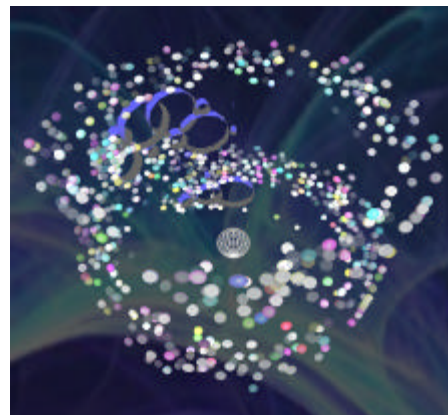


Figure 2: Whole-hand input from the MTC Express creates obstructions (blue circles) that affect the flow of the particles.

Extending Interface Practice: An Ecosystem Approach

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Abstract

Interface ecology is an emerging metadisciplinary approach, in which the creation of rich interactive experiences spans n disciplines -- such as computer graphics, mathematics, gaming, visual art, performance, and cultural theory. Interfaces extend beyond interactive artifacts, activities, and social spaces, forming intricate ecosystems. Interfaces are the catalytic border zones where systems of representation meet, mix, and recombine. Through this recombination, interface ecosystems generate fundamental innovations of form, experience, knowledge, and technology. This panel brings together a diverse range of practitioners who work from concept to experience not in terms of a particular discipline, métier, or medium but with a practice that interconnects multiple systems, forming a whole.

Keywords: interface ecology, interface, metadiscipline

1 Introduction

The creation of rich interactive experiences spans an n-dimensional conceptual space, in which disciplines -- including computer graphics, mathematics, gaming, visual art, performance, and cultural theory -- function as basis vectors. Interface ecology is an emerging metadisciplinary approach. In this ecological approach to interface, developers assemble diverse media (along with their epistemologies and creative, technological and semiotic processes) as expression. This gives form to human experience.

In social spaces, people's activities and behaviors are connected through interactive artifacts, processes and experiences. Interfaces extend beyond these artifacts, forming intricate ecosystems. Interfaces are the border zones where systems of representation meet, mix, and recombine. Through this recombination, signs - the semiotic units of meaning -- flow into new configurations that engage participants. The structure of interface ecosystems has a catalytic effect on these processes of recombination and engagement, setting emergent phenomena into motion. Interface ecosystems generate fundamental innovations of form, experience, knowledge, and technology.

This panel brings together a diverse range of practitioners who work within an ecological framework: *who ecologize*. Each of the panelists moves from concept to experience not in terms of a particular discipline, métier, or medium, but with a practice that interconnects multiple systems, forming a whole. They will discuss their processes of assemblage, and results that have emerged. They may also look to the future, and brainstorm about how the ecosystems approach will influence new interfaces.

2 Natalie Jeremijenko

Validating Interaction with Tangible Devices

Tangible interfaces to information technologies combine digital information and physical devices. These have proven popular, mediagenic, and yet remain difficult to validate. Of the accounts

for the success of these interfaces, none provide empirical evidence or measures. I will present recent studies that examine the interactive activity with tangible interfaces, vis a vis a screen based display of the same information and purpose. The common claim, that Tangible Media is 'more intuitive' by virtue of its familiar physical form, is refuted by this data. Naïve users made more errors with the tangible media devices than with the well-codified interaction strategies of screen based interaction. Nonetheless, this work does find evidence for the effectiveness of Tangible Media. Understanding how tangible media works requires the capture and measurement of the interaction through over and around, rather than with interfaces. This study presents evidence for understanding: a) the role of the physicality of tangible media; including its persistence and attention directing function; b) the role of peripheral participation, monitoring and interaction in the different contexts and applications; c) the role of shared use on interaction including: how errors are corrected and variability managed; how skill is developed; how to characterize a 'use career' of these applications; how multi-user interfaces effect the single user interaction; what aspects of the information and interaction scripts presented are legible to a wide variety of users and which are prone to more misinterpretation (or variability in interpretation); the role of open-ended interaction scripts.

I will show video data of the interactivity that is staged around the tangible devices in four studies. Building on these findings, I present several new projects that extend the potential of Tangible Media. One set of projects exploits mechanical actuation as the parameter with which to display information, and a second set of projects adapts the nonphysical strategies of tangible media to several screen-based interfaces.

Natalie Jeremijenko is a design engineer and technoartist, whose work examines how technology works, in technical and social accounts. Recently she was named one of the top one hundred young innovators by the MIT Technology Review. Her work has been presented at Tate Gallery, MASSMoCA, Rotterdam Film Festival (2000), Guggenheim Museum, Museum Moderne Kunst, Frankfurt, LUX Gallery, London, Whitney Biennial, Documenta, Ars Electronica, the Museum of Modern Art in New York, and at MIT Media Lab. She was a 1999 Rockefeller fellow. She did graduate engineering studies at Stanford University in Mechanical Engineering, and at the University of Melbourne in the History and Philosophy of Science Department. She is known to work for the Bureau of Inverse Technology.

2 Thecla Schiphorst

Body Interfaces: Navigating Sense and State Space

Dominant western paradigms underlying the development of digital technologies have typically excluded knowledge domains of experiential body practice. Interface design can be informed by, and extended through the application of methodologies articulated within these practices. These include fields of somatics, theatre, dance, and non-western movement forms such as tai chi and martial arts. Rigorously articulated, first person or experiential

methodologies provide models for knowledge acquisition, information design, networked connectivity, remote sensing and ecological multivocality. Applications of these models suggest an ecosystem approach in which inter-activity is coupled with inter-subjectivity and inter-affectivity.

Body interfaces can share system states between multiple bodies and their multiple interactions. The answer to the question ‘What is Body?’ is an evolving, shifting construction in the arts as well as the sciences. Within interface practice, intentional grammars can be developed to intermingle meaning, presence and agency. We need to draw on our ability to dynamically map our understanding of ‘what is body’ into interface practice. We can alleviate current expressive impoverishment to extend dynamic range, by including the intimate, the intelligent, the sensory, and the taboo. I will illustrate these concepts through my work,

In *Bodymaps: artifacts of touch* (1996), the input of touch re-directs and re-positions the habits of our visual perceptual systems. This creates interplay between the liminal, sensual connections made through the direction of the body’s attention. *whisper* is a new work based on small wearable devices and handheld technologies. The *whisper* [wearable, handheld, intimate, sensory, personal, expressive, responsive] system constructs networked messages based on inferred states of the carrier bodies [which host the small wearable devices]. *whisper[s]* are wearable body architectures. Intention functions to direct and apply whispered messages, which range between direct and subliminal, suggestive and overt, seductive and definitive.

Thecla Schiphorst is a Vancouver based computer media artist, and an Associate Professor in Interactive Arts at Simon Fraser University. She is the recipient of the 1998 Canada Council biennial PetroCanada Award in New Media. Her formal education in computing science and contemporary dance has shaped her work, which integrates models of scientific representation with the experience of the physical and technical body. She is a member of the original design team that developed Life Forms, the computer compositional tool for choreography, and has worked with choreographer Merce Cunningham since 1991. She is a PHD Candidate in the CaiiA-Star program at the University of Plymouth in the School of Computing, and has an interdisciplinary MA in computer compositional systems from Simon Fraser University.

3 Michael Mateas Expressive AI

My work is in Artificial Intelligence (AI) based art and entertainment. I simultaneously engage in AI research and art making, a research agenda and art practice I call expressive AI.

Expressive AI has two major, interrelated thrusts: (1) exploring the expressive possibilities of AI architectures - posing and answering AI research questions that wouldn’t be raised unless doing AI research in the context of art practice, and (2) pushing the boundaries of the conceivable and possible in art - creating artwork that would be impossible to conceive of or build unless making art in the context of an AI research practice.

The fusion of art and AI can be conceived of in terms of a shared interest in exploring what it means to be human, and a shared methodology of knowing-by-making. The field of Artificial Intelligence is a recent incarnation of an age-old quest or dream, the dream of building an image of the human in the machine. It is this dream, fueled by science fiction representations of AI such as Hal 9000 or Commander Data, which is the initial inspiration for

many researchers entering the field. This dream is not just about modeling rational problem solvers, but about building machines which in some sense engage us socially, have emotions and desires, and, through our interactions with them, tell us something about ourselves. AI is a way of exploring what it means to be human by building systems. An AI architecture is a machine to think with, a concrete theory and representation of some aspect of the human world. Art also explores what it means to be human by building concrete representations of some aspect of the human world. Artists often explore aspects of humanity which have been under-explored or ignored in AI research.

Combining these two ways of knowing-by-making opens a new path which takes seriously the problem of building intelligences that robustly function outside of the lab to engage human participants in intellectually and aesthetically satisfying interactions which, hopefully, teach us something about ourselves.

My presentation will explore methodological and conception issues in expressive AI, particularly the notion of a doubled system which consists of a technical machine engaging in uninterpreted computation, and a semiotic machine which organizes the rhetorical strategies used to narrate the operation of the machine. These ideas will be illustrated with example AI-based artworks, such as the interactive drama, *Facade*.

At Carnegie Mellon, Michael Mateas is adjunct faculty member in the Entertainment Technology Center, Research Fellow in the Studio for Creative Inquiry, and a PhD student in Computer Science. Michael has presented work at SIGGRAPH, New York Digital Salon, AAAI, the Carnegie Museum, the Warhol Museum, and the Walker Museum. Previously, Michael worked at Intel Labs, where he co-founded GEAR (Garage Ethnography and Applications Research), a research group employing ethnographic techniques to understand how new computing technology fits into people’s lives. Michael received his BS in Engineering Physics from the University of the Pacific and his MS in Computer Science (emphasis in HCI) from Portland State University.

4 Wolfgang Strauss Interfacing Mixed Reality as an Ecology of Aesthetics

To connect the notion of interface with the term ecology reminds me of a passage by Paul Virilio: "traditionally architecture and design are related to interface the exterior world to the human, the design of landscape, buildings, stages etc.; now we have to care both for design of exterior and interior spaces; those new electronic interior spaces, mainly imagery, build up the look and feel of our electronic mindscapes. They are part of the urban ecology."

Unfortunately, ecology in our built environment is usually fed by very traditional visions directed backwards. This makes life quite boring. An example arises in Berlin, a former focal point of cold war. There is a serious decision about rebuilding the traditional heart of the city. The Schloss (castle) represents the hierarchical Prussian state of last centuries. Situated on the Schloss site, and opposite the central government building of the former GDR, the Palest deer Republic (palace of republic), has been renovated at a cost of 80M Euro, due to the ecological disaster of asbestos contamination. The palace building is now finished and will be closed for demolition. Estimated costs to run the building in a provisional condition, giving space for emerging culture, is just 1.7M Euro. Politicians say: "No money, no way."

The vanishing aesthetic awareness of public spaces is beaten by digitized consciousness, somewhere on the net, in favor of a castle

in the air. What we really need are interfaces for living in mixed realities, creating ecosystems rather than constructing artifacts.

