Moving with Awareness: Bridging Somatic Theories and Methods for Interaction Design

Aaron Levisohn
Simon Fraser University
250 - 13450 – 102 Avenue
Surrey, BC V3T 0A3
Aaron_levisohn@sfu.ca

Thecla Schiphorst
Simon Fraser University
250 - 13450 – 102 Avenue
Surrey, BC V3T 0A3
thecla@sfu.ca

CHI'13, April 27 – May 2, 2013, Paris, France.

Abstract
Movement researchers in HCI often utilize theories from the field of Somatics to support their investigations into tangible, ubiquitous, and wearable computing systems. Despite recent advances in integrating movement theory within HCI, the practice of incorporating the associated Somatic methods and referencing the epistemological perspective integral to their development is often lacking. This epistemological gap limits both the value of the theories and their potential to inform HCI interaction models. In this paper we discuss the value of Somatic epistemology and provide a case study to illustrate the benefits of bridging Somatic theories and their associated methods.

Author Keywords
Movement, somatics, kinesthetic awareness, felt experience, laban movement analysis, user experience

ACM Classification Keywords
H5.2. [User Interfaces] Interaction Styles, Theory and Methods, User-centered Design

General Terms
Design; Theory

Introduction
As computers move ubiquitously into all aspects of people's lives, new lenses are needed more fully understand computer use and to develop new forms of interaction. HCI has a history of incorporating multi-disciplinary lenses, often as research methods borrowed from the social sciences and humanities.

Movement has become a more common modality of interaction influenced by the development of ubiquitous, tangible, and wearable computing systems, which have in turn required new methods for interpreting and understanding kinesthetic interaction. HCI researchers have historically looked to existing frameworks from movement-based disciplines to inform their research. These frameworks are often based on theories of embodiment. Theories of embodiment take as their starting premise that the body is the basis for the construction of conscious experience. In HCI, theories of embodied cognition have been heavily utilized to support research investigating movement interaction. These theories while explaining cognition, have inadvertently minimized the critical experiential and phenomenological aspects of embodiment. Researchers interested in the lived experience of interaction have as an alternative turned to movement-based disciplines for theoretical insight and support.

One framework in particular that has been given a great deal of attention by movement-researchers interested in embodied experience is Laban Movement Analysis. Laban Movement Analysis (LMA) is an analytical system developed by Rudolph Laban to allow for the systematic interpretation and notation of human movement. LMA was developed within the discipline of Somatics, a field dedicated to investigating the kinesthetic potential of the body, straddling the spectrum from health to artistic performance.

Concepts derived from Somatic practice, such as those encompassed by LMA, are based on experiential practice and rely on the cultivation of awareness of the moving body. Their application within HCI, however, is often removed from practice, reducing the concepts to theories disconnected form direct experience. This usage of somatic concepts creates an epistemological gap that misplaces the value of somatic knowledge by separating the theories from the methods used to develop them.

Our approach of using Somatic theories such as LMA in conjunction with their associated methods provides new opportunities for understanding the role of movement as a component of interaction and user experience. We discuss the design of an ongoing study investigating movement interaction to illustrate the benefits of this approach for HCI research, noting that this strategy supports the consideration of movement as a component of interaction in ways that are different from traditional approaches and can lead to both new knowledge and new interaction techniques within HCI.

Background

Movement as a form of interaction with computational devices has seen slow public adoption outside the field of gaming. Yet movement has the potential to overcome numerous challenges and to provide new approaches to interaction that can support ameliorative and adaptive user experiences.

Despite enormous advances in portability, smart phones and tablets differ little from their desktop counterparts with their reliance on text-based communication and limited support for full-body sensory engagement [19]. Current mainstream interface designs maintain the primacy of the screen during interaction, borrowing from desktop computing models that overlook the body's role in communication and experience. Smart phone technology has the potential to extend interaction beyond the screen, yet designers continue to develop applications that prioritize visual and aural content over other forms of sensory communication. This dependence on visual

modes of input and output relies heavily on a user's attention, presenting problems for performing common tasks such as walking or driving. In order to support human-to-human communication and interaction in complex social and physical environments, mobile computing must move beyond a reliance on visual and auditory modes of communication and expand to include embodied forms of communication including movement. Researchers working in the areas of tangible and ubiquitous computing are exploring a wide range of interfaces to overcome these limitation and to expand interaction onto the body. This includes investigating gestures that better align with human cognitive processes, and developing wearable interfaces that take advantage of tactile and haptic interaction.

