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 visuality 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 not 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 workshops[3]. 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.

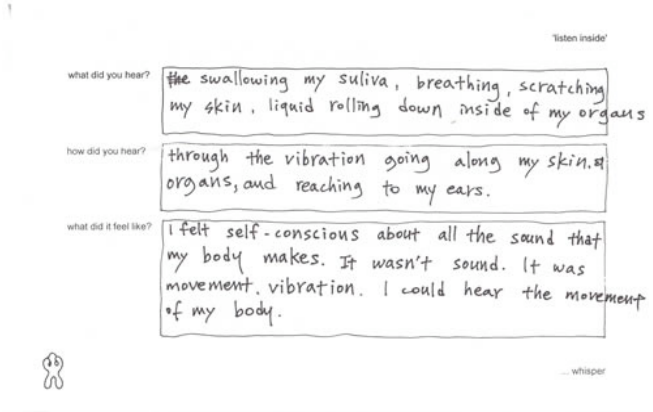

Figure 3. response card example

[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.

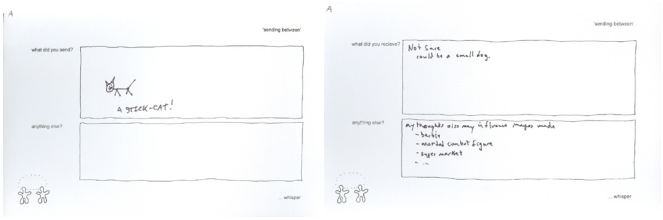

Figure 4. sending and receiving invisible signals

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.

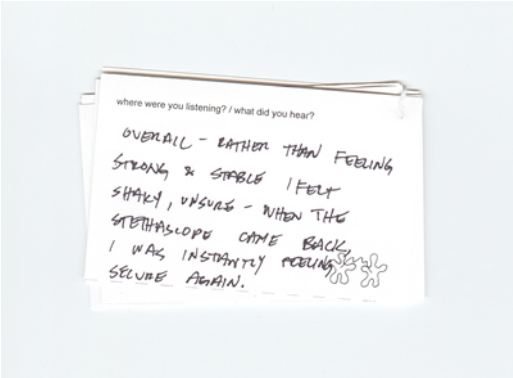

Figure 5. Response Card Sharing Physiological Data

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 physiogical 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

(soft^n) 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 *(soft^n)* 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. *(soft^n)* 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 *(soft^n)* 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 *(soft^n)* objects communicate wirelessly to each other within their network.

To summarize: *(soft^n)* 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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