

The boundaries between 'the digital' and our everyday physical world are dissolving as we develop more physical ways of interacting with computing. This forum presents some of the topics discussed in the colorful multidisciplinary field of tangible and embodied interaction.

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Move to Design / Design to Move: A Conversation About Designing for the Body

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Being in our bodies is so natural that it can slip out of our awareness. Yet the simple act of paying attention to our movement reconnects us with the body. In our technology-centered world, *moving to design* and *designing to move* restore the concept of design as bodily activity. Focusing on how moving can develop “knowing bodies” is an important design strategy that may radically impact the way designers work.

As authors, we come from different contexts and have not worked together. Yet our approaches overlap through a shared passion for designing for, with, and through the body in movement. We design *through movement*, rather than through the body. This is an important nuance—we engage people physically, phenomenologically, imaginatively, and creatively throughout the design process. We use movement as an agent to support and inspire nonverbal or “extra-discursive” reflection that in turn informs our designs. Our research privileges the knowing-

ness that emerges from embodied engagement [1].

Designing for the body requires expertise in a broad range of disciplines. Our toolkits include industrial design; engineering; interaction design; architectural design; computer systems design; costume, garment, and theatrical artifact design; dance and performance creation; and a range of complementary somatic (body-based) techniques. As designers and makers, we cross-pollinate these divergent fields to develop opportunities for embodied interaction and sense-making, focused on the aesthetics of interaction.

In this article we discuss individual projects, interweave notions and approaches common to the three of us, and report nuances of difference. In doing so we hope to provide material for reflection.

For Movement

The body is constantly in motion. By designing for the *moving, experiential body* we can access knowl-

edge, expertise, or connoisseurship that otherwise eludes articulation. In traditional design education, we are encouraged to keep personal viewpoints and experiences at arm's length. Felt experience is idiosyncratic and difficult to articulate, and, despite the shared experience of being human, may vary dramatically. Bodies have different fits, feelings, and ways of moving. These differences affect design processes and outcomes. By considering body-based design as an emergent, phenomenological process, the personal experiences of designers can become an important, if not central, part of the design process.

Engaging in movement as discovery supports the exchange of bodily experiences with end users, as well as with the design itself. Emergent bodily knowledge thereby becomes an essential material of the design process.

Through and To Movement

Movement focuses attention

through the body and therefore supports attentiveness to the body. By using movement-generated attention as a material for design, we can focus on bodily experience. We approach this idea in different ways. Schiphorst uses somatic techniques throughout the design process to *bring attention* to the body's inner and outer movements. Wilde extends the body to *provoke shifts in attention* from gesture to the technologically embodied results of gesture, to change qualities of attentiveness, and, as a result, the kinds of embodied knowledge a participant might access. Klooster creates *cycles of attention* to the body, through the body, to and through artifact, and back to the body. The artifacts' evolution becomes an inherent part of the movement development [2].

This notion of cycling to and through movement as an iterative process is an important aspect of all three approaches. Being attentive to (re)experiencing the self in returning moments, so that movement may be (re)invented, supports the emergence of new perspectives and *in-habitual* practices.

Useful somatic techniques employed in body-based design include activities such as slow-motion walking, focusing on the breath while moving, closing the eyes and following the path of sensations in the body, comparing two movements to assess comfort and fluidity, and "connecting" in space with another participant [3]. The resulting "data" reflect different movement qualities, including how they feel and communicate, and may be used as inspiration and material for tangible design.

The value of attention in its relationship to movement lies in its ability to effect change in the body and in bodily knowledge. This

aligns with the emerging focus within HCI of "design for the self."

Extending Attention

Networked, wearable, and tangible technologies allow us to use attention collectively to create group dynamics that simultaneously focus inward and outward. A design may begin with the participants' first-person interactions with their own body-states then extend through the network to allow numerous participants to share state data. For example, Schiphorst's projects *whisper* and *exhale* prompt participants to turn their attention inward to the internal movement of breath and heart rate, creating an ecology of collective movement and a space for common experience.

whisper is a networked wearable installation consisting of six kimono-like garments with breath and heart-rate sensors and embedded LED displays. The kimono garments are used to share real-time personal body data. The data is sonified and projected onto the floor in light pools to reflect the participants' configurations. Through their awareness of the projected sounds and images, participants can "snap" together in a variety of playful and even absurd ways.