There has also been an increase in the number of gestural interfaces being developed with the availability of depth cameras such as the Microsoft Kinect©. These movement-based systems (sometimes referred to as natural user interfaces or NUI) focus almost exclusively on easily detectable movements, rather than on the complex and subtle range of actions used by people in their daily lives. This omission is largely due to past limitations of the technology, requiring designers to utilize those gestures which were easily detectable; this focus on detectability reflects a technology-driven design process that is counter to the human-centered design practices espoused by contemporary HCI practitioners.

Gestural interfaces also largely ignore the kinesthetic experience of the user. For example, the use of the arms or hands for deictic tasks such as pointing emphasizes the communicative and semiotic aspects of movement while prioritizing the observer's perspective. The kinesthetic experience of the mover becomes subservient to the communicative task resulting in the experience of an "absent body" [18]. This omission neglects a primary characteristic of the human sensory experience that supports knowledge recall and human cognition.

Embodiment

A concept that is particularly useful for investigating kinesthetic experience is *embodiment*. Over the last twenty years, theories of embodiment have become central to research investigations in a variety of disciplines including cognitive science, media studies, dance, performance, interactive art, and philosophy. Historically, the concept of embodiment developed as a critical alternative to the long standing Cartesian separation of the mind and body in which the mind or brain is given primacy in the construction of experience and cognition. A central tenant of all theories of embodiment is that the body is the basis for the construction of conscious experience. Theories of embodiment do not dismiss the role of the brain in cognition, but rather view it as one of the many organs that comprise the body [23]. Researchers in a variety of disciplines have identified myriad ways in which embodiment supports human cognitive[16], emotional [6], and social development [1].

Research Approaches

Most embodiment research conducted within the scientific community investigates embodied cognition, a specific area of research emphasizing the role of the body in the development and support of human thought processes. This approach toward the study of embodiment is also the most often utilized within the field of Human-Computer Interaction (HCI) due to its cognitive science origins. An alternate and less common approach to understanding embodiment is to examine

the role that the body plays in the construction of lived experience. Rather than reducing the scope of investigation, the latter perspective expands it to include elements of experience that are typically considered less research worthy within the scientific paradigm. Instead of solely focusing on the body's contribution to linguistic, mathematical, or conceptual thinking, this approach emphasizes sensory and tacit knowledge directly, to better understand how the body informs aspects of lived experience.

The contrast between cognitive and experiential approaches to embodiment is highlighted by scrutinizing the methods and techniques used in cognitive science and those applied in body-based practices. These methods exemplify the contrasting epistemological orientations assumed by researchers in different areas. Neuroscientists often employ methods that involve the collection of quantitative data from fMRI machines, psychological studies, and anatomical charts [5,6,22]. While new developments in neuroscience have altered our understanding of the importance of movement in human cognition they do not suggest practices to elicit movement experience. Researchers in the field of dance, on the other hand, generally utilize qualitative methods to study embodiment through the active use of their bodies and their first-person experience of body ownership [2,26]. Their methods which are based on somatic practice emphasize the phenomenological aspects of embodiment, highlighting the active body and its transformation through time. These two approaches to movement can be summed up as functional and experiential and they emphasize two different epistemological perspectives.

Embodied Interaction

The concept of embodiment was utilized in HCI for over a decade before being officially introduced to the larger CHI community by Paul Dourish in his book *Where the Action Is* [8]. Dourish formalized his notion of *embodied interaction* based on trends in social and tangible computing to emphasize the ways in which users create meaning through action in the world. He advocated for a model of computing that took into account the full spectrum of human skills. Dourish introduced the concept of embodiment by tracing its origins through the history of phenomenological philosophy, which is concerned with the way that consciousness and subjectivity are structured, and emphasizes the isolating of the phenomenon of experience through practices such as bracketing (epoché). Since the book's publication, numerous other HCI researchers have investigated aspects of embodied interaction. Yet despite Dourish's focus on phenomenological experience, his work has most often been used to support cognitive and social approaches to embodied interaction.