The goal of the development of netzspannung.org is an architecture for making visible the interrelations between media art, science and technology. In order to realize this, we are exploring the extension of the common notion of web platforms as means of presenting and sharing information, toward the model of an *online media laboratory*. By this, we mean a web-based platform that combines tools for contextualization of information into a collaborative knowledge space, with tools for active experimentation with networked media spaces. This takes into account the fact that the use of the web for creation and distribution of information in different disciplines (e.g. art, science, technology) is today perhaps the most significant example of mixed realities: the contents of the web represent a myriad of different perceptions of "realities", of "knowledge about" and representations of the world, expressed as networked constructs combining different media (text, image, video, 3D, mobile communications etc.) and often as a result of a collaborative process. Such a highly meditated situation of communicating and constructing knowledge requires new models for discovering contexts and relationships and for understanding how meaning is encoded in complex structures of networked media. This concern cannot be met with the "old" model of a passive user with arbitrarily intelligent" technologies. Rather, tools that enable (empower) the user to actively explore her/his own ways, and construct her/his own models for dealing with information, become essential.

Wolfgang Strauss is an architect. He has held teaching positions in Interactive Art at the HDK Berlin, at the KHM Media Art School Cologne, at the School of Fine Arts Saarbrücken and the Kunsthochschule in Kassel. He co-founded Art + Com, Berlin. Currently he is research fellow at the Fraunhofer - Institute for Media Communication. In opposition to the theory of the disappearing body, he introduces intuitive interfaces for playful interaction. His work has been presented at ZKM, Nagoya Science Museum, SIGGRAPH, ICC Tokyo, Imagina, ISEA and was awarded with the Golden Nica at Ars Electronica 1992.

5 Will Wright SimCity and The Sims

One of the primary roles of any designer is to fully represent the end user of a product. As a game designer I find myself not just standing in for the typical player but for all potential players regardless of their skill, interest or motivation. Many recent games are beginning to "leave the box", that is they're using web sites, player customization tools, databases of player-created scenarios and so forth to expand the scope of what users can do with the product. In a sense the players are becoming more and more an integral part of the development team. As a more diverse set of player activities becomes available the players themselves diversify to fill these niches. The different niches of player activity (tool builders, skin artists, web masters, browsers, casual players) grow to be quite interdependent and self-supporting. The game community functions as an ecosystem. As the activities around a product leave the box, so must the responsibilities of the designer. I used to think that my job as a game designer was to create a cool game, I now think my task is to facilitate the creation of a cool community with a game at the core.

Will Wright is the creator of both the SimCity and The Sims franchise. SimCity was released in 1989, and within a few months became a hit. The latest incarnation and definitive version of SimCity, SimCity 3000 Unlimited, has continued in this

tradition. Wright's game, The Sims, puts players in charge of the lives of a neighborhood of simulated people. Released in February of 2000, this title has become a cultural phenomenon. The Sims has sold over 5 million copies worldwide to become the best selling PC game of all time. The Sims has inspired four expansion packs; Livin' Large, House Party, Hot Date and Vacation. Combined sales for The Sims' franchise total 11 million units life-to-date. Next up for Wright is The Sims Online(tm). Scheduled for release in the second half of 2002, The Sims Online will enable you to take your Sims to an online world where you get to be yourself or whoever you want to be.

6 Andruid Kerne The Conceptual Space of Collage

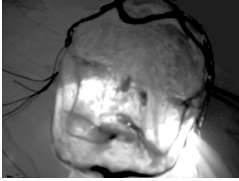
CollageMachine [<http://mrl.nyu.edu/collagemachine>] is a creative web visualization tool that learns while you surf. Instead of waiting for you to click a hyperlink, the program proactively crawls the web, seeking content of interest. *CollageMachine* parses websites, modeling the web as collections of linked documents and their constituent media elements - images and chunks of text. These media elements continuously stream into a dynamic, user-interest-driven collage.

You can use collage design tools to create your own look and feel. By engaging in visual design, you also express dis/interest in media elements. *CollageMachine* learns about what you like from these interactions, and annotates its model to represent your interests. Decisions about what content to pursue and how to build the collage are made according to the model. The Collage Visualization Grid allocates screen real estate and history-enriches collage elements as a representation of your intentions. Unlike typical information visualization systems, perceptible structure develops bottom up. Navigational trajectories and combinatorial concepts emerge. The user experience blurs boundaries between web browsing and art-making.

The *CollageMachine* interactive artifact and the interface ecology theoretical framework are being co-developed, through back and forth loops of reference on multiple levels. *CollageMachine* promotes the emergence of new ideas through hypermedia combinations. Interface ecology, as a metadiscipline, investigates the process of combining whole systems of representation. This investigation proceeds both structurally, and in the situated contexts of particular applications, connecting theory and practice. For example, through investigation of *collage* and *emergence* -- in the context of *CollageMachine* development -- their application on the conceptual level -- in interface ecology -- became apparent. Thus, in this co-development process, theory does not inform practice simply; rather strange loops of reference, operation, and influence emerge through multiple levels of collage.

Andruid Kerne [<http://www.andruid.com>] is a research artist scientist who specializes in information visualization, agents, databases, audio, video, distributed real time systems, and public installation. He opens the range of social processes embodied by computational artifacts, for instance, substantiating play as a mode of activity and interaction. His work has been presented at SIGGRAPH, SIGCHI, the Guggenheim Museum, New York Digital Salon, ISEA, Milia, Ars Electronica, and the Boston Cyber Arts Festival. Kerne holds a B.A. in applied mathematics from Harvard, an M.A. in music composition from Wesleyan, and a Ph.D. in computer science from NYU. Andruid was recently a visiting professor at Tufts University, where he taught courses in human computer interaction, object oriented game programming, and public web installation.

pulp fashion | wearable archi[ves]tectures



[fabricating the whisper project]

authors: Thecla Schiphorst and Susan Kozel

on-line essay at:

<http://deaf.v2.nl/deaf/03/221-117-229-207-116-102-152-49-79-100-19-11-14-99-208-171.py>

wearable | handheld | intimate | secret | personal | expectant | response | system
wireless | heuristic | invisible | sensory | private | environmental | reproducing | system

networked | wireless | computer interactive | telepathy
video | audio | physical response | invisible | desire
installation | performance | mapping | unearthing

abstract

This essay explores the conceptual, technological and physical processes of the whisper project. whisper is a major collaborative art research project based on engineering small wearable devices and handheld technologies resulting in a participatory installation.

*whisper is a [wearable, handheld, intimate, sensory, personal, expressive, responsive] system which constructs networked messages based on inferred states of carrier bodies – the hosts for small wearable devices. whispers are wearable body architectures. This essay elucidates the **creative and collaborative processes** which include collective first person methodologies, and our version of the 'sewing circle'; the phenomenon of the **participatory installation** as an emergent, non-hierarchical performative form; the **aesthetic** of whispers which emerge directly from handworked fabrication of the materials: (sensors, circuits, electronics embedded in latex, silicon, rubber, and the body) in a play across the opaque, translucent, transparent; and reconfiguration of **attitudes toward the body** which allow for our corporeal selves to be seen as fluid, networked and dynamic systems with concealed information to be unearthed and mapped onto linked and networked devices. whisper appropriates the attention, breath, brainwaves, heartbeat and affective qualities of a community of participants, rewriting them as shared signals on the network. Data flows are generated and represented in intimate connection with the bodies that produce and alter them.*

The concept of 'pulp fashion' is a metaphor for the impermanence of physical states. We borrow from Maurice Merleau-Ponty's concepts of the invisible and 'pulp of the sensible'. whisper 'pulps the sensible', de-frocking the habitual, shredding our non-physical rationality. It 'nips and tucks' at the subtleties of our bodies. As devices are

designed to link our breath and gesture, pulp fashion also becomes a source of 'inspiration'. whisper devices intimate the invisible as tactile and kinesthetic. Flesh is the connective tissue spanning the organic and the inorganic.

introduction

Visible and mobile, my body is a thing among things; it is caught in the fabric of the world, and its cohesion is that of a thing. But because it moves itself and sees, it holds things in a circle around itself. Things are an annex or prolongation of itself; they are encrusted into its flesh; they are part of its full definition; the world is made of the same stuff as the body. (Maurice Merleau-Ponty, 1961:163)

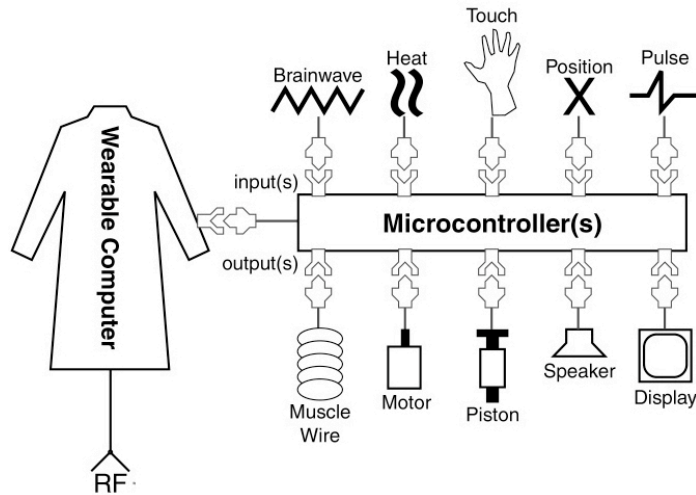
whisper is a participatory installation based on small wearable devices and handheld technologies. *whisper[s]* are wearable body architectures. *whisper* networks the inferred states of carrier bodies – the hosts for small wearable devices. *whisper* takes place in an installation space and on the web. It generates and represents data flows in intimate connection with the bodies that produce and alter them. *whisper* builds upon physical practices such as dance improvisation, and manifests cultural and scientific theories of embodiment.

whisper aims to unearth physical data patterns of the body, mapping that data onto linked and networked devices worn close to the surface of the skin. Collections of wearable devices will be networked together, between bodies, or traversing a single body. A range of physiologically based input signals will be explored: breath, pulse, brainwave patterns, electrical energy, and temperature. *whisper* appropriates the attention, breath, and heartbeat of a community of participants, rewriting them as shared signals on the network. *whisper* extrapolates from the body onto the larger collection of networked bodies: effectively a **performance** piece in a **social space**.

Both the input and output components are worn close to the skin, on clothing, around the neck, wrist, or ankles, like jewelry, attached to a piercing, next to the heart, or on one's sleeve. Through the use of small motors and sensors, the components can output vibrations, temperature changes, sound, light, color, miniature texts & images, even low-bandwidth video displays. Basic analogue devices are used alongside more sophisticated components (including biofeedback – or brainwave – sensors). A wearer may configure their plugout device(s) to vibrate, tickle, or sigh when it receives data associated with a particular pattern set. Maximum configurability is accomplished by 'plugging in' components, by mixing and matching functions within this modular system.

whisper plays in an ironic way with domains of influence, visibility, and the shifting threshold between the tangible and intangible. The continuum that spans the range between intangible and tangible is a threshold of perception. *whisper* shifts our attention to this mobile threshold and introduces concepts of **future memory** as a function of mapping previous states and extrapolating them into present interactions. As the whisper system evolves over time, it re-visits its past decisions, in the light of current intentions, and recovers past potentials obscured by the initial instantiation of behavior. Not everything can be known at the point of its initial enactment; the past is incomplete

and the *whispers* can revisit and reconstruct past views as they progress. The past is not replaced, it is augmented and restructured as the system perception grows. And the rediscovery of the past propagates into the future and the system's anticipated behaviors. Intention is constructed, communicated and functions to direct and apply whispered messages which range between direct and subliminal, suggestive and overt, seductive and definitive. Emerging behaviors are created and based on sharing sense-based communications between bodies that emanate their softly voiced messages within a space.



