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Editorial
Somaesthetics and Technology

This special issue of the Journal of Somaesthetics contains articles that deal with the aesthetic relationship between technology and the soma. Special focus was intended on the applications of somaesthetic theories and practices on the design and evaluation of technology, and their comparison to other theoretical frameworks. Instead, we have mostly received contributions that are discovering somaesthetics. Regular and invited submissions went through a peer review, combined with editorial suggestions. We hoped the submissions would focus on the theory and practice of somaesthetics. What the articles have in common is their focus on the techno-social materials and themes.

Migration, for example, is an important socio-dynamical construct. In the artistic work INTIMAL, Ximena Alarcón Díaz explores the soma expressions of Colombian migrant women in telematic sonic improvisatory performance work. The design of the system has been informed by several interdisciplinary practices including embodied music cognition and deep listening, as well as an oral archive with testimonials from Colombian migrants. Alarcón presents data from field work with migrant women and two experiments with groups improvising to the oral archive, while being recorded with optical motion capture and sensors for breathing and muscle activity. Based on the results, Alarcón presents the design of the system.

Recently, virtual, augmented, and mixed reality had tremendous momentum. It is widely accepted that soma-based experiences will be an important design goal for these techno-social extended realities. We (Erkut and Dahl) present an approach of teaching virtual reality interactions, as used in our embodied interaction course for master's students at Aalborg University. In order to help the students to develop the designer skills necessary for successful development of virtual interactions, the course includes theory on soma-based design, movement exercises with focus on first-person experiences, and a practical workshop jointly with students at the Danish National School of Performing Arts. We present four student projects from the course and discuss them in relation to experiential somaesthetics.

Two invited papers aim to highlight new voices in the field. The Doctoral Committee papers from the 2018 Movement and Computing Conference were invited, revised, and organized by the guest editors. They together expand the bounds between body, brain, and environment to inanimate objects and matter in the environment.

Kensho Miyoshi highlights the potential use of kinesthetic empathy in the context of design. Can the designers feel kinesthetic empathy to objects as much as they feel towards people? Beyond their function, could the quality of object movements evoke feelings useful for design? The author applies kinesthetic empathy to the perception of kinetic objects, with the aim of revealing the relationship between object movements and our embodied and empathic

reactions. Kinesthetic empathy could open a new perspective on our embodied and visceral response to dynamic objects and environments, in relation to somaesthetics.

In the second doctoral work summary, Garrett Laroy Johnson and his colleagues focus on techno-social construction of ensembles in designing responsive media. Within their work Lanterns, they show how people and augmented pendant lamps together form an ensemble and how people are entrained *with* the Lanterns. Based on the concept of ensembles, the authors summarize their design tactics and investigations, which provide insights about the embodied experience with respect to technicity.

The highly speculative essay by Monica Yadav combines the diverse fields of neuroscience, philosophy, and theatre into a techno-social bound between body, brain, and environment. Specifically, technology, seen as a surface, produces in reflection an encounter of the triadic relation of body-brain-environment with itself. The author proposes that the triad is in both a material and virtual relation, where material and virtual are *allelic* pairs.

This issue includes an insightful interview with Kia Höök on her new book *Designing with the Body*, conducted by Dag Svanæs. Not only did Höök "shop for" and transfer somaesthetics into actionable research in somaesthetic interaction design, but she also produced and documented beautiful soma design exemplars and literally "moved" an international research community with her effort. Svanæs, another strong mover on the importance of the body in interaction design, brings out fine details of the book in the interview. Both the book and the interview are highly recommended readings in soma-based design of the current and future technologies that shape us.

The last contribution is a book review. Max Ryynänen critically assesses the anthology *Aesthetic Experience and Somaesthetics* edited by Richard Shusterman containing thirteen articles. Ryynänen discusses a selection of them concluding that the notion of somaesthetics, on the one hand, offers an accessible and necessary conceptual platform for thinking and practicing with and through the body, but that, on the other hand, the contributions are in danger of losing philosophical rigor and depth that could be regained by connecting to the field's philosophical foundations as elaborated by Dewey and Shusterman.

Compared to the first call for papers, the issue clearly is very different than we the editors have first imagined. The contributions challenged our disciplinary competences, indicated many future directions, and took us to reach out for reviewers in many different fields. We hope that they will have the same effects on you, including slowing down a bit and feel the fundamental question of interaction design with your entire soma: "what if …".

Cumhur Erkut and Sofia Dahl, Issue Editors

Conceptual Design for INTIMAL: A Physical/Virtual Embodied System for Relational Listening

Ximena Alarcón Díaz

Abstract: *This paper articulates the design for the first stage of INTIMAL: a physical/virtual embodied interactive system for relational listening in the context of human migration, set within the artistic practice of improvisatory telematic sonic performance. Informed by the Deep Listening experiences of nine Colombian migrant women in Europe and integrating Embodied Music Cognition Methods, INTIMAL draws upon sensorial experience in dreams, virtual spaces, and physical spaces to develop a holistic understanding of the body as an interface that keeps one's memory of place. Technologies are intended to be used as mediations aiding the co-relations in listening for the sensing, processing and retrieval of an oral archive of other women's testimonies from the Colombian civil war, while improvisers' body movements, voices, and spoken words resonate with these voices. The author suggests how INTIMAL system could act as catalyst for creating new layers in the reconstruction and transformation of embodied memory, opening paths for individual and collective healing of feelings associated to the migratory experience and the armed conflict.*

Keywords: *interactive system, relational listening, embodiment, memories, migration, Colombian-conflict, women, telematic sonic performance, oral archives.*

1. Background

While working in the fields of sound arts and networked performance,[1] I became interested in opening paths for the creative expression of feelings derived from the migratory experience. Between 2012 and 2016, I created Internet-based Telematic Sonic performances–which involve telecommunications and computers in the transmission of unidirectional or bidirectional streaming of audio. Migrants from all over the world listened to *"in-betweeness"*[2] in the context of human migration; that is, a limbo experienced in between lands, cultures, and identities, and perceived in one's surrounding acoustic environments.[3] Using Pauline Oliveros's Deep Listening

1 Garret Lynch and Denis Rea, "Body, Space and Time in Networked Performance," Proceedings from Remote Encounters: Connecting Bodies, Collapsing Spaces and Temporal Ubiquity in Networked Performance conference 2013. *Liminalities: A Journal of Performance Studies* 10, no. 1 (May 2014): 2-15.