whisper evolved out of five exploratory movement workshops that used attention as material, exploring ways to listen to and share one's own body data. Outcomes of this design process included: an interaction model for sharing breath and heart-rate data between self and other; networked wearable interactive garments that support movement in playful, extraordinary ways; and the articulation of generalizable design techniques of somatic connois-

seurship, which use the designer's experience with movement to support access to more subtle qualities of experience and emergent bodily knowledge for participants [4].

exhale consists of eight networked skirts embedded with sensors and LED patterns. Wireless "breathbands" send the wearer's breath rhythms in real time to vibrators and small fans sewn into the linings of the skirts. Each participant can experience his or her own breath data or share it with other participants through the visceral, real-time reflection of the data close to the skin. The skirt's exterior contains a visible, organic LED array pattern that dims and brightens with the breath rhythm. Participants' autonomic nervous systems entrain their breathing rhythms to synchronize, creating an empathic group breath state shared through the networked wearable system. Such ecologies represent an extended body.

Extension

In a different kind of extended body, the *Light Arrays* project, initiated by Wilde, then developed into a suite of works with Alvaro Cassinelli, explores extension of the body through light. An array of visible LEDs and lasers embedded into a garment project a dynamic representation of body movement and posture onto the environment. The lights are visible for the garment wearer and observers. This illustrates two lines of research: *augmented proprioception*, generated with an artificial visual feedback system, and *enhanced body interaction*, using an interactively augmented body with lights that reflect and respond to movement through time as well as space. The *Light Arrays* prompt wearers to interact through the lights with

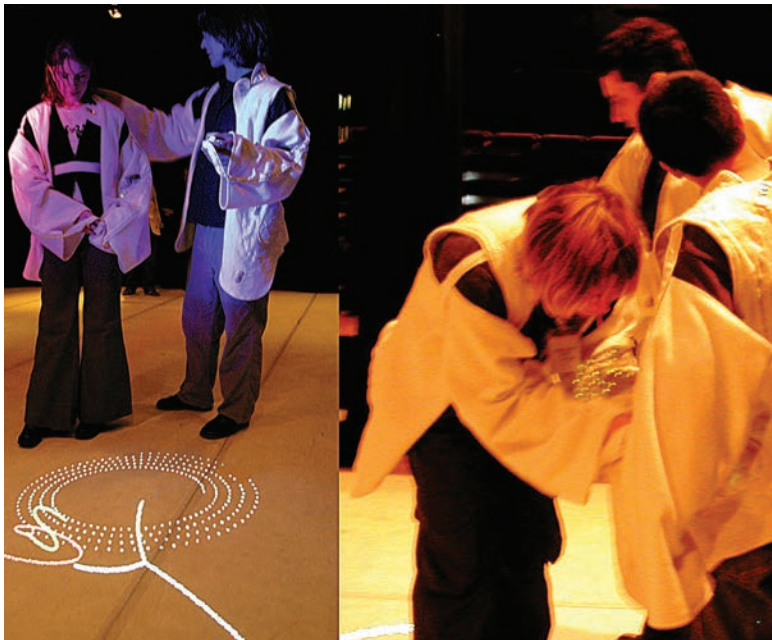
► (Schiphorst and the whispers research group, 2004-2006): *exhale* interactive skirt, movement workshops, and installation space.



► *whisper* (Schiphorst, Kozel, Andersen et al., 2002-2003) evolved out of five movement workshops.



► *whisper* (Schiphorst, Kozel, Andersen et al., 2002-2003) installation interaction and garment design.



posture, movement, and dynamic spatial location. Wearers report being inspired to move and discover their bodies through movement in ways that differ from their usual approaches and habits. Suggested uses include learning complex somatic techniques and

speeding up rehabilitation, as well as exploring the body's expressive capabilities. While the impact in rehabilitation contexts is yet to be tested, radical improvements in outcomes for patients and participants with physical challenges are suggested [5].

Extending the body outward paradoxically extends attention inward, resulting in an intense and in-habitual focus on internal physical and emotional states. Such heightened awareness has been described as poetic and strange, and feelings of elation and a desire to share the idiosyncratic nature of the experience are common. The attention is brought full circle to an engagement with the outside world, with the other.

Light Arrays and related research engage the body through imagination, and imagination through the body. The systems are open and create vacuums for self-discovery through movement.