The overall aesthetic of *whisper* emerges through work with materials. Explicitly stated: the aesthetic of this project is generated by process and practice. We deliberately avoid conventional wearable aesthetics, such as cyberpunk or the current sports accessory look. Our aesthetic comes from designing for invisible connections. It is emergent and ambiguous, almost a 'reconstructed feminine' but with hard edges; it is a juxtaposition of what seems like the 'soft organic' with the 'soft & hard inorganic'. The look and feel emerge from our materials: latex, silicon, rubber, paper, circuits, wires and exposed sensors. Colours include: amber, white, clear, milky, some black and pink. The transparent, translucent and the opaque converge with skin.

*a taste for the overlaid and the incised:
translucency as well as total transparency.
(Hawley, 1998:169).*

Skin is the richest source of inspiration: marked, mapped, extended, exposed, nurtured, celebrated. Ultimately, our devices will be fetish items, things people will desire to take home with them to relive their experience of *whisper*.

*my flesh and that of the world therefore
involve clear zones, clearings, about which
pivot their opaque zones, and the primary
visibility (Merleau-Ponty, 1964:148)*

research & devising [fabricating] process

The r+d/fabrication process for whisper is based around the simultaneous creation of hardware, software, movement, and textural, material vocabularies. The process is in turn refined and developed through its own iteration. We are committed to social design, performance design, and technical design through **materializing** the *whisper* project. We craft **collective first person methodologies** as processes and strategies for collaboration across scientists, technologists and artists.

The *first person* of these methodologies comes into play through emphasis on design that is intimately connected to the body. Like phenomenology, collective first person methodologies are based primarily upon physical experience, but emphasis is shifted to the collective rather than the individual unit. Each stage of the research period is linked to exploration in the (movement + electronic) studio. Physical improvisation techniques determine emergent movement vocabularies and inform the design process. The process is not simply to import pre-fabricated devices into the studio. All materials and devices are tested physically in collusion with body knowledge, while the hardware/software design occur simultaneously. The creative development of the wearable devices is an embodied and performative process.

We call our process the **sewing circle**. Generally attributed to groups of women, domesticity and textiles, the term is associated with 19th century social and creative processes. This term is employed in the interests of rehabilitating a largely dismissed creative activity. The implied message is of crafting an artifact according to an inherently social and collective design process. Like the members of sewing circles and other creative collectives, we are building our own vocabularies, physical techniques and methodologies. We are also committed to working with textiles and mapping the skills of knitting and stitching onto device design. Our sewing circle may stitch latex and knit with rubber, but we will also wire our bodies into wearable devices and physically improvise, fabricate, and engineer in the studio.

The effort to create apertures became much more deliberate, and the pathways of both heat and light emerged as an essential component rather than as the result of applied aesthetics. (Hawley, 1998:173)

The *whisper* design process iterates across physicalization, conceptualization, device construction, and software development. These are no longer first generation wearables which were basically “one-liners” (strap them on and get the point immediately). The *whisper* devices awaken in us the knowledge that we dwell in/with/through our bodies, and with dwelling comes a commitment to building relationships. Learning any physical technique is a process of building relationships between our centres of gravity, visual perception, kinaesthetic perception, muscle tension, and communication with others. We become liminal beings as our layers of subtle body knowledge are reconfigured with any

new technique, orchestrating the internal with the external until these distinctions dissolve.

pulp fashion

The concept of 'pulp fashion' is a metaphor for the impermanence of physical states, and as such is, for us, vastly innovative and seductive. To fashion is to engineer, create, to sew, to ergonomically render, through a process of nips, tucks, slices and stitches. Enough has been written about commercialization and commodification of fashion (yet more can always be heard about fetishization...). The opulent is fundamentally not about cost but about sensuality. Fashion is the painstaking crafting of the changeable, or the ephemeral. Our bodies are ever changing fields: chemico-perceptual shifts, mood swings, neuro-physical peaks and valleys, kine-to-tactile data feeds. Stasis is a myth. We can hardly keep up with ourselves. The suggestion that we are a nexus of information flows is accurate, but only partial. We are these, but we are flesh at the same time. Flesh is not the 'meat' of cyber-lore. Flesh slips through and smothers the tired dualities of mind/body, consciousness/meat. We exist in a network of flesh. Our bodies participate in the overarching "**pulp of the sensible**" (Merleau-Ponty, 1964:268).

Maurice Merleau-Ponty's enigmatic understanding of flesh encompasses bodies, organic and inorganic objects and what used to be known as space.

the flesh is not matter, is not mind, is not substance. To designate it, we should need the old term 'element,' in the sense it was used to speak of water, air, earth, and fire... (Merleau-Ponty, 1964:148)

Flesh contains within its very fabric the connection we feel with the environment, the perceptual play of light and shadow, our embodied selves, and the bodies of others. It is impossible to understand our flesh as it enters into an exchange with the *whisper* devices without the related phenomena of the **invisible** and the **hidden**. The goal, when accessing the invisible (or subtle) is not simply to bring it to the surface so that it becomes visible, just as the point of *whisper* is not to de-frock the subtle, but rather to work in an ambiguous territory, within the realm of the physically and semantically tentative. This approaches the state between waking and sleeping, allowing oneself to remain in that state to witness one's own participation in an alternate flow of activity. A direct or literal exposure of deeper body knowledge would strip it of its essence. The whispering between devices based around the pluggable/unpluggable and reconfigurable inputs and outputs, give us the choice of acknowledging the invisible while retaining its hidden, subtle qualities.

*the invisible is
1) what is not actually visible, but could be
(hidden or inactual aspects of the thing – hidden
things, situated 'elsewhere' – 'Here' and
'elsewhere')*

2) *what, relative to the visible, could nevertheless not be seen as a thing (the existentials of the visible, its dimensions, its non-figurative framework)*
3) *what exists only as tactile or kinaesthetically, etc ... (Merleau-Ponty, 1964:148)*

participatory installation

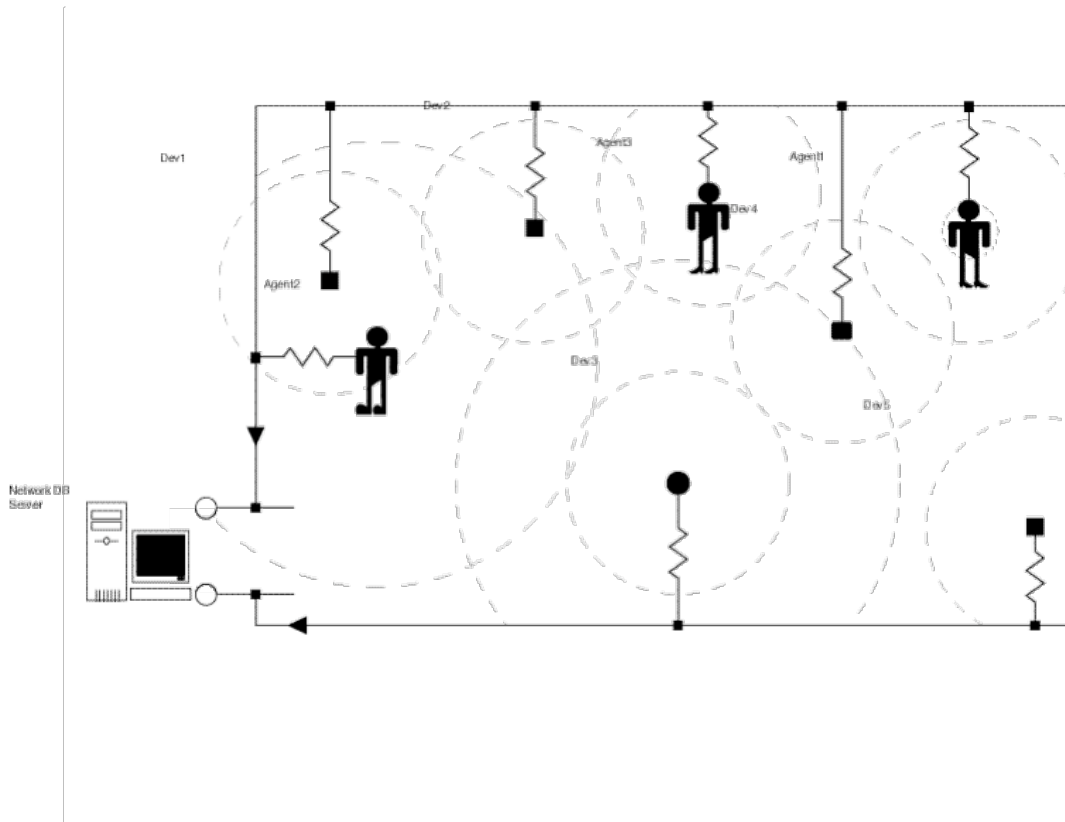
The space of the installation can best be described as a networked ecosystem containing input and output devices. Up to 12 participants may move and browse in and out of the space with access to a set of devices sewn into a jacket or cape, hanging from the grid above or lying on the floor waiting to be picked up. Sound is generated on the body and is affected by the networked data as it is transmitted. The devices will resemble a cross between cyber-jewellery, exquisite art objects, creepy prosthetics, peculiarly ornate theatrical costumes, and body sculpture; they will be a weave of analog and digital components and circuitry. Participants visiting the space enter a community of bodies and objects which have a functionality yet to become manifest. They will be invited to take their place within this ecosystem.

Instead of situating the participants within the flow of a pre-scripted event, they will be involved in a conceptual, physical, aural and visual journey that unfolds according to their participation as a body, as a system. Their responses will drive the experience, and encourage the development of other senses within our synaesthetic matrix of sensory perception and proprioception. It is for this reason that we have coined the term 'participatory installation' to describe form of *whisper*. We foster "a being by porosity" wherein our bodies and the distances between ourselves and others "participate in one and the same corporeity or visibility in general" (Merleau-Ponty, 1964:148).

emanating relationships

Interaction in *whisper* is based on creating and emanating relationships through subtle exchanges between the devices. Each *whisper* device emanates its state to the other whisper devices that are within range. The receiving whisper perceives and incorporates the state space of the other[s]. The state of the whisper device is a direct function of the body that wears it, along with its memory and future memory. Emanation is abstract but perceptible, it implies a sender [source; originator] and a receiver [of the abstract and perceptible thing], and suggests outgoing and incoming signals.

Each device has a *whisper* device-state, and the collection of devices defines the current global whispers system-state. Device states emanate from or are whispered to other devices within proximity of the range of influence. *whisper* devices also 'perceive' these emanations based on their current state, and alter their own state, based on incoming perceptions. *whisper* device states are learned and emerge from living on a specific body, thus representing that body. The whisper devices also remember past bodies and states, and these past lives influence their behavior.



The **device** is a gadget, tool, apparatus, mechanism, appliance, gear, invention, analytic tool, metaphor and literary technique; the device is gendered, an extension of the self, an interface, prosthetic and fetish object. It is an object of industrial design. The design of the device incorporates dominant cultural narrative within its functional and aesthetic properties including the displacement of taboo and desire; the device is a network object, a browser, a search engine, a system and theatre, the device is thought, is telepathy, is our own body.