2 M. Ortega, "Multiplicity, Inbetweeness, and the Question of Assimilation," *Southern Journal of Philosophy* 46 (2008): 65, 80.

3 Ximena Alarcón, "Networked Migrations: Listening To and Performing the In-Between Space," *Liminalities: A Journal of Performance Studies* 10, no. 1 (May 2014): 2–21.

practice[4] and the telematic medium, people in my study engaged in a *set of relations* involving dreams, body expression, voice, and spoken language.

Inspired by the embedded relationality of *migratory aesthetics*, "characterized by its success in interweaving and interconnecting the fragments, disengaged from older structures and discourses",[5] and the concept of *relational listening*[6] where the psychological and technological processes are part of the possibilities of listening to others' listening, I have engaged in the development of INTIMAL: Interfaces for Relational Listening.

Through my development of the art-research project INTIMAL, I hope to gain a greater understanding of the experience of the body within the interrelations among the condition of migration, the voice, and the telematic medium; interrogating *the role of body as an interface that keeps memory of place*, thereby opening paths for the healing of loss and dislocation. Specifically, my research looks at (1) how co-located and telematic technologies can expand a relational dialogue that directly responds to the embodied experience of migration; and (2) how an oral archive that represents a disembodied memory of voices can be integrated into this process of remembering as a catalyst for emerging relations.

I envision INTIMAL as a physical/virtual "embodied" interactive system for *relational listening* that interrelates body movement, voice and language, oral archives, and the memory of place in the context of migration through the artistic practice of improvisatory telematic sonic performance.

To inform this interactive system, I explored the migratory listening experiences of nine Colombian migrant women presently residing in the cities of Barcelona, London, and Oslo - in counterpart with an oral archive containing testimonies collected by the Commission of Colombian Migrant Women for Truth, Peace and Reconciliation,[7] most of which describe experiences derived from the Colombian armed conflict. Thus, the project is situated in the historical context of Colombia post conflict and the feelings that arise for Colombian migrant women during this process.

As a result, a modular design for virtually and physically mediated ensemble interaction[8] involving technologies for *sensing* (body movement, voice, and language), *processing* (in relation to the oral archive), and *retrieval* (the audio response that the improvisers receive from the system) has arisen, to be tested in May 2019 by project participants via a telematic improvisatory performance. In this paper, I will describe the conceptual design of INTIMAL, its supporting theories, and the methodology used in my fieldwork with the nine Colombian women. Although this scope does encompass their responses to the oral archive, I have left aside the curatorial, annotation, and technological work that accompanied the oral archives.

4 Pauline Oliveros, *Deep Listening: A Composer's Sound Practice*. Lincoln: iUniverse Books, (2005).

5 Isabel Hoving, "Between Relation and the Bare Facts: The Migratory Imagination and Relationality." In Sam Durrant and Catherine M. Lord, eds., *Essays in Migratory Aesthetics: Cultural Practices between Migrations and Art-Making*. New York: Editions Rodopi B.V., (2007): 179–190.

6 Lawrence English, "Relational Listening: The Politics of Perception." In *Ear Wave Event*, Issue 2 Spring 2015. Accessed 29 September 2015, earwaveenvent.org

7 A grassroots organization operating mainly in Barcelona and London, where most Colombian migrants reside in Europe; see http://mujerdiaspora.com.

8 Charles Patrick Martin, "Apps, Agents, and Improvisation: Ensemble Interaction with Touch-Screen Digital Musical Instruments." PhD thesis, Australian National University, (2016).

2. Theoretical framework and methodologies

INTIMAL is informed by interdisciplinary practices and concepts including Deep Listening, the philosophy of embodiment, migration anthropological studies, and the methods and theory of Embodied Music Cognition.

When situating this project in migration studies, Ahmed notes that "journeys of migration involve a splitting of home as place of origin and home as the sensory world of everyday experience." Embodiment in migration narratives involves a "spatial reconfiguration of an embodied self",[9] so that issues of absence and presence,[10] as well as a sense of place,[11] insist upon daily attention from people who experience migration. To access and explore these migratory narratives, INTIMAL uses Oliveros's practice of Deep Listening, which invites one to expand one's "perception of sounds to include the whole space/time continuum of sound—encountering the vastness and complexities as much as possible."[12] This practice uses sonic meditations, unconscious dreaming,[13] Chi Kung and Tai Chi Chinese body energetic practices, and free movement[14] to increase one's awareness of sound in one's internal and external environments. Listening to and sharing dreams, as well as migratory experiences on a virtual platform creates an interesting experience interweaving different perceptions of space and time, and share unexpected encounters between people in different locations.[15] As Sharon Stewart explains, Deep Listening "is founded upon a remarkable devotion to opening the body, through developing a regular, personal movement practice that helps free the body (of tension) while at the same time stimulates awareness of the energy (flow) of the body." Stewart favors the label *somatic listening* "which encompasses both a listening inwardly to the sensations and movements of the body as well as a listening with the entire body, which becomes highly sensitive and responsive to the kinetic energy (movement) of the sound it engages with".[16] Thus, with experience as paramount, nourished also by philosophical Eastern traditions, Deep Listening is in dialogue with practical *Somaesthetics*,[17] cultivating an awareness of listening as potentially reciprocal and non-judgmental: in which when listening to someone/something (e.g. our body, dreams, surroundings) always will imply that someone/something might be listening in return. Deep Listening practitioners have explored listening to the body via different avenues: focusing on a "prosodic body," which is formed around the sounds we speak;[18] listening with the feet by exploring slow walking and voicing people's sense of place;[19] and breathing and touch in craniosacral therapy, listening for the "still-point" to create a dialogue with disturbances and

9 Sara Ahmed, *Strange Encounters: Embodied Others in Post-Coloniality*. London: Routledge, (2000): 90

10 Ann Brooks, and Ruth Simpson. *Emotions in Transmigration, Transformation, Movement, and Identity*, 31–51. Basingstoke, Hampshire: Palgrave MacMillan, (2013).