The Field of Somatics

The field of Somatics presents as being particularly beneficial in the study of kinesthetic experience and provides methods for investigating the phenomenological aspects of movement interaction that can support research in HCI. Somatics developed in the late 19th and early 20th century with roots in the Delsarte method as well as eastern philosophical traditions [24]. The term *Somatics* was coined by Thomas Hannah in 1976 to describe the collection of disciplines exploring embodiment and sensory awareness. One of the earliest works on the subject, *The Use of the Self*, was published by F. Mathias Alexander in 1932 [2]. Numerous other practitioners

have contributed to the canon since then, including Elsa Gindler, Moshe Feldenkrais, and Rudolph Laban [9,10,15]. Unlike other body-based practices, Somatics does not focus on the external body, but rather is concerned with understanding the soma, the experience of the body perceived from within. This orientation provides a unique outlook that differentiates Somatics from other body-based practices [11].

Somatics is a practice-based field. Whether one is a dancer utilizing somatic techniques to improve their craft or a therapist assisting a patient improving their gait, the techniques provide a way to increase awareness of the way in which the body moves. Unlike physical therapy where the clinician manipulates the patient's body and prescribes exercises to improve strength or flexibility, in Somatic therapies the patient is guided through movement patterns with the aim of becoming aware of the experience of moving. This awareness allows them to transform their relationship with their body and to improve overall functioning. Somatic methods are epitomized by their ability to expand awareness of kinesthetic experience.

The techniques utilized in the field of Somatics function as unique and valuable research methods, providing a way to gather empirical data that are of a first-person nature. Through the cultivation of awareness, skilled somatic practitioners extend their ability to perceive the body, enhancing awareness of each limb's position and motion as well as the sensations relayed through nerves, joints, muscles, tendons, and the skin [11]. This type of first-person inquiry provides a unique approach to understanding the body and its role in structuring human experience. Additionally, it highlights the role of an active body and of movement in embodied experience.

Somatic techniques provide multiple benefits to research in HCI. First, they can be utilized by designers of technological systems as research tools by facilitating the identification and exploration of facets of bodily awareness that are applicable to technology design. They also provide models for how somatic awareness can be utilized in the development of new modes of interaction by emphasizing bodily experience, embodied cognition, and the incorporation of full body movement. Finally, Somatic techniques lend themselves to the investigations of user experience as it relates to gestural, tangible, and movement-based interaction in general, an area that needs to be better understood by researchers and practitioners alike.

Laban Movement Analysis

One Somatic framework that has been widely applied within HCI is Laban Movement Analysis (LMA). LMA is a comprehensive somatically derived system developed by Rudolph Laban beginning in the early 20th century to support the observation and analysis of movement providing documentation and evaluation techniques.

While Labanotion is often understood as equivalent to LMA, it is important to differentiate between them. Labanotation it is a specific use of detailed notation that describes movement at the body level and applies overarching principles of LMA within it. Labanotation is a subsidiary system within LMA and provides a method for documenting and annotating sequences of movement. This system is similar to musical notation and provides a way for choreographers to document, distribute, and archive their work.

Laban Movement Analysis (LMA) is a comprehensive system for describing movement, including its over-arching themes and its specific attributes and characteristics, encompassing qualitative characteristics

and the subjective experience of movement. LMA takes a holistic view of movement by connecting outward movements with people's inner attitudes. Unlike other models of movement that approached analysis from a purely functional and efficiency-driven model, LMA considers the both the mind and body [3]. This method allows for movement to be considered based on four primary components: Body, Effort, Shape and Space, which is referred to as BESS. The LMA system understands the dynamics of movement as encapsulating multiple perspectives. For example, the observational perspective enables a characterization of defining movement characteristics based on visual cues and kinaesthetic empathy. The somatic perspective references the felt experience of movement – the awareness of muscle, bone, organs, tissue and the other proprioceptive and physiological elements, which make movement possible. The somatic perspective requires a different lens than visual observation necessitating proximal techniques (such as touch), and is more fundamentally experienced by the mover herself, through directed attention and awareness. Another perspective is the inner attitude that generates expressive quality of the movement conveying the mover's inner experience -- her intent and emotional state [3]. Within LMA there are overarching themes that link multiple perspectives for observation and analysis, and that link theory with practice to describe experience.

LMA and HCI

LMA is a commonly referenced somatic framework within HCI; however, its usage is frequently presented without reference to its Somatic roots or their accompanying methods. Various researchers using LMA emphasize the use of Labanotation as a research instrument to aid in the transcribing of users' movement patterns. This includes Lian Loke, et al who focused on using the notation system as a tool for designing input into interactive systems [17] and Mads Vedel Jensen who used Labanotation as a means of transcribing movement data during ethnographic field work. [13]. Tom Djajadiningrat expanded on Jensen's research by exploring ways to characterize movement in terms of its expressive and emotional qualities rather than solely on its functional contributions to interactions [7].