Our **body as system** creates a metaphor for the operating model of *whisper*. Our bodies are composed of multiple networked systems, which communicate autonomically with each other. So do the devices in *whisper*. Our bodies are shaped with multiple thresholds that operate in stealth at one moment, overtly at the next moment. These thresholds lie at the liminal boundary of our perception. Our bodies are fluid, networked, and dynamic. Our bodies have secrets, contain multiple intelligences, conceal information in unlikely places, and develop strategies for the expression of current and archived states. So do the devices of *whisper*. Our bodies surrender things to one another. Our bodies learn, habituate and unlearn by applying directed attention. So does *whisper*. Any one of our bodies is a 'we'. When our bodies are together they can operate as an 'I'. So can the devices in *whisper*.

The interconnected, autonomous wearable sensor I actuator collections of the *whisper* system are combined with a local processing module. The processing module, along with the sensors I actuators connected to it, are worn or carried by the body. This processing module (a micro-controller, such as the BASIC Stamp, PIC or a VIA II), gathers the data from multiple sensors and whispers to (communicates with) its

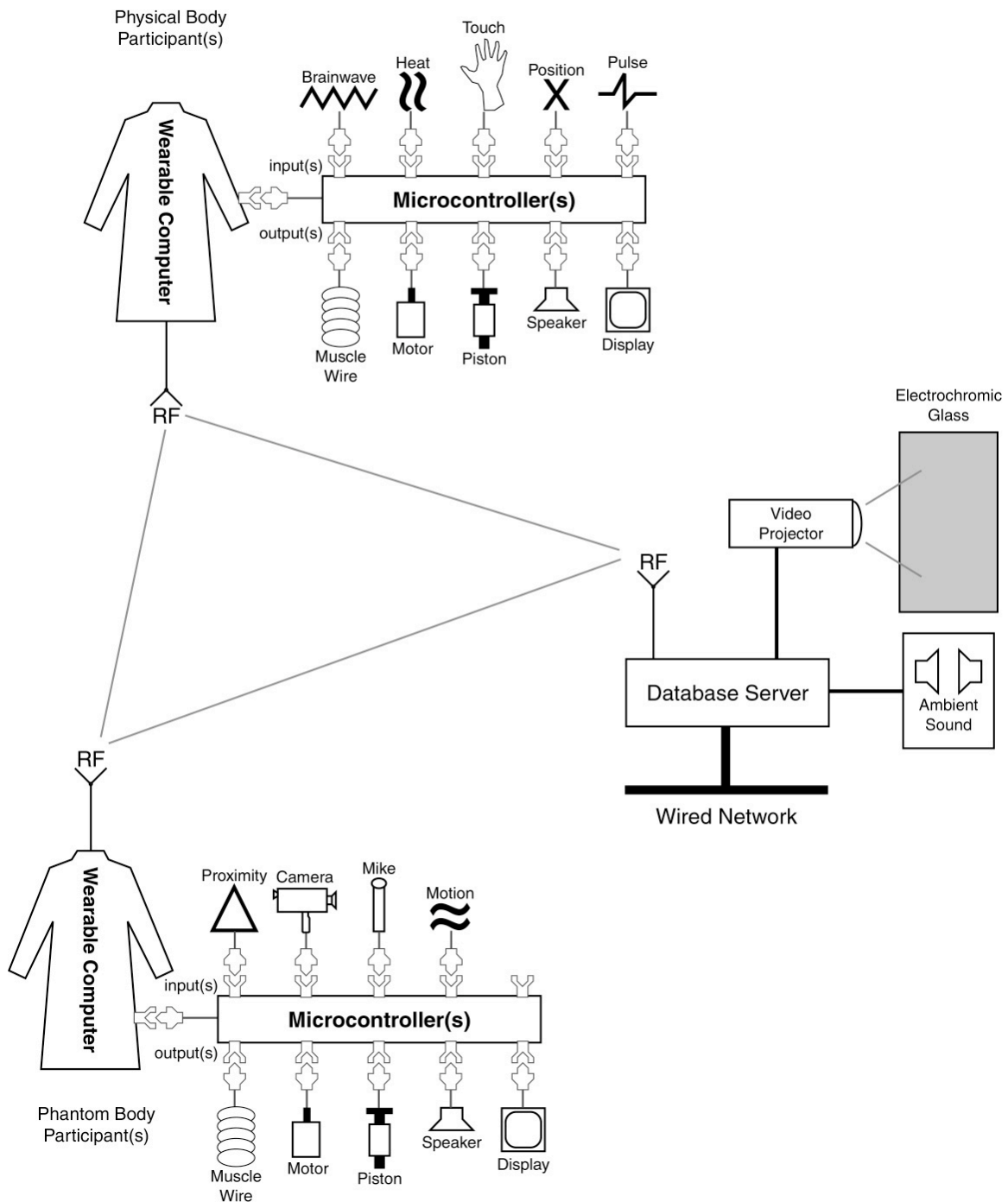
neighbors, and a central whisper server, via low-power radio frequency (RF) transceivers. The server, database and micro-controller systems together determine the response to the actuators. They provide feedback in the form of sound, graphics and tactile feedback devices that are worn on the body, along with the sensors. The whisper central server also visualizes and displays a dynamic representation of the system-state both on the web, and projected onto the electrochromic projection display within the installation space.



The sensors that are configured can be roughly divided into three major categories. Direct manipulation sensors require active participation by the body that wears them. Autonomic sensors capture physiological data that is indirectly controlled by the body that wears them, and environmental sensors measure attributes of the space, rather than of individual bodies within the space. Examples of these sensors are:

- 1) direct manipulation: include touch-sensitive pads, microphones, tilt switches, strain gauges (piezo-electric, bend-sensors).
- 2) autonomic: include sensors which detect body temperature, galvanic skin response, breath-sensors, brain waves and heart-rate
- 3) environmental sensors: include ambient heat, motion detectors, position sensors, pressure plates, video and still cameras.

Not all of these sensors need to be used simultaneously. The system design is constructed to enable dynamic configurability and flexibility. This means that different combinations of sensors can be used at different times. There could also be sensor-less microcontrollers that provide localized processing for the system as a whole.

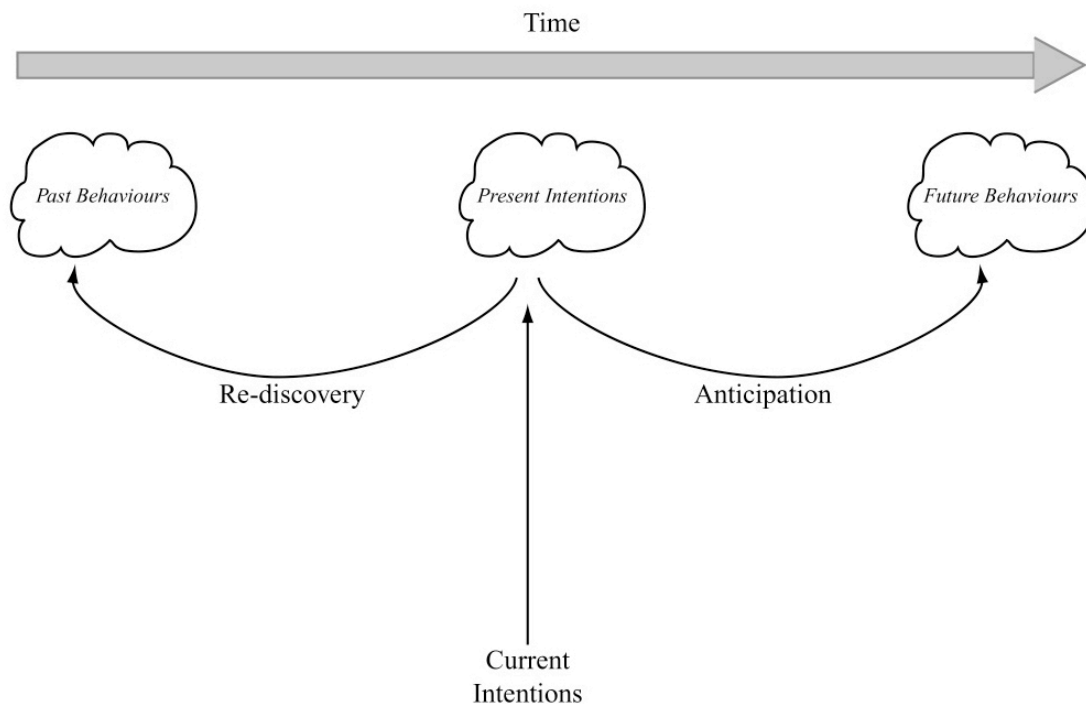


future memory

In *whisper*, the concept of future memory is represented through the dynamic visualization of its own system state. *whisper* maintains and displays a dynamic representation of its memories, the computational equivalent of precognition, electronically augmented telepathy. The whisper devices and participants, through their behaviors anticipate potential future behaviors and state. The state flows from the past to the future; the intentions are always dynamic, as velocities and accelerations of behavior.

As the whisper system evolves over time, it will be able to re-visit its past decisions, in the light of current intentions, and recover past potentials obscured by the initial instantiation of behavior at that time. Not everything can be known at the point of its initial enactment; the past is incomplete and the whispers can revisit and reconstruct past views as it progresses.

The past is not replaced, it is augmented and restructured as the system perception grows. And the rediscovery of the past propagates into the future and the system's anticipated behaviors.



In *whisper*, communication is characterized by its context: whispers can be *qualified* [in contrast to quantified]. Qualified communication deals with intent: gesture, tone, pitch, repetition, redundancies: are all qualified elements of communication because they provide *context*.

unearthing I hiding

whisper is a foray into the cultural study of telepathy and of mapping techniques: impressions are transferred invisibly, mediated both through body and technology. The research process explores invisible datastreams as wireless networks and suggests, both playfully and literally, that telepathy is the ultimate wireless network. *whisper* builds **wearables for the telepathically impaired**: as 'aware-able' devices, they make bring to awareness functions of embodiment and perception that were previously ignored.

The concept of mapping as a dynamic unearthing knowledge is critical to design and research, and is related to the 'aware-able' device. Mapping is a technique that can help to reveal or define underlying patterns of processes and information. Mapping offers a new view on an idea, a process, an event, an object or a place. Maps provide a means of visualization that might unearth patterns within one of these views. Mapping is a discovery: it may reveal new knowledge within an area thought previously to be known, or it may help in the acquisition of knowledge or experience of what is not known. Rediscovery within known areas is often achieved by combining views which might, at first seem irrelevant to each other, like mapping processes that are not normally regarded as important. This research will map data signals from collected and networked bodies, using sensors that collect physiological data. This reflects the awareness that our bodies are subtly evolving maps of our identities and our lives. *whisper* excavates the invisible. It is a search for lost things.

*movement that touches
and movement that is touched
(Merleau-Ponty, 1964:148)*

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Using a Gestural Interface Toolkit for Tactile Input to a Dynamic Virtual Space

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Abstract

In this paper, we describe the development of a gesture interface toolkit that has been applied to an application of tactile gesture recognition within an artificial life environment. The goal is to design a gestural semantics of caress, in which qualitative attributes of gesture are expressed as a function of tactility. A touch-sensitive tablet capable of detecting multiple simultaneous contacts was used to provide a source of tactile gestures (stroking, pressing, tapping, wrapping, spreading, pinching, nudging) which were then interpreted by the software as events to be sent to the active creature in the environment. Participants could observe the creature reactions within a three-dimensional immersive display system.