11 Doreen Massey, *Sense, Place and Gender.* Minneapolis: University of Minnesota Press, (2001)

12 Pauline Oliveros, *Deep Listening: A Composer's Sound Practice*. Lincoln: iUniverse Books, (2005).

13 Carole Ione Lewis, *Listening in Dreams*. Lincoln: iUniverse Books, (2005).

14 Heloise Gold, *Deeply Listening Body.* Kingston, N.Y.: Deep Listening Publications, (2008).

15 Ximena Alarcón, "Telematic Embodiments: Improvising via Internet in the Context of Migration." In David Rothenberg, ed., Vs. *Interpretation: An Anthology on Improvisation*, vol. 1. 85–93. Prague: Agosto Foundation, (2015).

16 Sharon Stewart, "Listening to Deep Listening." *Journal of Sonic Studies* 2, no. 1, (2012).

17 Richard Shusterman, "Somaesthetics" in The Encyclopedia of Human Computer Interaction, https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/somaesthetics accessed 23 January 2019.

18 Robert Kocik, *Supple Science: A Robert Kocik Primer*. Michael Cross and Thom Donovan, eds. On Contemporary Practice: Oakland, CA, (2013).

19 Viviane Corringham, "Listening with the Feet." In Monique Buzzarte and Tom Bickley, eds., *Anthology of Essays in Deep Listening.* Kingston, N.Y.: Deep Listening Publications, (2012): 143–148.

blockages felt in the body.[20]

In light of these Deep Listening experiences, embodiment can be understood as a holistic concept; according to Sean Gallagher, embodiment encompasses perceptual, emotional, and interactive processes, the use of language and metaphor; "the exercise of free will in intentional action," and "the creation of cultural artifacts that provide for further human affordances."[21]

Also in line with Deep Listening practice, Nina Sun Eidsheim[22] proposes transitioning the traditional listening perspectives of singing and other musical performances from the "figure of sound"—that is, the sonic narrative, which focuses only on audio parameters and processes—to the "figure of vibration"—that is, the sensing of sound and listening. This shift helps one to delve deeper into sonic spatial relations, beyond the auditory experience alone.

Shanken and Harris[23] refer to Oliveros's work as "techno-intuitive" and her methods for extending embodied knowledge and expanding consciousness as a foundation for transforming our relationship with the earth and creating "community and healing". They highlight Oliveros's recurring themes in telepresence and telepathy manifested in her Telematic Circle,[24] a group of musicians improvising through the Internet, as well as in Dream work led by IONE[25] and experienced by participants in Deep Listening retreats. They mentioned further explorations by artists such as Nina Sobell using biofeedback "brain waves drawing over the Internet between Poland and Los Angeles" with the intention of creating "a non-verbal intimacy in cyberspace, one world, one time."

In non-visual network interface performances, Mills and Beilharz note that listening and the semiotics of sound are the *main mediators*, in that they illustrate "the role of metaphor and embodiment in the perception of musicians creating and responding to musical signs in networked synchrony." In turn, they also support the idea of using a framework of Distributed Cognition to achieve "fluidity in networked musical dialogue" via extended listening practices, "replacing visual referents in facial expression, body language and the physical marking of time."[26]

In my experience with telematic sonic performances that try to listen to someone across the ocean while simultaneously trying to be heard, migrants also undergo what Franziska Schroeder calls Networked Listening, which provokes an "*unselfing*" or decentering, or the "state of moving from oneself to the other."[27] Migratory processes also generate this decentering condition, and this alignment represents the intersection around which this research has interwoven the medium of improvisatory performance into the context surrounding it. In order to delve deeper into embodiment, that is, I incorporate into INTIMAL the use of Embodied Music Cognition as "a method to reveal motion features that contrast with the original audio, or to reveal motion

20 Lesley Greco, "Deep Listening and Touch:Unwindying the Body of My Voice." In Monique Buzzarte and Tom Bickley, eds., *Anthology of Essays in Deep Listening,* Kingston, N.Y.: Deep Listening Publications, (2012): 153–159.

21 Sean Gallagher, *How the Body Shapes the Mind.* Oxford University Press: Oxford, (2005): 247

22 Nina Sun Eidsheim, *Sensing Sound: Singing and Listening as Vibrational Practice*. Durham, N.C.: Duke University Press, (2015).

23 Edward Shanken, and Yolande Harris, "A Sounding Happens: Pauline Oliveros, Expanded Consciousness, and Healing." *Soundscape: The Journal of Acoustic Ecology* 16 (2017): 4–14.

24 See http://paulineoliveros.us/telematic-circle.html accessed 03 December 2018

25 IONE, "Deep Listening in Dreams: Opening to Another Dimension of Being." In Monique Buzzarte and Tom Bickley, eds., *Anthology of Essays in Deep Listening*. Kingston, N.Y.: Deep Listening Publications, (2012): 299–313.

26 Roger Mills and Kirsty Beilharz, "Listening through the Firewall: Semiotics of Sound in Networked Improvisation," *Organised Sound* 17, no. 1 (2007): 16–27, doi: 10.1017/S1355771811000471.