Other researchers utilize elements from LMA as lenses through which to understand interaction incorporating concepts such as the Effort-shape factors. Michael Bacigalupi integrated LMA with John Dewey's aesthetic theory to investigate the role of aesthetics in constructing an interactive experience [4]. W.N.W. Hashim et al used themes from LMA in the development of the concept of Graceful Interaction, a framework for designing desktop interfaces that are more effective, enjoyable, and easy to use [12]. Ana Paiva et al used LMA concepts to inform the development of the movement in their exploration of a *sympathetic interface*, a particular type of affective controller that responds to user's emotional gestures and touch [21]. And Katherine Isbister and Kristina Höök use LMA concepts to inform the design of their project *FriendSense,* a movement-based system that enables friends to share the physical sensation of emotional closeness [27].

Discussion

HCI's multi-disciplinary nature is beneficial as it allows for the expansion of the scope of the discipline. The incorporation of ethnography as a lens for understanding users, for example, brought with it both a new theoretical perspective as well as associated

Figure 1: Participants being guided through Somatic techniques as they explore LMA concepts

research methods. Coupling theory and method allowed ethnographic inquiry to gain widespread acceptance and utilization within the HCI community.

The use of Somatic concepts – those from LMA in particular – has similarly demonstrated the significance of interdisciplinary movement-based scholarship. The prevalent use of somatic theories, however, has not seen a corresponding utilization of somatic techniques. It is the incorporation of Somatic methods that articulate specific repeatable techniques for creating affordances for awareness that offer the greatest potential for researching and developing new movement-based interaction models.

While the use of LMA concepts, a specific Somatic approach, has provided insight for researchers investigating movement, the lack of reference to their origins in Somatics is problematic since it neglects the process oriented and action-centered basis of knowledge in the discipline and creates an epistemological conflict. This misalignment does not precluded the utilization of LMA concepts, however it severely limits their usefulness by removing them from the context within which they were developed creating a paradigmatic mismatch. The research examples presented above do not take full advantage of the benefits of LMA because they have separated the theory from the methods used to produce it.

To fully understand this misalignment it is necessary to consider the origins of the techniques used by Somatic Practitioners; in particular, the central role of movement as a means of cultivating awareness in the development of Somatic theories. First-person somatic techniques, such as those used in LMA were developed as practice-based instruments in direct dialogue with the theories that they embody. The application of the frameworks and underlying theoretical perspective is predicated on the facilitation of personal body-awareness as exemplified in Schiphorst's notion of *somatic connoisseurship* [25].

Case Study

To illustrate the integration of somatic theory with somatic practice we describe an ongoing research project exploring how Somatically-based workshops can inform technology design. This case study illustrates several ways in which somatic techniques can assist in research investigations: First, by providing an alternate approach to considering the role of movement in interactions as a way to facilitate the recall of embodied knowledge; second, as a tool for priming participants in order to engage their kinesthetic intelligence; and finally as a method for motivating real time discussions of movement experience.

By using LMA as a starting point for our investigation, we conceived of using movement qualities rather than coded gestures for interaction. An LMA lens for describing movement quality enables us to observe and analyze how qualities of movement relate to subjective experience [20].These qualities of movement provide glimpses into the internal state of the mover, and are tightly connected with embodied and tacit knowledge. In LMA movement quality is divided into four *Effort Factors*, each representing a specific type of movement experience for an individual. The effort factors are described as *Flow*, *Weight*, *Space*, and *Time*. The movement qualities represented by combining these Effort factors are not mutually exclusive and normally occur in concurrent blends that vary fluently over time; however for the purposes of this investigation they are explored individually.