Keywords

gestural analysis, tactile input, gesture recognition, gesture toolkit, immersive environment, Laban Effort-Shape analysis, movement analysis, gesture-based interface, whole hand input, CAVE, Max/MSP, Tactex MTC

Introduction

The Gestural Interface Toolkit (GIT) is an Application Programming Interface (API) for developing responsive systems that require access to tactile feedback devices. The objective of the toolkit is to provide uniform and consistent handling of several classes of input and output, and to support complex analysis and recognition algorithms directly [3]. In this initial implementation of the GIT, Tactex Controls Inc. [7] pressure-sensitive material called Smart Fabric, is being used. This optical fibre array has been packaged into a device called the Multi-Touch Controller (MTC). Data from the device is in the form of a continuous stream of pressure values, which can then be used to detect multiple simultaneous contact points or touches [10]. The sampling rate for the device is

comparable to video frame rates, so that the appearance of smooth, instant response is achievable.

Our goal of developing a gestural semantics of caress requires the development of qualitative models for data flow and data-architecture and the development of semantics for gesture that refines the extension of tactility [2]. Although not yet implemented, new devices, such as six-degrees-of-freedom (6DOF) tracking devices or 6DOF trackballs, biological (heart-rate, galvanic response, brainwave) sensors and as well as sound, graphical and other tactile sensors can be integrated into the Toolkit to provide new modes of interaction [6]. As an infrastructure, the Toolkit has mechanisms to support remote attachment of devices and collaboration between heterogeneous systems, via support of messages through TCP/IP channels.

An existing artificial-life environment was selected as a test-bed for the innovative use of tactile gestural input [4,5]. The environment consists of a community of creatures that evolve under the guidance of a genetic algorithm. There is also a mechanism by which external agents (web browsers or direct keyboard input) can influence the behaviour of the creatures. New “verbs” were added to the system to accommodate the expected behaviours from the Toolkit, which was subsequently adapted to provide a mapping from the detected gestures to this mechanism.

Implementation

Implementation of qualitative semantics is based upon definitions from Laban Effort-Shape Analysis [1] which defines movement efforts based on Time, Space, Weight and Flow characteristics. In Laban Effort-Shape qualitative characteristics can be aggregated and expressed as ‘drives’ and ‘states’. The pressure data from the MTC device is mapped into a rectangular coordinate space and then filtered and processed using techniques from image processing and recognition. The software for this process is an image processing tool [8] that is an extension of the Max/MSP programming environment [9]. Parameters are extracted from this raw image data, which are used for preliminary gesture recognition. These measured parameters are

interpreted in terms of subjective linguistic terms, which lead to the effort-shape model. Gesture divisions are not extracted at this stage, and the more data-intensive pathways are not determined, as the goal is not to match previously performed gestures but, rather, to obtain the subjective quality of movement represented by caresses on the MTC device.

In Laban effort-shape movement analysis, the attributes of Time, Space, Weight and Flow are defined as follows: Time is represented on a Quick/Sustained continuum, Space on a Direct/Indirect continuum, Weight on a Light/Strong continuum and Flow on a Free/Bound continuum. Information is extracted from the device in various categories, differentiated by the level of calculation required to extract them. These categories are direct parameters (Location, Size, Start Time, Stop Time, Intensity and Number), which are measurements from the device, calculated parameters, and inferred parameters. Indirect parameters (Duration, Speed, Direction, Direction Change) are those that are calculated from the direct parameters. All of these parameters are quantified into three or four levels of activity. For instance, intensity is quantified into values between light and strong, which map to the Laban *weight* effort. The quantified value is subjective in nature and corrected via threshold adjustments based on experience over time.

Results

The combination of the artificial-life system with the GIT created a very responsive environment in which natural gestures (the petting of the creatures) resulted in immediate and relevant responses. This gave a feeling of connection and familiarity to the experience, despite the extremely abstract representations used for the artificial life forms.

The integration of the GIT with the application was successfully mapped, as the gestures could be recognized in real-time and quickly converted into the commands or “verbs” needed for the environment. By physically separating the gesture processing from the application, it was possible to easily explore alternative solutions for the gesture mapping and interpretation.

Implications to HCI

Gestures appear to provide a very natural means to interact with an evolving environment such as this artificial life simulation. Rather than aggressively moving objects from point to point, pushing buttons or grasping, as is often done in virtual reality (VR) systems, the gestures used can be gentler, less invasive, and with a greater dynamic range. This permits the system to develop with perturbations that are proportional to the forces applied. As well, the nature of the gestures (“petting” or “stroking”) is much closer to the way children interact with animals. They don’t attempt to dominate other creatures – they express interest, affection

and wonder. These modes of interaction are not exhibited in such domains as video gaming. The MTC device is a viable alternative to conventional touch surfaces, with sufficient sensitivity and responsiveness for use in hand gesture recognition.

Future work

The GIT primarily needs to be enhanced in three directions:

- 1) Further work on the gestural language, with provision for handling gestural phrases or time-dependent inputs,
- 2) Support for more devices and characterizing its behaviour with multiple devices, possibly networked and
- 3) Reduction of the size of the system(s) required to implement the GIT, so that a wearable version can be developed

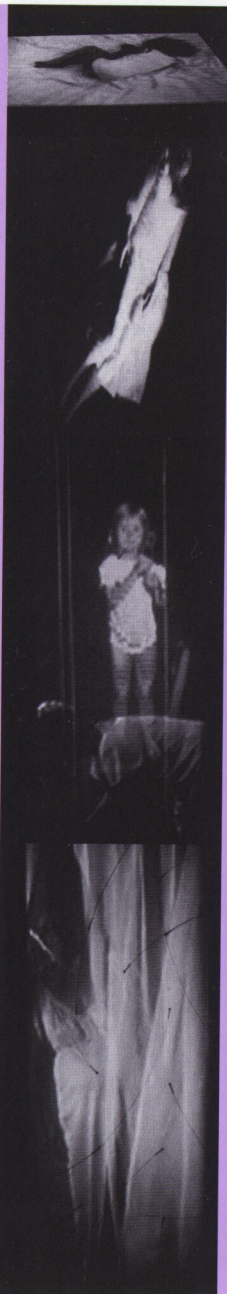
Acknowledgements

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Thecla Schiphorst



Thecla Schiphorst is a Vancouver-based computer media artist and Associate Professor in Interactive Arts at the Technical University of British Columbia. She has an interdisciplinary MA degree in computer compositional systems from SFU, did undergraduate studies in dance and computer systems, and has a Diploma of Technology from BCIT in Computer Programming and Systems Analysis. She is a member of the original design team that developed *Life Forms*, the computer compositional tool for animation and choreography, and has worked with choreographer Merce Cunningham since 1991. She has published numerous essays and articles, and lectures extensively, facilitating workshops and exhibiting her work. She is the

I am going to give you a little bit of history about my work and how I became interested in this area of research, which I have been doing for the last 15 years. An important aspect of that research is this question you see above my head: What is body? I will begin by looking at some examples of my previous work. Like Chris Speed, I am also quite interested in navigation from a very particular point of view. Navigation is movement through space. I am interested in the way a body recognizes and constructs knowledge in spaces in general, including in data spaces.

Body, interface, navigating sense and state space



I have a background in both software engineering and in performing arts practice. I am a dancer and choreographer, and I worked in theatre for many years when I was a young girl. I studied computer and after getting my undergraduate degree, I studied for my Masters degree. When I did my Masters I began to explore some of the relationships between body knowledge and the language which is used in studio-based practice. This is what I call 'experiential body practice' and I use this to build tools, software systems, software and hardware artifacts and construct artwork which is both installation and performance-based. From my personal history and my own

live performance experience I developed the notion of body knowledge and what I call 'first person methodology' and use this as a basis for interface design. An area of experiential body practice outside of dance and theatre, for example, is the study of somatics, the study of the body as it is experienced from within the body. An incredible amount of knowledge, methodologies, practices and techniques has been incorporated in both the study of somatics and the study of movement and theatre.

I am sure that, as performers, many of you understand that improvisation methods are first person methodologies, which are

past chair of the
Conference on
Dance and
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Simon Fraser
University in July
1993, and she has
served on numer-
ous juries includ-
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*Award for New
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based on exploring a way of navigating in time and space, a way that is differentiated from the teleological systems of navigation that Chris Speed is talking about. But improvisation is only one particular kind of practice in methodology. It is built within some kind of a structure so that quite often when you begin to look at improvisation either in music, in dance or in theatre, you are developing structures, you are making rules or practices into which you build certain kinds of outcomes. These kinds of methods and methodologies are really interesting to me and from my dance study, I know that not only do these kinds of techniques enable us to access knowledge, but we also construct knowledge through these methods and methodologies. One thing that experiential body practice has in common with this, is that it uses a direction of attention which is our own intention to produce a 'body state'. This notion of using direction of attention to produce specific body states is something which I have explored in my work in quite a number of different ways.

I was one of the original designers of *Life Forms* which is a computer choreographic tool. I worked with Merce Cunningham for about ten years to develop a vocabulary for movement and studied the relationship between interface design and the way in which one explores compositional ideas, in this case compositional ideas about movement. I have also worked with movement

gesture systems; interfaces using motion capture and transforming the information so that the outcome was compositional rather than a literal replication of the recorded movements. I have built navigational systems for art databases which explore modes of navigation and states of navigation where you can express various ways of moving through a space.

What is body? Well, we all have one and we have very specific notions of what a body does, of how we perceive, and of the limits and thresholds of constructing knowledge and perception based on the input sense data and the output data of our bodies. Of course, we all recognize that this knowledge is just a model of what we are. We know that these models are multiple models which are changing all the time. Some of the work that is done now in neuro-physiology and cognitive science is, quite radically in some cases, restructuring these models and forcing us to rethink what is body and what is perception. I am interested in thinking of the body in relation to the construction of systems. I can describe the body as being fluid, re-configurable, having multiple intelligences, as being networked, distributed and emerging. You will notice that many of these words are similar to the way that we describe our technologies and our technological systems.

The body is fluid and re-configurable. An example of this is sensory substitution on which experiments have been done over a number of years. In the early sixties Paul Bach-y-Rita did an experiment where he placed a camera on the head of blind subjects. These subjects once had the ability to see but lost their sight later in life, so they did have access to neural-physiological patterns which could detect sight. It is important to know that their brains had knowledge of seeing at one point in time. These blind subjects had a camera on their head and the data from a very low-resolution camera was used as input into their bodies through their skin, so the visual data was transformed into tactile data. There

were two groups. A control group which did not move their heads, they simply sat in the room and things moved in front of them. And an experimental group who could move their heads in the space and in which they moved around in the room. The results of the experiment were as follows: after about two hours the brains of the subjects who could move their heads started to re-pattern the sensory information which was coming into their arms as tactile data in such a way that they were no longer feeling the data in their arms, but they were seeing three-dimensional objects in as low-resolution as the camera was providing. In other words, they were seeing, you might think of it as holography, but what was actually happening was that their brains were re-patterning, substituting the sense of touch for the sense of vision within their own bodies. This is an example of the fluidity of the way in which our bodies operate. It is an example of a way in which we are re-configurable.