27 Franziska Schroeder, "Network[ed] Listening—Towards a De-Centering of Beings," *Contemporary Music Review* 32, nos. 2–3 (2013): 223, accessed 14 August 2013, doi: 10.1080/07494467.2013.775807.

features that are not easily visible to the naked eye."[28,29] Recalling Eidsheim, such methods assist in the measurement and understanding of *vibrations* represented in biofeedback signals such as muscle movement, breathing, and body macro and micromovements that are not usually considered to be sonic in networked performances, and which, in combination with Deep Listening, might enable "an understanding of the relationship between mind, body, and matter, using methodologies that draw upon experimentation and computer modeling."[30]

Focusing on language and voice as its principal listening resources, INTIMAL treats oral archives as disembodied voices that present *vocality*, an expression of embodiment and uniqueness,[31] and the historical memory that is carried by the voice and speech. In turn, migrants' performative expressions, rooted in free bodily improvisation, the voice, and the spoken word, are understood to represent *multivocalities*, or "private and experimental sites where one can try on new voices or identities without fear, performing the new voice to whatever capacity one feels one is able to perform."[32]

The present methodology, then, derives from issues of loss, place, presence, and embodiment in the context of migration; the invisibility of the body in telematic sonic performance; the possibility of perceiving and *sonifying* "vibrations" using the methods of Embodied Music Cognition; and the role of voice and language as unique and as embodying memories of place. It is intended to help integrate oral archives and the listening experiences of nine women using sensorial, qualitative and quantitative approaches. In alignment with the concept of *relational listening*, my intention is to integrate physical and virtual embodied experiences, where improvisers explore their sense of place and sense of presence as new "spatial reconfigurations" of their embodied selves in migration.

3. Colombian Migrant Women in Europe: Case Study

Colombia is presently in a post-conflict condition following a war that lasted for sixty years and became part of the collective memory of at least three generations of Colombians. Around six million people left the country during this time, looking for a better future all over the world[33] (Bermúdez, 2006). The human disruption has been profound. Colombian migrant women, for example, have experienced loss thanks to the migration itself, but also as a result of the conflict that spurred it.[34] Upon arriving in Europe, these women seem to experience an awakening regarding their gender role, questioning social situations that were considered normal in Colombia's patriarchal society. Based on my interviews with INTIMAL, I associate this experience with the muting of women's gendered experiences of violence[35] minimizing these in the midst of the

28 A. R. Jensenius, and R. I. Godøy. "Sonifying the Shape of Human Body Motion Using Motiongrams." *Empirical Musicology Review* 8, no. 2 (2013): 73–83.

29 A. R. Jensenius, "Exploring Music-Related Micromotion." In Clemens Wöllner, ed., *Body, Sound and Space in Music and Beyond: Multimodal Explorations*, 29–48. New York: Routledge, 2017.

30 Marc Leman, *Embodied Music Cognition and Mediation Technology*. Cambridge, Massachusetts: The MIT Press, (2008): 26

31 Adriana Cavarero, *For More Than One Voice: Towards a Philosophy of Vocal Expression*. Translated by Paul A. Kottman. Palo Alto: Stanford University Press, 2005.

32 Julie Choi, *Creating the Multivocal Self: Autoethnography as Method* (New York: Routledge, Taylor & Francis, 2017).

33 Anastasia Bermúdez Torres, *Colombian Migration to Europe: Political Transnationalism in the Middle of Conflict.* Working paper no 39. Centre on Migration, Policy and Society, University of Oxford, 2006.

34 Psychological and physiological consequences of these women's migration experiences include feelings of guilt, fear, anger, indifference, powerlessness, disillusionment, social and family judgment, solidarity, the experience of silence, and the manifestation of illness. See Commission of Colombian Women in Diaspora, *Truth, Memory and Reconciliation: Commission of Colombian Women in the Diaspora*, pilot phase achievements report, September 2017 (London: Conciliation Resources, 2017).

35 Florence Thomas, *Conversaciones con Violeta: historia de una revolución inacabada.* Bogotá: Aguilar, 2006.

"real violence" of the conflict.[36] Given this context, I wanted to explore the spaces for suppressed voicing and listening that overlapped the conflict and look at how an awareness of those spaces might emerge through the women's process of listening to their own migration.

To establish co-relations, INTIMAL incorporates two sources of migratory experiences: the listening experiences of nine Colombian migrant women residing in the cities of Barcelona, London, and Oslo, both in Colombia and in the places to which they have migrated, and an archive of audio testimonies by other Colombian migrant women. Because the Colombian conflict has touched all layers of Colombian society, this precise comparison between the nine women's listening and sounding experiences and the stories in the archive is crucial to expanding the relationality of listening to the diversities of the Colombian migration and to opening space for women's voices in a creative and non-judgmental space for free expression.

Through insights derived from the Colombian case, this project hopes to offer a universal take on experiences of migration caused by armed conflict.

4. Development

Listening to the oral archive

In the oral archive, I identified four *semantic* themes or spheres of migratory memory: (1) *body stories* that emerged as an intimate physical space involving body/mind inner geography; (2) *social body*, which offers a dimension of shared time and identity involving social and family links; (3) *native land* (Colombia, in this case), which broadly represents the historical shared dimension of this specific migrant community, informed as well by the causes that motivate or force someone to migrate; and (4) *host lands*, which offer a dimension of migration that reflects stories in the present land or other foreign territories that have been part of women's migrations.

Each space includes categories with literal and figurative language forms. For example, body stories include categories such as *body events, illnesses, selfcare, mind, sexuality,* and *sensations* and *feelings*. Social body includes categories such as *blood family, friends* and *colleagues, created family*, key stages of life such as *childhood* and *teenage*, and *values*. Native land includes categories such as *conflict events, conflict actors, economy, education, land,* and *values*, and host lands has categories that mirror native land and invite a broader understanding of conflict in contemporary societies. I also identified prosody in the archive via three types of voices: the *disillusioned voice*, the *demanding voice*, and the *transformative voice*, communicating emotions (Scherer, 2003). These spaces are not intended to be fully representative but served instead as a basis for understanding body/mind in geographical dislocation, and for opening creative paths for a balanced listening in between memories of place (Figure 1).

36 Laura Tolton, "A Groping versus 'Real Violence' in Colombia. Contrast as a Minimisation Strategy." *Journal of Critical Discourse Studies* 11, no. 3 (2014): 322–341.