Figure 2: Participants sorting their images based on LMA Effort factors

Considering movement in this manner enabled us to conceptualize an exemplar research application to investigate how embodied meaning can be attributed to photographic content through the use of kinesthetic or movement tagging. Digital tags, or metadata, are often used to classify and describe the contents within large databases of information in order to make them more easily searchable. Typically, metadata use language-based lexical units, providing textual labels that describe a characteristic of a particular piece of digital content. This research explores the use of full-body kinesthetic movement as a means of characterizing digital content. We consider movement and gesture as forms of human experience that can be richly and qualitatively described through the articulated theoretical semantics of LMA; however, rather than focusing on the semantic information as a separate, and non-embodied semiotic form that pre-defines experience, we utilize experience to shape the semiotic form and its underlying properties. In the application, users' movements are analyzed for the qualities they express. Users are able to search and sort their photographs and images using expressive movement. This tagging method differs from current approaches to using gestures for digital interaction which often mimic functional movement literally or metaphorically [14].

Our eight workshop participants were skilled movers workshop was held in a dance studio providing an environment conducive to moving. The goal was to explore various ways that people represent their experience of an image or images through the application of the LMA *Effort* factors. We devoted two hours to the investigation of each of the four *Efforts*.

Each of the four phases began with a priming stage in which a Certified LMA expert conducted a 45 minute somatic-based movement exploration to enhance body awareness, tailored to embody the particular Effort Factor being investigated. These improvisations focused on self-observation of movement qualities with the participants responding to descriptors of images as they were experienced metaphorically (Figure 1).

Following the priming stage participants were given a set of 34 identical photos, which they were asked to sort based on the Effort qualities evoked by the image (Figure 2). For example, when investigating the *Flow* Effort they laid out the images on a continuum from *Bound Flow* to *Free Flow.* Participants selected an image from each side of the spectrum and created a short movement phrase of 3 to 5 seconds that embodied the characteristics of the photographic image, emphasizing the particular Effort factor. Participants paired up and performed the short movements for their partner. Each group was given a Flip Camera® with which to record the movement and the ensuing partner discussion. This was followed by a group discussion in which the participants shared insights as movers and observers.

The use of the Flip Cameras® provided a method for capturing both movement sequences and discussions simultaneously without sacrificing the immediacy of the experience or compromising the participants' kinesthetic state. The cameras also enabled us to capture large quantities of data in a less formal and more natural manner (Figure 3).

Our analysis of the workshop data focuses on the *strategies* used to embody the photographs, as well as a *thematic analysis* of the participants' discussion about their observations and analysis. This study is enabling us to identify the correlation between movement experience and image categories such as memory,

Figure 3: Screen captures from the Flip Camera® videos depicting the participants performing movement sequences for their partners

identity and social and familial structures. In this investigation Effort quality is not only enacted as a lived experience, but is used as a method of inquiry for observing experience. As a method it frames experience in the context of real-world artifacts and facilitates decoding in a semantic framework that can be accessed by users in their relationships with images through meaningful properties such as memory, artifact, and metaphor.

CONCLUSION

Within HCI, designers and researchers are articulating a fuller range of design practices that support embodied experience within computational interaction. While which human cognition and behavior are dependent upon the experience of the body, techniques for invoking and modeling awareness of bodily experience as a design tool remain relatively sparse. By better understanding how theories of embodiment can be explicitly operationalized through rigorous somatic techniques of self-observation and self-reflection, transform HCI by re-conceptualizing the role of movement during interaction. This transformation has improved fidelity of communication, and better support for human cognition and emotional well-being.

Although the concept of embodiment has gained considerable ground in HCI, there is still an emphasis on theories that focus on the body's contribution to cognition alone. A review of the frameworks and theories that inform the use of movement in HCI reveals an increasing awareness of the body's role in constructing experience [19]. With mobile and ubiquitous computing platforms transforming where, when, and how people access information, new opportunities for investigating embodied interaction continue to develop relevancy and agency within opportunities, however, a more direct approach to investigating bodily experience is necessitated.

Areas traditionally considered disconnected from HCI, such as the field of Somatics, have already impacted research by providing theories and frameworks to model movement for interaction. These theories, however, have generally been utilized without reference to their associated methods, reducing their efficacy and usefulness. These Somatic techniques function as unique research methods that are both empirically-based and provide a first-person perspective. This unusual combination makes them extremely valuable for investigating movement experience as it pertains to interaction. Although Somatic practitioners require years of experience to hone these methods for self-observation and analysis, our case-study illustrates how such experts can support the expansion of Somatic awareness for participants within a workshop context. This study also demonstrates how the bridging of Somatic theory and method exposes new opportunities for the investigation of movement within HCI.

References

[1] Ackerman, J.M., Nocera, C.C., and Bargh, J.A. Incidental haptic sensations influence social judgments and decisions. Science 328, 5986 (2010), 1712 –1715.