We know that having multiple personalities is a pathology. And we all know we also have other sorts of more fluid multiple personalities, in the way we speak, in who we are at different points in time. These personalities are state-based, so as we shift our state, we shift the way in which we present ourselves to the world. In studies of multiple personalities it has been shown that different personalities within the same body can have totally different physical attributes. One personality, for example, would be allergic to oranges and have imperfect vision. Instead of having 20/20 vision maybe this personality had 20/100 vision. Another of the multiple personalities was not allergic to oranges, had perfect vision but was a little bit hard of hearing in one ear. If the subject ingested an orange when he was in the personality which was not allergic, but then switched to the other personality, he would immediately have an allergic reaction to the ingested orange in the body. The body, from the moment in which the personality switched, totally reconfigured itself;

shifted its vision, shifted its hearing, shifted its own internal relationship to what kind of data was traveling through it. So our bodies have these kinds of properties. We are used to teaching ourselves to perceive in certain ways and many of us believe that perception is not something that can be shifted consciously, but indeed, there are many studies that show that our range of perception, our bandwidth, and the interconnection between our senses is much more fluid and much more controllable through conscious effort than we had previously believed. If you have studied movement or theatre or any kind of art form in which the body becomes an instrument, you know that this is an important critical aspect, in that you learn and can construct repeatable states in the body. In dance and in theatre, for example, it is important to be able to construct a repeatable emotional state or a repeatable physical state to be able to re-enact a point in time or a characterization. These kinds of ideas are the kinds of ideas which I am interested in, and how they relate to our definitions what our technologies are, how we define what our interfaces are capable of, and how we can re-define and re-work our technological systems.

You may have heard of *Life Forms* as a choreographic tool and compositional system for movement. It was something I worked on in the late eighties and early nineties. It was interesting to look at multiple levels of abstraction in compositional processes and design processes. We investigated how moments really occur as intersecting layers by looking at things from different points of view and blurring the boundary between the representation of space and the representation of time. And we also studied some non-literal representations of the body. Indeed, studies on movement illustrate that we recognize and can illustrate and perceive movement. The work with Merce Cunningham was important in the development of this tool, particularly in the early nineties. He was a very important twentieth century choreographer and

artist. He was the partner of John Cage for over fifty years. Together they explored the relationship between chance operation and chance procedures, non-literal forms of representation. They radically altered the way we think about the compositional process. A lot of these techniques were used in Merce's work using this particular tool. One of the things we found out about is how we visually process data when using digital technologies. Since they tend toward precision in representing outline and surface, our reading of that tends to completion, to a completed object and to a completed sense of movement.

At the same time we found that in notional representation, the idea of the process is not something complete and can be shifted. We haven't come to terms yet with the way this relates to digital representation. This is just a small example of something that Merce constructed. What you can see, first of all, is that it doesn't necessarily look life-like, it doesn't have sort of warm, normal human rhythms, but is inter-cut and idiosyncratic. One of the important ways in which he worked was, first of all, not to necessarily conflate the idea of whether he liked it or not, with what I did. He would use his idea of chance and how that can be constructed from the computer system and apply it in the world. He also did not attempt in any way to make it look real. He was interested in exploring the question of: What is movement? and was actually more interested in de-habituating the way in which he thought of movement than in trying to reconstruct something that he had been seen before.

The motion capture system I sometimes use, wires the body and captures the motions real time in 3D. It is used in animation to get a highly precise literal digital representation of the motions made by a human body in 3D space. Since I am more interested in re-mapping aspects of movement in a choreographic way, I built a system that would enable parts of the

body, an arm, a gesture or the entire body to be re-mapped, and then I do things like phase shifts, and use compositional techniques. I do many things that are usually done in sound composition where you work with algorithmic layers. I take the movement of the arm and put it on the spine, accelerate or decelerate it in time so you can functionally use the same kind of input and re-map it onto the body. Usually what comes out of this is that it is quite an impossible movement to actually perform, but it was simply the result of using of digital technology which leads to this notion of impossible dances, where the construction of movement is based on an exploration of movement. It could be performed by the body but not in the way that you would illustrate it, if it were a notational tool.

Another area in which I worked is the area of interactive performance where a performance space is wired, for example, and performers interact with that space, and again, in music this is quite common. I became interested in the exploration of how, from the dancer's point of view, you get a totally different sense of the space, since the direction of the dancer's attention is changed by the fact it is mediated. But the audience is still sitting out there. It is not an exploration of the same kind, i.e. of the direction of the audience's attention in relation to the performer's attention. This breach is one of the things that moved me into working with installation space. Here the audience and the performer are embodied within the same person, the audience becomes the performer. And the question becomes how do they interface with that space which is the interface between themselves and the mediated technology, the art interface?

In 1996 I created a piece called *Body Maps* which is an interactive installation in a darkened room. When you enter the room, you see a table which has video projected onto it. The room is essentially silent except for the sound

of a single drop which is coming from the projector. The piece is silent and still until it is touched. In a sense it is begging for interaction through the touch, through the caress, of the participant in the space. I worked with engineers to construct some of the sensor technology. We programmed it in Max. The video and the sound were developed in order to construct a local interaction at the moment of contact with the surface. It worked not only with touch but also with proximity, a notion of skin consciousness. You are sitting fairly close to each other and you will notice that you may be in the proximity of the person next to you. You can sense their proximity, you can sense their distance. Clearly our skin is a boundary in a sense, but our ability to perceive is something that emanates past the surface of our skin.

This idea of what skin is, what skin consciousness is, how touch can re-direct the way in which we understand ourselves, is what I was interested in. In this piece the participant and the audience become one. It deals with a lot of issues that have to do with the idea of attention state. It is a highly auditory-visual piece, it is synaesthetic because touch is used as a way to begin to hear the visuals. Sound is a way in which we touch ourselves in this kind of space. In western culture we are taught to use our eyes in very specific ways. A simple example is that not all cultures use perspective in representation. We fall for tricks like these e.g. when we see two lines which have exactly the same length in perspective, but one has arrows going that way, and one has arrows going the other way; we see them as being of different lengths. Not everybody is prone to these mistakes. We are taught to see in these specific ways and we are also taught to use our eyes to differentiate subject and object. It is very much a construct of the way in which we deal with knowledge in our culture. We have to find a way to shift that in the interface itself, in the experience of the interface.

I talked about the notion of skin consciousness. Kinesthesia is our way of perceiving movement. When you are a performer you will notice the way your body responds to movement in another space right away. That is your kinesthetic response. I talked earlier about sensory substitution and that our senses share the space of our body and they are not as easily separated as we have defined them to be in the constructs of who we are. We have to include synaesthetic notions, such as the kinesthetic eye listening as an act of touch, and the skin as an organ of autonomous response. Brian Massumi, a cultural theorist, has written about the autonomy of affect in an essay which explores the relationship of affect to the skin itself. In his view our cognitive and perceptual systems do not all operate in the same time frame nor do they recognize the same data. The skin is an affect center operating in a different way than the brain and the linguistic system. It turns out that skin measures affect even though the brain is saying something else. That means that as we touch, we have access to this whole range of what we perceive and who we are. I was interested in trying to build a system, a container, which would enable some of that exploration through interaction of the body in the space. Touch is not discrete. This is not only because of the continuity of sensory information but also this idea of indiscretion implies that we can't lie to ourselves through our skin. Touch is also a way of subverting the primacy of vision. Physical interaction is a totally different experience. We have privileged seeing to such a high degree, as something that gives us so much information, but touch can subvert that in a certain sense, and bring us back to our senses in another way. We have dealt with the visual arts for such a long time. Interactive art, even though it uses visuals, can be used to collapse the visual in a sense. The visual is a way to draw in, but this moment of contact, where the interaction occurs through other senses, is what the interface is about.

The next piece I made was called *Felt Histories* and it is a piece that explores touch. It is a twenty-foot long corridor, quite narrow but four-foot wide. You have to walk through the entire corridor to the end where a doorframe is located. The doorframe is a Plexiglas surface onto which video images are projected. I began to explore this idea on *Felt Histories* after the work I did in *Body Maps* and on this notion of gestural access, and from prior work on databases and different ways that we can access and search databases. Video and sound are networked across computers. They are activated by the physical act of the caress. The sensors are embedded in the Plexiglas frame. Plexiglas is somewhat pliable, as you know, so there is some movement but it is not a totally flexible surface. There are zones of sensitivity, the projection surface has to be touched in order to activate or navigate. The directionality and the energy and the length of time that you touch the surface are used to calculate direction, location, relative location, velocity, and acceleration, etc. Those were the variables that were used to search and navigate the database. A whole system was set-up which is pseudo episodic, in a way it was a pseudo narrative. It was not really narrative but it had a narrative quality to it.

The sensors were drawn from the lines of my hand, so it is about the idea of scale, the micro and the macro. It is about the way you touch the surface of a hand, that is how the sensors were constructed. Four different episodes were used to respond to the image and the sound in different ways. The visual material was organized into visual episodes and each of the episodes had a particularity in terms of how the navigation occurred, and how the images were connected with one another. There was no cutting, so everything dissolved into one another. It was really meant to be a very sensual experience. It wasn't that you were aware that you were reconstructing a story but you were given an opportunity to construct a

relationship with a sort of body in a space. There were specific rule sets for each of the episodes for the selection and mixing of the video material. In *Body Maps* I used my own body and I performed the piece. I directed the video but I didn't direct it by visually composing it, but by physically composing it. Very much like you would do in a theatre or performance, I went into a number of specific physical sense states to access the range of physical relationships that would occur through touch. From the highly sensual and the highly erotic to a more violent kind of response that was very much identified with inside my own body. At the same time, in this piece, I began to explore the idea of desire within decay and resolution and the relationships between them.

For the last year and a half I have been investigating wearable technologies. This idea of wearing yourself can be extended into a network distributed over a small wearable device system with intelligence which is shared between people. We do wear ourselves and our many selves all of the time. The notion of modeling some of the systems of how we understand ourselves is part of what this is about and I think probably much of the kind of work that is done in media technologies is wearing yourself. For instance: on your sleeve, under your skin, in your ear, near your heart, in your hair, under your skirt, between your toes, off your back, between your eyes, around your thought, in your hand, shared amongst others, divided between yourselves, unknown to the left hand, hidden from your own eyes, substituting your senses, substituting other's thoughts.

The way that we learn is that active intention through movement is the basis of the thought process as it develops in the body, from the time that we are very young children. So if an aspect of that is missing, either the intention or the movement or the link between the two has not been developed in our cognitive system. In other words it is necessary for us both to

intend and to move that intention in order to think and develop thought in our bodies. Di'Mazzio has written two books about Descartes' vision of looking at the necessity of both emotion and the rational states, which are not separate within our body. People cannot act in the world if the emotional aspect of the brain is damaged and they are only left with the rational side, even though that body may score well in a written IQ test, for example. They are incapable of physically acting; our rational behavior requires our emotional mind to be connected with it. These kinds of notions are not separate elements but are co-wired in our own bodies.