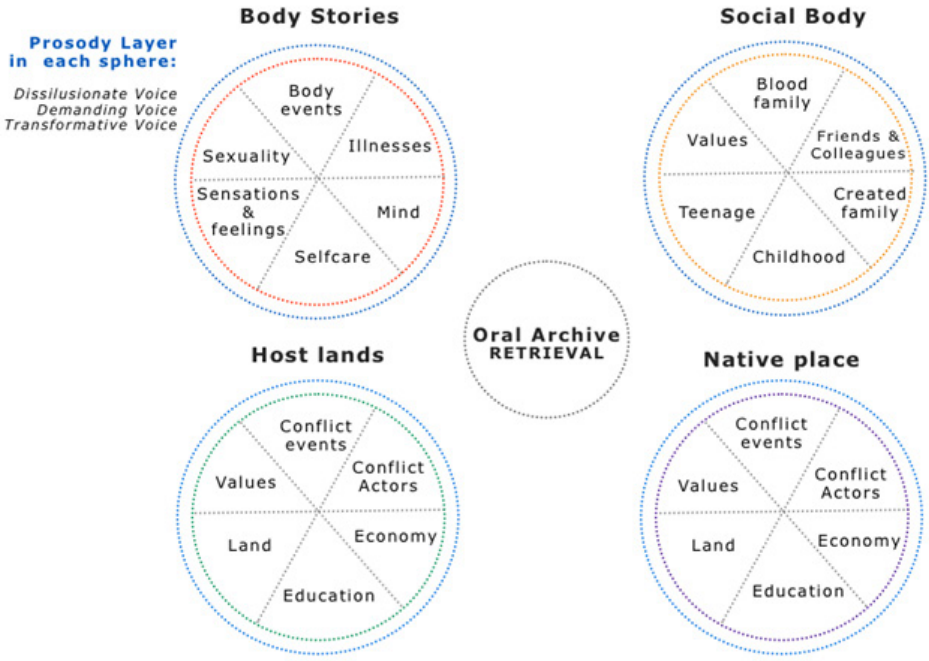

Figure 1: Spheres of migratory memory derived from the Oral Archive.

The spaces and categories described above define selected fragments from the oral archives that are understood in the project as short stories. These will be retrieved by the INTIMAL system to be heard by other women and trigger their own memories. The INTIMAL system will help the sonic retrieval of fragments of the oral archives, according to the actions of the performers.

Fieldwork with nine women

By integrating my previous research experience with Deep Listening and telematic performance into the methods of Embodied Music Cognition, I designed a methodology to holistically understand nine women's migratory experience via (1) semi-structured individual interviews, (2) dream-awareness online virtual workshops, (3) a Deep Listening intensive workshop, and (4) a motion-capture session. Each step in the methodology contributed to the INTIMAL system design, and its integration with the oral archives is described below.

By exploring the women's listening and sounding as spaces that sound but that also have "vibrations" generated by body movement and feelings (see Eidsheim above), the interviews revealed their daily efforts to embody different public spaces and work environments. Their responses indicated how difficult it was to freely move and navigate in the public environment without feeling invaded by unwanted whistles that explicitly referred to their bodies and how they are sexually desirable, or worrying by their safety, as well as the ways in which they automatically embodied other ways of being in a working environment:

> *"I had to do many things to be able to walk in the streets in Bogotá. For instance, I needed to know where geographically the construction was to avoid whistles and piropos (…) which were mostly very ugly. (…) As a woman I have done thousands and thousands of things to avoid the bombardment of situations like finding geographically the space [where I could move], knowing what time I can leave, what time I should arrive." (LR)*

> *"I remember that if I was not teaching, my voice was like . . . how to say it, very thin. And once I was teaching I had a different voice, another strength, otherwise I could not survive in front of 30 male students (…) [feeling it] in the body too, a bit warmer but at the same time stronger, I had to be stronger, present. I had it very clear; it was a bit automatic." (VO)*

The need to map their public spaces, the *muting* and transformation of their voices, together with the difficulties of freely expressing religious, sexual options and reclaiming agency over their bodies represented, to me, physical and metaphorical revelations of minimized violence. The women's accounts offered accumulated reasons for leaving the country, which one of them expressed metaphorically as having:

> *"plenty of sounds in myself, and in Colombia (…) I was repeating the same note, the note that was expected from me, that was part of the score, as the society expects that we all sound. That was the note that I was sounding externally, but internally I knew I didn't want to remain in that." (CL)*

After migrating, their listening experiences in their host lands involved further *muting*, but also an eventual expansion and expression of sounds, once they managed to learn the foreign languages and new cultural codes—that is, to become *multivocal*.

> *"I was almost mute for one year (…) I had moments in which I was scared of buying a burger, it might seem silly (…) I wasn't able to order a burger; I felt judged all the time, and it was an enormous effort. (…) My sound was opaque, very opaque. It took lots of effort. It was not lots of time, but, yes, lots of work and effort to find again my voice." (LR)*

> *"I am not sure if [it is] because the Italian and the Spanish are similar, but at some point I lost my speaking voice. I think I was lost in a corporal level of memory and identity, and it was a linguistic colonization that took me to the silence, until I said to myself, "here something is happening," and until I left Italy (to come to Norway), I realized I needed to recover my native language, my Colombian identity in every sense (…) Norway is a very silent country." (AR)*

Despite these women's different ages and migratory experiences, the current Colombian moment of post-conflict has revived shared feelings regarding Colombian space and old and recent memories of the Colombian conflict. This situation, then, "touches" them, overlapping directly and indirectly upon their migrations:

> *""It was a contrast between the sound, like of happiness, to be with all your friends and all of a sudden the eruption of the firecrackers of the demonstrations, and of the Red Guard. (…) I think that defines very well how I did feel there, a deep desire of being with people there, but also a very unstable situation, with very strong sounds that suddenly erupted and silenced all of that." (BS)*

> *"And I went to bed (and when waking up) my partner said…the NO won [referring to the Colombia Peace Agreement Referendum in 2016]. And I couldn't stop crying,*