[2] Alexander, F.M. The Use of the Self: Its Conscious Direction in Relation to Diagnosis, Functioning and the Control of Reaction. E.P. Dutton, NY, 1932.

[3] Arnheim, R. A turning point in movement therapy - Body movement: coping with the environment. *The Arts in Psychotherapy 8*, (1981), 245–254.

[4] Bacigalupi, M. The craft of movement in interaction design. In proc. the working conference on Advanced visual interfaces, (1998), 184.

[5] Craig, A.D. (Bud). Human feelings: why are some more aware than others? *Trends in Cognitive Sciences*

8, 6 (2004), 239–241.

[6] Damasio, A.R. Descartes' error: emotion, reason, and the human brain. Avon Books, New York, 1995.

[7] Djajadiningrat, T., Matthews, B., and Stienstra, M. Easy doesn't do it: skill and expression in tangible aesthetics. Personal and Ubiquitous Computing 11, 8 (2007), 657–676.

[8] Dourish, P. Where the Action Is: The Foundations of Embodied Interaction. The MIT Press, 2004.

[9] Feldenkrais, M. The Elusive Obvious or Basic Feldenkrais. Meta Publications, 1981.

[10] Gindler, E. Gymnastik for people whose lives are full of activity. In D.H. Johnson, ed., *Bone, Breath, and Gesture: Practices of Embodiment Volume 1*. North Atlantic Books, 1995, 5–14.

[11] Hanna, T. What is Somatics. In D.H. Johnson, ed., Bone, Breath, and Gesture: Practices of Embodiment North Atlantic Books, Berkeley, CA, 1995, 341–352.

[12] Hashim, W.N.W., Noor, N.L.M., and Adnan, W. A framework for graceful interaction: Applying Laban effort theory to define graceful movement quality. User Science and Engineering. (2010), 139 –144.

[13] Jensen, M.V. An Anthropological Move Towards Tangible Interaction Design. Nordic Design Research Conference, NorDes (2005).

[14] Kettebekov, S. and Sharma, R. Understanding gestures in multimodal human computer interaction. International Journal on Artificial Intelligence Tools (IJAIT) 9, 2 (2000), 205–223.

[15] Laban, R. von and Lawrence, F.C. Effort. Macdonald & Evans, London, 1947.

[16] Lakoff, G. and Johnson, M. Metaphors We Live By. University of Chicago Press, Chicago, 1980.

[17] Larssen, A.T., Loke, L., Robertson, T., and Edwards, J. Understanding Movement as Input for Interaction–A Study of Two EyeToy Games. In Proc. OzCHI, (2004).

[18] Leder, D. *The Absent Body*. University Of Chicago Press, 1990.

[19] Levisohn, A. and Schiphorst, T. Embodied engagement: supporting movement awareness in ubiquitous computing systems. *Ubiquitous Learning: An International Journal 3*, 4(2011), 97–112.

[20] Maletic, V. Body, space, expression: the development of Rudolf Laban's movement and dance concepts. Mouton de Gruyter, NY, 1987.

[21] Paiva, A., Andersson, G., Höök, K., Mourão, D., Costa, M., and Martinho, C. SenToy in FantasyA: Designing an Affective Sympathetic Interface to a Computer Game. Personal and Ubiquitous Computing 6, 5 (2002), 378–389.

[22] Rizzolatti, G. and Craighero, L. The Mirror-Neuron System. Annual Review of Neuroscience 27, 1 (2004), 169–192.

[23] Rohrer, T. The Body in Space: Dimensions of Embodiment. In R.M. Frank, R. Dirven, T. Ziemke and E. Bernardez, eds., Body, Language, and Mind: Volume 2: Sociocultural Situatedness. Walter de Gruyter, 2008, 420.

[24] Schiphorst, T. The varieties of user experience: Bridging embodied methodologies from somatics and performance to Human Computer Interaction. University of Plymouth. Dissertation. 2009.

[25] Schiphorst, T. Self-evidence: applying somatic connoisseurship to experience design. Ext. Abstracts CHI 2011, ACM (2011), 145–160.

[26] Sheets-Johnstone, M. The primacy of movement. John Benjamins Publishing Co, Amsterdam, 1999.

[27] Sundström, P. and Höök, K. Hand in hand with the material: designing for suppleness. CHI 2010, ACM (2010), 463.