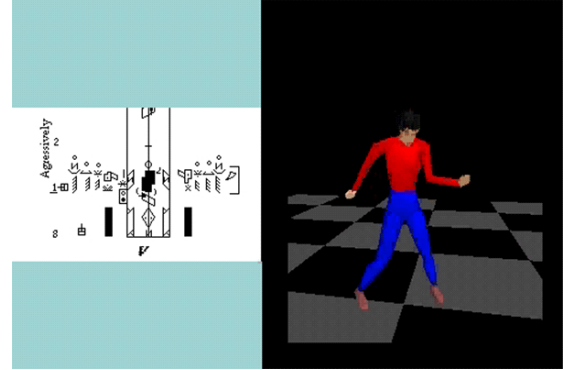
At present, I am working with Tactex, a company in Victoria. Victoria is a city very close to Vancouver in British Columbia. Tactex is developing a marketing technology which they call *Smart Fabric*. This is a fiber-optic array which has X and Y-axes and Z pressure so every place where the optic fibers intersect with one another is one of their tactiles. This technology is really interesting because it can be constructed into different form factors, for example, wearable form factors. I am working with them in finding different kinds of ways of using the fabric in wearable technologies as an element of the input device, but I am also extending the range of input and output. This is just a little bit of an ironic twist, but if you think about transmission, the network's transmission of thought and communication, you could say that, in a sense, telepathy is the ultimate wireless network. Even though there is an irony to it. I am sort of implying that our bodies, the technologies we are developing are as much about how we re-model ourselves, how we think about ourselves, even though we may not be doing this consciously. The working title of this piece is *WHISPER*, it can be read as an acronym of Wearable, Handheld, Intimate, Secret, Personal, Expectant, Responsive system or of Wireless, Heuristic, Interactive, Sensual, Private, Expressive, Reactive.

The work is based on small wearable devices and handheld computers. Participants move within a networked ecosystem which could be a space like this, but it could also be outside on the street. The space contains, and they wear, small intelligent devices which emanate their state. In other words, they whisper to one another and they can whisper with the knowledge of the person wearing them or of their own accord, based on the wearer's movement and intention. The whispering devices are networked to a database server which constructs a system state visualization. The entire system itself is alive and the communication and its visualization are transmitted to a projection surface in the installation and also to the Web.

The database system is based on the notion of future memories and on the history of the devices themselves. A device can be left behind and worn by somebody else. So in a sense the devices themselves have their own past lives based on who the wearer was before. They remember that state and the database serves as sort of a representation of state time as well. We know, for example, that when we have a radical change in how we understand something about our lives that may be in the past, we have a different view of that event and so in a way you could say that you are altering your view of the past. Similarly, whatever kind of attributes we have in terms of the way we look at things now, these can be extrapolated into the future, so the state visualization has this ability to reconstruct the past and extrapolate it to future memory. So memory is not just an archive of the past. Memory is something which is active, in which you are modifying the past and modifying the future based on how you are currently interconnecting with the devices and this part of the visual representation. Each of the devices has states which are shared with the other devices.

<http://www.caiia-star.net/people>

paper

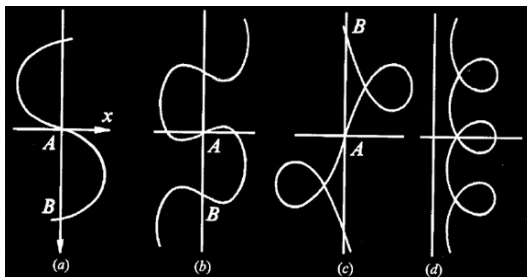


intentional grammars: networked gestural analysis for mixed realities

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Abstract

The Intentional Grammars research is investigating, designing and implementing a predictive and encoded gesture-based approach to transform and reduce the motion data for transmission in a networked environment. This research will be based on emerging knowledge in the domain of experiential movement analysis, and is being built upon Credo Interactive's Life Forms movement tool and its new research project, the I-Move single stream video translation system. Gestures encapsulate the intent of the motion performed by the user in an input video stream. Thus, only the important characteristics of the motion are transmitted to other users in a multi-user application. The transmitted gestural information will also contain encoding for synchronization, interpretation and re-creation of motion data at the destination. An example is a multi-player networked game scenario, where players use video camera input to represent their movement and interactions while connected to their computer. A key to the analysis and categorization of gesture will be modeling intentionality within the gesture.



Keywords: gestural analysis, gesture-based performance, dance and technology, perception of movement, gestural recognition, design process, full-body interface, intention, action theory, effort-shape analysis

Project Partners: Credo Interactive, TechBC [Technical University of British Columbia], Electronic Arts, NewMic Foundation

1. Introduction

Research and development in game interface dialogues and architectures can be informed by, and benefit from the research domain of gestural movement analysis. Movement analysis techniques incorporate interdisciplinary knowledge domains such as computing science, cognitive science, psychology, kinesiology, somatics, and the performing arts. In the latter categories, [somatics and the performing arts] movement analysis methodologies are constructed from experiential body practice which provide a means to accessing and constructing knowledge.

The Intentional Grammars research is investigating, designing and implementing a predictive and encoded gesture-based approach to transform and reduce the motion data for transmission in a networked environment. This research will be based on emerging knowledge in the domain of experiential movement analysis, and is being built upon Credo Interactive's Life Forms movement tool and its new research project, the I-Move single stream video translation system. Gestures encapsulate the intent of the motion performed by the user in an input video stream. Thus, only the important characteristics of the motion are transmitted to other users in a multi-user application. The transmitted gestural information will also contain encoding for

synchronization, interpretation and re-creation of motion data at the destination. An example is a multi-player networked game scenario, where players use video camera input to represent their movement and interactions while connected to their computer. A key to the analysis and categorization of gesture will be modeling intentionality within the gesture.

Gestures can be defined as "body movements that are used to convey some information from one person to another" (Väänänen & Böhm, 1993). If our goal is to get away from pre-defined interaction techniques and create natural interfaces for human users, we should concentrate on the type of gestures that are used in normal human communication. We know that listeners attend to unplanned, unselfconscious gestures, and that they use gesture in communication to form a mental representation of the communicative intent of other gesturing human body.

What kinds of meanings are conveyed by gesture? How are these meanings extracted by viewers | players? Does gesture in mixed reality environments and experiences differ in intention, scale, resolution, or range from other types of gestures? How does gesture enable a greater level of immersion in immersive environments?

Rudolf Laban's movement analysis [Laban], and the work of other researchers [Bartenieff et al.], [Dell], are examples of gestural typologies that analyze and specify a range of qualities and modes of movement for gesture recognition. They present possibilities for exploration into ways that the computer can recognize different aspects of movement, and define a means to approach recognition of gesture systematically. Movement theory can be incorporated as an analytical framework for real-time recognition. The purpose of the research is to find a means to use gesture to control interaction within a 3-d environment. Along with extracting quantitative movement information, building a categorization schema for the qualities of movement being performed can enable an initial model of gesture intention. Intentional grammars can form an interaction with the computer that augments current technologies by extending the input paradigm.

The intentional grammars project will provide the grammar, vocabulary, and knowledge base for a specific domains of movement. Definition of specific movement domains will be an aspect of the project. Intentional grammars for motion encapsulate the "intent" as well as the "kinesthetic" aspects of the motion domain.

1.2 Background

Life Forms was developed at Simon Fraser University at the Computer Graphics and Multi Media Research Lab under the direction of Dr. Thomas Calvert. [Calvert et al, 1991, 1993], as a pilot project in the research of compositional and design processes in movement, dance and technology. Life Forms is a movement tool for choreography and animation, and has innovated a visual way of representing, manipulating, and experimenting with human motion. Merce Cunningham has been composing with Life Forms since December 1989. Cunningham's early work with Life Forms enriched and expanded the interface to a high degree. Today, Choreographers use it for discovery, planning, and visualization [Schiphorst, 1997]. In addition to Merce Cunningham, its users include Michael Cole a former principle dancer with the Merce Cunningham Dance Company, Jimmy Gamonet de los Heros, and Professor Rhonda Ryman from the University of Waterloo. Cunningham's use of Life Forms is primarily a procedural tool for exploring non-habitual ways of constructing, viewing and developing movement for

performance. Cunningham continues to use LifeForms in an on-going basis to invent movement sequences individually that form the basis of a new major work. Jimmy Gamonet de los Heros, an independent choreographer formerly with the Miami City Ballet Company, uses Life Forms as a tool to visualize or transform his dance from an internal choreographic visual gesture, to a large ensemble of sometimes 40+ animated dancers.

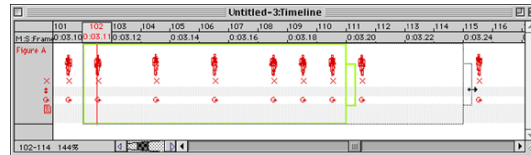


Figure 1. Lifeforms Timeline

Rhonda Ryman, Professor of Dance at University of Waterloo, uses Life Forms to recreate digital libraries of ballet and modern dance vocabulary for education and preservation. Today, Credo Interactive develops and distributes LifeForms movement animation software and is partnering in research which includes features that support higher level compositional activities in motion analysis, capture, editing, visualization improvisation and composition.

1.3 Current Research in Movement Notation and Translation

The Intentional Grammars research is an aspect of current special research projects for movement notation and video extraction. One of the most recent research projects is the collaboration between movement notation and Life Forms animation. Credo Interactive, with the Dance Notation Bureau and TechBC, is working on a major initiative to translate between movement notation and Life Forms 3d animation. A related observation is that reading notational script requires domain knowledge, i.e. the reader or notator adds information in interpreting the notation. They fill in the gaps of notation with domain specific knowledge based on specific movement vocabularies as found in context specific traditions of modern dance or ballet. In addition to Laban and Benesh notation, there are, and has been, many other movement notation languages, some that are very narrow designed specifically for the specific domain they represent.

I-Move is another research technology project under development for partial- and/or full-body motion control for interactive entertainment and online community. The I-Move project is the underlying technology that Intentional Grammars is based upon. I-Move is a key strategic project for the extraction of 3D motion data from a single markerless video stream (e.g. Fig 2. Notation translated to 3d movement of human motion). A related problem is the synchronization of motion from different people in an online multi-user platform that is subject to load-based transmission delays.

The I-MoVE project investigates and develops new knowledge-based technologies and user-directed tools for analyzing, extracting and reconstructing 3D human movement from 2D image streams. Due to the complexity of human movement, the state-of-the-art only provides partial solutions for the reconstruction of 3D movement from single view 2D video streams.

The objectives of the i-MoVE project are:

- development of new algorithms for 3D motion reconstruction from 2D imagery;
- enhancement of algorithms for component technologies (e.g. more "natural" solutions for inverse kinematics computations);
- design of editing tools that integrates video into the animation process; and empower animators and other users with next-generation 3D tools.

The stream of extracted 3D data can be used to control a 3D character in an interactive application (e.g. a computer game) or an "avatar" in an online community. However since the extracted 3D data is mostly on a frame-by-frame basis, the data stream is dense and not optimal for transmission over the internet for online community applications.

1.4 Intentional Grammars

With a single video stream, there is incomplete information for reconstructing 3D human motion, and thus, heuristics are being explored to guide the reconstruction process. The project team's knowledge of movement, and specific domains of movement, can provide information to assist in the reconstruction process. For example, with I-Move as a core-technology, tai-chi movement could be tracked and reconstructed as 3D motion. The rules and the knowledge of the actual tai chi motion grammar/vocabulary are necessary in order to analyze and extract valid movement, transition and blending from one movement to the next, expected sequences of motion. The key element is to couple analysis and reconstruction with heuristics and prediction techniques.

The research will investigate, design and implement a predictive and encoded gesture-based approach to transform and reduce the motion data for transmission over the internet. Gestures encapsulate the intent of the motion performed by the user in an input video stream. Thus, only the important characteristics of the motion are transmitted to other users in a multi-user application. The transmitted gestural information will also contain encoding for synchronization, interpretation and recreation of motion data at the destination. An example in a mixed reality scenario is where users are standing in front of a video camera connected to their computer.