> *I am still crying, and it was a moment of rupture for me, of saying "I don't want to be Colombian, I don't want to be part of that country… it has nothing to do with me". I don't know why I am still crying. It was very strong, and that has been the last thing that has happened to me, to reconnect with being Colombian (…) I am that, but I don't want to be that country, I am a country that doesn't exist anymore and never will exist because the NO won." (BS)*

In light of these memories, sonic creative expression activities in the fieldwork focused on the exploration of interstitial spaces such as dreams and virtual space—spaces that might offer "texture" for imagining telematic presence. While listening to their dreams, the women were invited to explore spaces and sounds that could be heard there. This dream work was crucial to opening spaces of memory involving mobility devices such as trains, wheeled devices, and scooters, as well as blended sounds and voices that reflected the state of their migrations. Also, the women shared feelings that were present in their migratory processes, such as the need for "breathing" or the feeling of being "without voice," as well as the presence of judgmental voices in their dreams. Within the limitations and possibilities offered by the virtual platform, they improvised with body movements and gestures, expanding the possibilities of nonverbal expression. They experimented with words that emerged from their dreams and allowed for alternate meanings, breaking linguistic agreements and opening spaces of silence, releasing the stress and need to be heard in any language. Sounds of the sea and seagulls were also powerful for some of the women, as was an increasing awareness of a spiritual appreciation for all beings. The women gave themselves permission to question relationships with known and unknown characters in their dreams and collectively proposed keywords to summarize their takeaways from each dream session, including "flow and transition," "take the voice out—integration of the other," and "sensory spaces." Because dream awareness touches upon issues of identity, agency, and power that are part of the daily challenges they face as migrants and as women; this exercise prepared them to speak out and move beyond the rigid limits of rational thinking to fearlessly explore new possibilities for expression and being.

At the two-day Deep Listening workshop in Glasslåven art centre in Norway, the women expanded their listening to their inner geography[37] and their multivocalities[38] and established connections with the Earth through early morning walks.[39] They also practiced spontaneous responses to voices coming from "dreams" or other unknown voices[40] in preparation for listening to the oral archives. These exercises opened spaces for each of the participants to accommodate respectful and powerful sharing as well as creative expressions, bringing to the surface common, diverse, and even opposing perspectives regarding Colombian culture. For example, the role of humor or the need for silence opened the need for acoustic spaces for Colombian cultural diversity and a shared history of conflict. These listening exercises informed a set of possibilities for expression for each woman regarding her migratory journey, with which to improvise in two free body-voice and spoken word experiments: the "migratory journey" and "listening to the archive."

37 Using the score titled "TAPPING into your inner PLANT (Discovering your Sound Seed)," a guided meditation by Sharon Stewart.

38 Using the score titled "Chhhidiomatikflui" by Ximena Alarcón.

39 Heloise Gold, *Deeply Listening Body* (Kingston, N.Y.: Deep Listening Publications, 2008), pp. 3-10.

40 Using the score titled "Histomemoriology" by Ximena Alarcón.

Experiments in the MOCAP Lab

In the Motion Capture Laboratory (MOCAP Lab) located at the Department of Musicology in the University of Oslo, I used technologies such as infrared cameras, sensors for muscle activity (EMG) and breathing sensors, and close, ambisonic, and directional microphones, to record body movements and acoustic information. Participants wore a total of 63 infrared markers each, placed on the face, limbs, back, and head, as well as a pair of EMG sensors in the cervical trapezius and breathing sensors. The motion-capture software *Qualisys* recorded video of the experiments. I looked for patterns in the women's bodily expression of their migratory journeys, for the ways in which they cross-influenced one another in free improvisation, and for the ways in which their vocal narratives might interrelate with stories in the oral archive.

Experiment 1 – Improvising their migratory journey

In the first experiment, a floor score derived from the four spheres of migratory memory guided each woman's improvisation by offering a space for listening. They improvised in trios that were grouped according to the city where they lived in Europe. Each participant had some time to perform as the *main improviser*, while the other two, called the *resonators*, accompanied her journey. The resonators were free to join the main improviser using body movements and voices, including spoken words. They stood in a triangle, with the main improviser at the point and the resonators to the sides. They were free to move all over the stage space. The solo performance was approximately two minutes each, and then the resonators joined the main improviser. The full performances lasted between about three minutes and about eight minutes (Figure 2).

Figure 2: INTIMAL participants, group 1, experiment 1.

I developed a process for analyzing this material using visual computational representation (plotting) of the collected data, direct observation of the video, and listening.[41] Plots helped me speculate regarding how the participants moved in the space over time. In the Mocapgram (fig. 3), a tool to understand how the different markers moved in time and space, each horizontal

41 (1) I used mocapgrams, a tool to understand how the different markers move in time and space dimensions, and plottings of breathing data and EMGs showing muscle tension; (2) I looked at video (without audio) and wrote general observations about things such as repetitive body movements, then compared those with the mocapgrams and other plottings; (3) I watched the video with audio; and (4) I listened to the audio only, looking for vocal expression and relations among their narratives and their body movements.

line visualizes the movement of a marker (it changes color over time). Repetitive colors along the timeline indicate rhythmic patterns. For example, sequences of little white lines are present in markers such as RMPart7G3 (Right Mouth) and LMPart7G3 (Left Mouth) and coincide with speech when one looks at the synchronized video and audio. The defined colored sections indicated that the improvisers were building spaces with their bodies in defined sections in different spaces on the stage. It might be that space was being created according to the floor score, but it is hard to know sure, because not all of the participants moved strictly according to the four spaces.