Vacuums for Possibility

Designing through movement also creates vacuums for artifacts to come into existence. Klooster's *Joint limb shield* and *Rings-ritual* are two examples of artifacts that iteratively evolved through movement development. The evolving artifacts positioned themselves in vacuums in the movement, to fit into and elicit the movement.

Joint limb shield emerged from the movement possibilities that arise when two people move together with touching palms. A number of artifacts were created to be worn so they join the right hands of both dancers. Based on its shape and material, each artifact tunes in to a specific characteristic of connected-hand duet movement. *Joint limb shield* is attuned to and elicits the spatial movement characteristics specific to scooping space between and around the participating dancers. The shield extends the plane created by their touched hands. The device's asymmetrical oval shape shifts in response to the changing length and angle of arm reach when the joined hands

assume different tilted positions. Two crevices in the oval shape allow the dancers' forearms to move from one side of the shield plane to the other as they bend their wrists.

Somewhat differently, *Rings-ritual* emerged from an exploration of a four-handed unfolding movement that aimed to form a ritual between a bride and groom as they put on each other's wedding rings. The resulting ritual features, and is framed by, an intricately folded serviette that contains both rings. The serviette supports the folding and holding of the bride and groom's four hands as they reveal, take, and lovingly place each other's rings. The design choreography features a gentle movement from secluded attention while jointly holding the rings toward open attention when giving each other the rings. It is a gentle rhythm of four folding and holding hands, from groom to bride, then from bride to groom.

Joint limb shield and *Rings-ritual* illustrate the cyclical nature of movement and artifact design, in which the artifact is developed to fit (into) the movement. Creating a vacuum for a product or an artifact through movement is similar to the somatic concept of slow-motion movement, creating a silence or "listening" space that can undo habitual movement and thereby create a space for emergence. For this vacuum to come into being, the attention must be shifted, the perspective turned, and in-habitual ways of moving and sensing movement provoked or supported.

Defamiliarizing

Defamiliarization is a common technique of ethnography, design, and art and is epitomized in the surrealist slogan "making the



► *Light Arrays* (Wilde and Cassinelli, 2010): *inertia LEDs*, *laserSpine*, and the *in-visible skirt*.



► *hipDisk* (Wilde, 2007-2010): The *hipdiskettes* explore choreographic composition.



► *hipDrawing* (Wilde, 2009): A human hip-controlled Etch-a-Sketch garment.



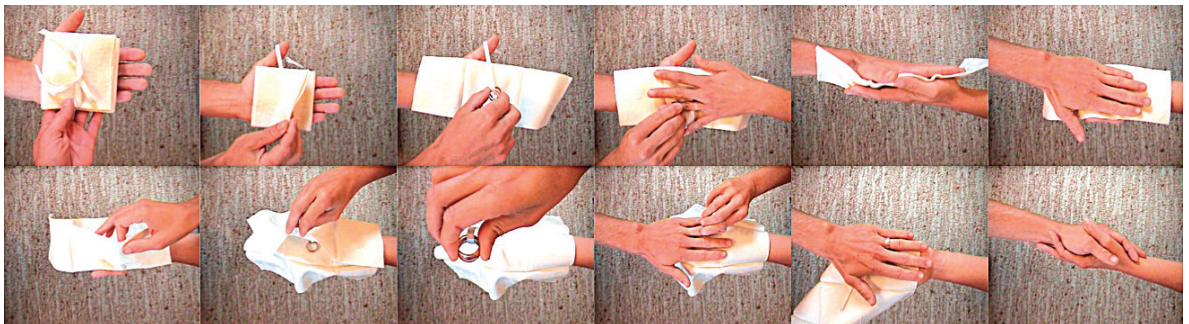
ordinary extra ordinary" [6]. The authors use this experiential concept in different ways. Klooster works through improvisational explorations, in which reflection on action is essential, making design an act of discovering instead of devising. This allows

her to find the extraordinary in the seemingly familiar, and results in design that is simple, yet new. Schiphorst often designs from inner movement sensations to defamiliarize collective movement contexts. Wilde defamiliarizes the movements of participants.

► *Joint limb shield* (Klooster, 2009): A duet design-choreography where an artifact mediates movement possibilities (and restrictions) between two hand-connected dancers.



► *Rings ritual* (Klooster, 2010): A ritual during the wedding ceremony, where both hands of bride and groom lovingly and cooperatively unfold and put on the rings.