Each user could be in their own personal local space while interacting with others in a shared virtual environment. Their motion must be synchronized in the shared space, viewed locally, and maintained centrally, particularly for contact points in the motion. Each user's local view is impacted by their individual transmission (and to a lesser extent computational) delays. A gesture-based approach to "compression" of the motion data will provide that synchronization needed for an engaging experience.

1.5 Investigation questions

Investigation questions include the following:

- What kinds of meanings are conveyed by gesture?
- How are these meanings extracted by viewers | players?
- Does gesture in game play differ in intention, scale, resolution, or range from other types of gestures?
- How does gesture enable a greater level of immersion in gaming environments?

- What are techniques can be applied for recognition and categorization of gesture gradients (how fine or broad is a "gesture")?
- What techniques can be applied for recognition and integration of partial body gestures?
- Is the gestural information layered and contained within unique channels (i.e. a separation of arm and leg gestures)?
- How should interruption and discontinuation of a gesture be handled by the system?
- What are the issues in mapping gestures from the input body (e.g. human body) to a virtual body?

1.6 Related work at Then | Else Interactivity Centre

As a research partner, Then | Else the Interactivity Research Centre at TechBC [the Technical University of British Columbia] is engaged in a number of research directions which complement this research. This includes: gesture-based performance environments and interaction; development of 3D behavioral animation; perceptually-based video compression; avatar interaction in virtual environments

1.7 Value to game development

The technology [intentional grammars coupled with Credo's i-Move technology] can be applied to immersive online environments in gaming, performance and other tele-present applications. The motion domain knowledge itself can be applied to other types of development where movement analysis, recognition or performance is a key element of the experience.

1.8 References

Somatics education is a term applied to several disciplines developed during the twentieth century in Europe and America. The field has been called Somatics by American philosopher Thomas Hanna, and Somatotherapie by French physicians and educators. Hanna founded the American journal *Somatics* in 1976, and French psychiatrist Richard Meyer the French journal *Somatotherapie* in 1989 to review theoretical and practical work in the field.

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poster



affect space

semantics of caress

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Abstract

This project focuses on the development of a language of interaction based on developing an affect space in collaborative sensing environments. The goal is to design a networked semantics of caress, where the interactivity can recognize, understand, and even express non-rational states such as emotion or intention. This suggests the development of qualitative models for data flow and data-architecture and the development of languages of intimacy, gesture, and the extension of tactility. This project builds a suite of inter-related networked devices within the collaborative sensing environment.

Initially we are prototyping several wearable or portable input and output devices with the goal of developing a networked performance environment. Central to the creation of the suite of devices is the gestural interface toolkit (GIT) which integrates input and output devices and networking necessary for encoding, transmitting and synthesizing affect data. A key input technology is the advanced optical smart fabric, developed by Tactex Controls Inc. This fabric recognizes multiple simultaneous points of contact, and can measure hand movement space so that touch can be transformed and recognized qualitatively. In the output domain, input 'affect data' such as gesture, caress or physiological data such as heart-rate can be transmitted to a remote location as 'gestural output'.

Keywords: interface design, multi-modal device design, remote sensing, networked wearables, sensory extension, collaborative sensing environments, whole hand input

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1. Introduction

This project focuses on the development of a language of interaction based on affect space and the semantics of caress. In order for interactive systems to genuinely model intelligence, we must enable the development of interactivity that can recognize, understand, and even express non-rational states such as emotion or intention. Emotional intelligence systems, [as distinct from artificial intelligence systems] suggest the development of qualitative models for data flow and data-architecture, the inclusion of models for navigation through liminal space [where boundary conditions are fuzzy, transparent, or fluid], and the development of languages of intimacy, gesture, and the extension of tactility. An initial focus of the work is the notion of 'tactics of caress'.

This project builds a suite of inter-related networked devices within a collaborative sensing environment. Initially we are prototyping wearable or portable input and output devices to explore the 'affect space' and semantics of caress with the goal of developing a networked performance environment. Previous work in gestural languages generally focus on the pragmatics of interaction such as manipulation semantics (reference needed: MacKenzie, Mulder, McNeil).

Central to the creation of the suite of devices is the gestural interface toolkit (GIT). The toolkit integrates input and output devices and networking necessary for encoding,

transmitting and synthesizing caress. A key input technology we explore is the advanced optical fabric, 'Smart Fabric' being developed by Tactex Controls Inc. The Smart Fabric is based on Tactex's Multi-touch Controller (MTC) that measures hand movement space so that touch can be transformed and recognized qualitatively: a stroke can be differentiated from a caress, for example. While the movement space of a caress has meaning in the physical domain, it also has meaning in an emotional domain as well. We are working with Tactex 'Smart Fabric' to design a range of form factors for wearable or portable application of this technology.



In the output domain, input 'affect data' such as gesture, caress or physiological data such as heart-rate can be transmitted to a remote location as 'gestural output'. An initial output prototype is a wearable 'hug' device which caresses the surface of the wearers body in response to input data

A central functional property of the Gestural Interface Toolkit (GIT) is the development of a prototype intention grammar. Gesture | Intentionality of the giver/sender can be recognized by analyzing the physical dimensions of input affect via caress and bio-sensor data. At 'the heart' of this project is the key notion that interface and device design can benefit from knowledge expressed within disciplines that incorporate experiential or body practice as a means to accessing and constructing knowledge. This knowledge is codified and exists in the forms of specific technical methodologies within the fields such as somatics, theatre, dance, bio-kinesiology, and non-western physical forms such as butoh. The giver/sender communicates through a language of interaction based on 'tactics of caress' sensing environment, devices and intentional grammars.

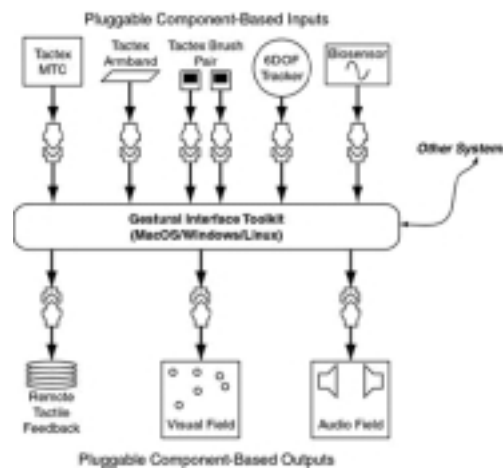
Contemporary research in neuroscience and the cognitive sciences suggest that the sensori-motor systems of the body are inter-connected to such a degree that the body can be seen as a 'fluid' system, capable of re-configuring functionality.[Varela, Damasio]. This metaphor of the body as fluid, re-configurable and networked provides the basis for the system design of our research. Various methodologies incorporating experiential body practice share the existence of definable processes based on the direction of attention in order to affect, alter or produce body state. Within Somatic disciplines, for example, retraining of perception through attention is produced through application of directed movement in the body [Sweigard, Benhke, Bartineff, Cohen]. The concept of 'repeatability' of body-states, suggests that through the direction of attention along with a definable set of procedures the body can be trained to access or construct specific body states. 'Tactics of caress' borrows from these physical metaphors notions of re-configurability, direction of attention, state-space and networked connectivity. Our multiple configurable and networked selves are the blueprint for devices, networks and collaborative sensing environments.

1.1 Language of Caress

To develop the language of caress we have developed from both a top down, affective perspective and a bottom up perspective looking at the semantics of whole hand input and body gesture.

The affective aspects of caress involve the relationship between the sender and receiver. The sender's action and intention can 'touch' the receiver. The intent of touch is critical to the sense of the caress, where the sender may actively or passively caress with specific intent. These intentional gestures can be analysed to form a prototypical intentional grammar. As such, caress is an experiential phenomenon and the exploration of the affective space provides directions for development conceptually, culturally, as well as technically. The pragmatics of gesture form the basis of a bottom-up approach to understanding caress. Whole hand gesture pragmatics can be classified into grasping, claying, chiseling [Mulder, 1998]. Other manipulation semantics can be found in [Kendon] [MacKenzie][MacNeil].

1.2 Technologies for Caress



In order to realize a computer-supported networked language of interaction based on affect, intimacy, gesture and caress system, we consider four areas: input (incoming affect data), output (remote gestural feedback), network connectivity and signal processing (GIT - gestural interface toolkit). The basic structure of our architecture is shown in figure 1.

With incoming affect data, we are primarily concerned with capturing information artifacts that are often far less structured than is usually the case with computer-based systems. Traditional input devices, such as keyboards and mice, do not reflect a range of modes of human interaction involved in a collaborative sensing environment where a 'caress' can be recognized as containing properties that reside in the physical, emotional, as well as intentional domains. From the technical standpoint we are currently looking at three categories of input sensors: pressure, biometric response and location/position sensors. A device of particular interest is a pressure surface known as 'smart fabric' (developed by Tactex Inc.). An initial stage in our blueprint project is to extend the form factor of the pressure sensitive pad in order to incorporate a wearable armband. The data from the sensors are blended, transformed and interpreted by the GIT and delivered to the output space. We are using a wearable 'hug' device (in development), auditory and visual displays, including a CAVE, for affective rendering. Together, the whole system provides the affect space.



1.3 Affective Space: Applications of Caress

One direction for using the affect space considers the elements of navigation from the literal, expressive and symbolic perspective. Touch and caress play an active role in our desire to navigate affective space. Sensing interaction with the pressure-sensitive pad, made wearable and hand-held, enables logical navigation through a virtual dynamic environment or space. The navigation may be: literal, as in current desktop and web applications, expressive as in on-line gaming, installation spaces, computer animation and choreography, or symbolic, as in applications requiring semiotic interpretation of caress. Symbolic navigation is a context dependent, context aware, and configurable navigation space.

As an example of expressive navigation we are using the pressure sensitive devices for navigational within in an immersive collaborative VR environment such as the CAVE. The visual representational field is a fluid particle space composed of discrete particles set in motion, interacting with one another other through their own motion, and through the motion induced by the gestural interaction of the participants. This fluid particle field can be thought of as a 'verb' space, where the gesture of the participants is enacted through their input. Gestures such as cupping, funneling, pushing, dispersing, molding, and collecting effect and 'enact' the visual particle field. A gestural taxonomy can be constructed based on a variety of gesture classifications modeled in movement theory and practice.

1.4 Summary

Affect Space builds from a key notion that interface and device design can benefit from knowledge expressed within disciplines that incorporate experiential or body practice as a means to accessing and constructing knowledge. We are creating an ensemble of tools that explore the pragmatics and expressive possibilities of affect space, particularly in the context of tactility. Inter-related networked devices creative affect space within a collaborative sensing environment. Initially we are prototyping several wearable or portable input and output devices to explore the 'affect space' and semantics of caress with the goal of developing a networked performance environment.

A key input technology is the advanced optical smart fabric, developed by Tactex Controls Inc. This fabric recognizes multiple simultaneous points of contact, and can measures hand movement space so that touch can be transformed and recognized qualitatively. In the output domain, input 'affect data' such as gesture, caress or physiological data such as heart-rate can be transmitted to a remote location as 'gestural output'.

At the bottom level we are creating a suite of software and hardware tools to encode, transmit and synthesize the elements of touch. At the middle level we are developing a language of caress that enables the interpretation of touch and affective sensing such as the bio-sensor data.

The representation of tactility in a language of caress enables intent to be communicated and modeled, and through the development of an intentional grammar, provides a foundation for the top-level of applications. We are actively developing prototypes to explore the elements of caress and affective responses where remote tactility constructs intimate data spaces.

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