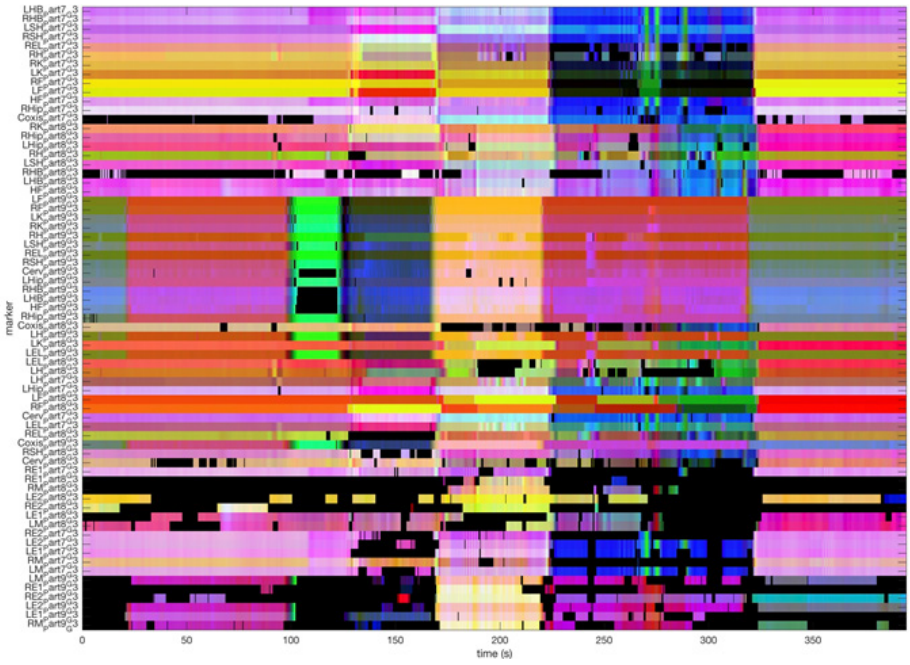

Figure 3: Mocapgram improvisation 3, group 3, Oslo.

Body Movement

Regarding *space*, I divided my observation into three areas of movement in the vertical plane, as well as the displacement that the women have on the floor space in the horizontal plane.

Observing the *lower body*, I noticed movements that denoted working the *land*, and also *body stories* such as crawling like a baby and expressing oneself with babble. In addition, the body moving on the ground extends to the sides, expressing a sort of liberation. One of the expressions brings with it the awareness of a body that weighs a lot when it is standing and feels lighter when it squats. Direct gestures from the womb and stories of maternity emerge naturally from the *middle body*, as do movements of the arms embracing the torso gently, to demonstrate love and caring, or with rapid movements, to demonstrate the feeling of a cold climate. Reflecting layers of *Colombian conflict*, it is interesting that one of the groups used arm movements that evoked military expressions or salutes to the flag; in this case, though, they were expressing orientations in the city of Bogotá (north, south, west, east) that clearly marked social class divisions. Regarding the *upper body*, when the person stretched upward, she was expressing ideas or beliefs about spiritual transformation. *Hands* gestures were used to imitate the use of a mirror, for example, and to accompany their spoken language—they would use hand movements to go out, or go in, or go up or down, and so on. In the upper body, as well,

there were repetitive gestures of *head up* and narratives of *land* involving other beings, trees, and mountains.

In the *horizontal displacement*, I observed running, marking steps, slow walking and the rhythmic, repetitive movements of foot stomping, all in relation to migratory journeys.

Because of the uncertainty that migration brings, rotations in a space and the search for directions or decisions regarding taking a step forward (in their narratives) or not are key movements to focus on in the INTIMAL system.

Poetic body movements acting as metaphors for a migratory journey also appeared in the brief encounters between improvisers while they were walking; they seemed to represent little pauses for mirroring movements. Resonators' movements and separations seemed to reassure the main improvisers as gestures of respect and acknowledgment regarding the story that the main improviser was telling. Group movement patterns were very distinct and suggested the influence of the space in which the given participants lived—those from London tended to be very individual in their movements and directional paths, whereas those from Barcelona seemed to engage more in collective body movements, and those from Oslo seemed to accompany one another, aligning themselves in the space and maintaining a certain distance. This aspect cannot be further studied in this stage, but it is open for exploration at later stages of the INTIMAL system.

When looking at the breathing data in Figure 4, we can see along the timeline that the breathing of the main improviser differed initially from the resonators, but when resonators became more active, at around the 700 milliseconds, for example, the representation of their breathing indicates more activity in response to the main improviser. I suggest that studying and sonifying breathing patterns in real time, when speaking or in silence, could offer the improvisers a sense of individual rhythms and togetherness, both in a co-located setting and with the others at a distance, telematically.