Wilde's *hipDisk*, for example, requires the wearer to move in exaggerated ways to force two body-worn disks to touch, and thereby generate simple tones. Twelve soft switches are spread around the disks so that different body positions trigger different tones. When wearing *hipDisk*, participants twist and distort their bodies into strange positions to create music, one ungainly tone at a time. It takes an inordinate amount of effort to play certain notes and rhythms. Multiple players may combine their efforts to make more complex compositions. In contrast to Klooster's *Joint limb shield* and *Rings ritual*, designs that embody specific movement variables, *hipDisk* embodies a question

by providing specific opportunities for unusual movement as an experiential process.

These works raise the notions of steering movement experiences and also of offering movement variations. As designers we try to offer clear affordances as well as undefined possibilities. By finding the right balance between these two polarities, a device may afford specific gestures, as well as offer the freedom to move in personal, idiosyncratic ways. This approach points toward opportunities for play.

The purposeful purposelessness of play. John Cage speaks of "the purposeful purposelessness" of play as "an affirmation of life—not an attempt to bring order out of chaos

nor to suggest improvements in creation, but simply a way of waking up to the very life we're living" [7]. Bill Gaver reminds us that ludic design can support values such as curiosity, play, exploration, and reflection—important values that are essential to well-being. Play is an important element of our design processes. Schiphorst offers playful opportunities for networked engagement in both interior and collective connection; Klooster creates designs that exploit body movement mechanisms to create opportunities for play through movement; and Wilde's systems democratize skilled, unskilled, and even clumsy use through play.

The graceful beauty of clumsiness. We commonly assume that plea-

sure and fluency are the targets for movement experience, yet all newness requires the unfamiliar, and discovery is often characterized by mistaken, erroneous, clumsy, and inappropriate sensations. Our interest in the aesthetic nature of learning includes clumsiness as a partner of graceful discomfort. Schiphorst emphasizes mistakes within a poetics of experience; Klooster practices design choreography in a multifunctional farm setting, offering contexts for low-profile experimentation and allowing the fruitful but unintended; and Wilde works with clumsiness as a direct design material.

hipDisk and related interfaces, such as *hipDrawing*—a human hip-controlled Etch-A-Sketch system—provoke unusual, often clumsy physical interaction. In direct opposition to the premise that we are most happy when we feel we perform an activity skillfully and gracefully, *hipDisk* and *hipDrawing* demonstrate that engaging physically in freeform ways that are unconventional and ungainly may generate very high levels of happiness—even elation. The freedom from strict definitions or notions of skill and grace seems liberating. The absence of solutions or required outcomes means that failure is irrelevant. These works bypass usual patterns of self-censorship and open up unusual experiences that have poetic valence for both user and viewer, as well as rich opportunities for playful interaction, regardless of the abilities or challenges a person might have. The research surrounding *hipDisk* and *hipDrawing* has resulted in surprisingly complex and detailed outcomes related to body-based learning among elite athletes, novices, and people of a range of (body-typical and altered) abilities [8].

By privileging bodily experience over externalized notions of beauty, a design can prompt different qualities of awareness in relation to the body. Engaging in skillful activities is clearly pleasurable. Clumsiness research challenges the hegemony of this idea. The systems are open, the interfaces unrefined, and the mappings clumsy. This combination of design qualities seems to oppose traditional notions of aesthetics and is more closely related to art and play than to purposefulness. It supports broad applications of movement-based design developed for, with, and through the body in motion.

Conclusion

The artifacts and experiences we design reflect inherent features of our embodiedness. They emerge through the knowing body and its innate ability to discover unexpected possibilities. They engage the wearer, observer, and designer in an evolving process of creation and reflection, by encouraging movement to transform normative physical awareness into surprise and knowing. Our approach to design provides insights into the variety of ways in which people employ their bodily imagination. It provides opportunities to engage with experience in unexpected ways, in unusual or unexpected contexts. For both designer and participant, the entire process invites a balance between offering affordance and creating space for the unexpected.

In writing this article, we discovered a common range of insights. Inviting the naturalness of movement into design awareness is a fundamental concept within our design. We hope this conversation incites reflection and further exploration regarding design for, through,

and with movement, highlighting its impact on the process of designing for the body.

ENDNOTES:

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basis for her research.



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