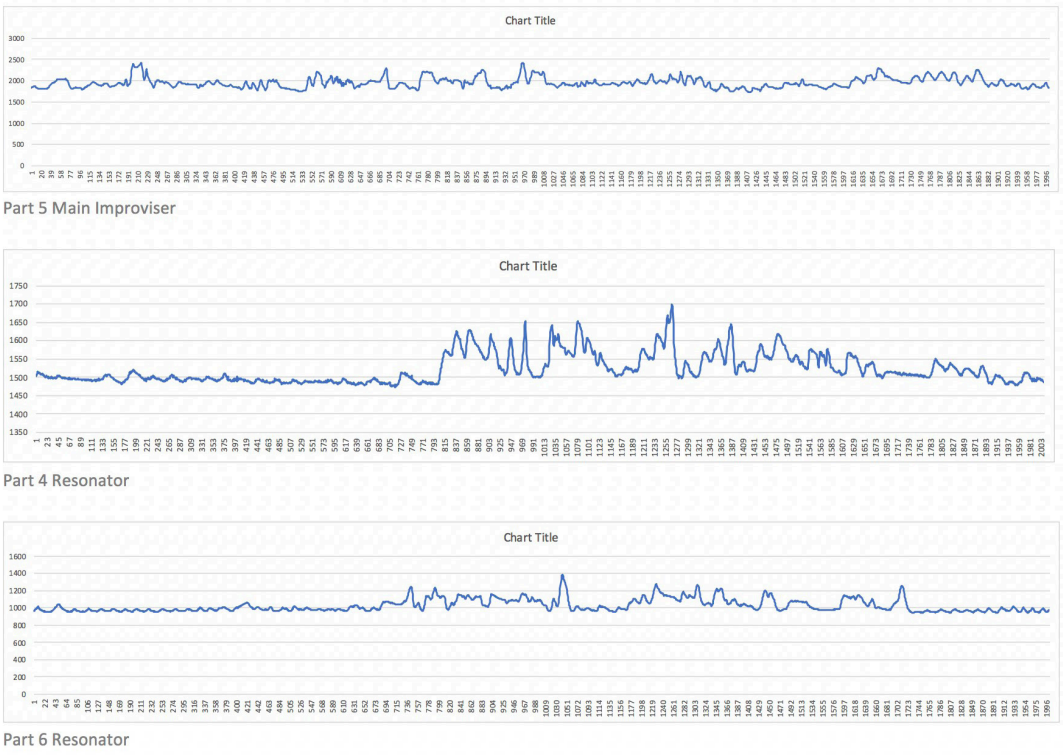

Figure 4: Breathing data for one improvisation involving the main improviser and resonators.

Voice, narrative forms

Participants used different narrative forms, such as poetry, conversation, and the performative voice. When they engaged in conversation, they summoned the voices of people from their pasts who offered advice or judgment. Performatively, they experimented with voices at a high pitch, or even screams, as the body stretched and they played with speed and transformations of words in different languages; creating fresh and evocative metaphors of migration. Changes between languages reflected "multivocalities" and the freedom to express oneself beyond one's official native language, even by creating new words. (See video 1 as an example of body movement and narrative voice)[42]

Experiment 2 – Listening to the archive

In the second experiment, in order to create an intimate listening experience (in addition to the technologies used in the first experiment) participants also used earbuds. They did not face one another so to not permit free reactions without direct influence from the others (Figure 5). They listened to twenty-two minutes of fragments from the oral archive that included stories from three women. Silences of forty seconds between the fragments were intended to allow for paused listening and a time to react through improvisation. The fragments were selected according to the four spaces of migratory memory.

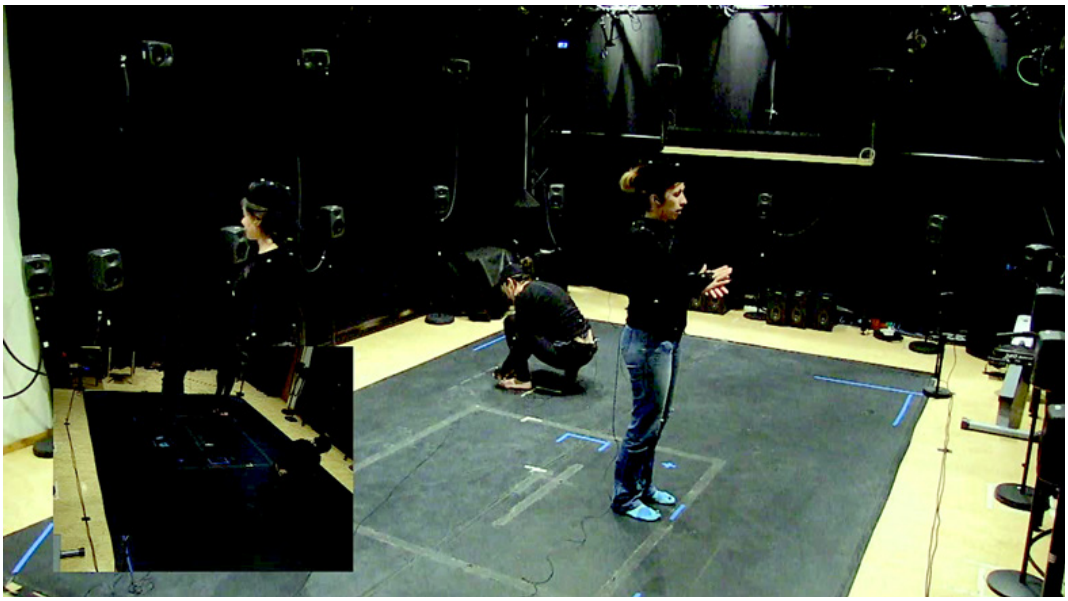

Figure 5: INTIMAL participants, group 2, experiment 2.

Body movement

Body stories seemed to inspire more variety in the movements, whereas during *land stories* the performers seemed to move in a more rhythmic manner than in, for example, *social body*. The upper body offered rhythmic patterns that seemed to be dictated by the voicing and spoken word. The hands also came into the rhythm, according to what the performer was saying, as part of the description or expressive amplification of the story. Shaking was a movement that was introduced in the Deep Listening workshops, and it was performed by some of the participants in this experiment. As in the previous experiment, walking was an important feature and also

42 https://vimeo.com/304188356

meaningful in all of its variations, including side to side and either slow or fast.

At different moments, there were noticeable synchronic opposite movements between the participants. For example, one participant closed her arms and bent down (to cry), while at the same time another opened her arms up and raised them above her head. This made me think of different responses to the same archive that could be used for co-relations in a telematic performance. In *native land*, stories of the Colombian conflict generated conversations between the women. When there were themes of reconciliation and transformation, the improvisers raised their heads. At the end of the experiment, performers in the three groups engaged in free movement as a ritual for ending: a collective acknowledgment of, and gesture of complicity in what they had heard together.

Voice narratives

Participants either translated, performed, or amplified the stories that they heard from the archive in their own words and gestures. They also engaged as commentators, as though part of a conversation or a secret confession of similar stories:

> *"Sometimes it was like a dialogue (…) There was a moment… that almost we had parallel lives (…) she told about the fish in the Magdalena river, and then I remembered when I went to the Magdalena river, it was strange. At the beginning it seemed that our lives were very similar, but no, they were very different." (LR)*

They evolved feelings about what they heard and released them dramatically, either with their body or their voice. The participants spoke in voices that perhaps evoked the *disillusioned voice*, the *demanding voice*, and the *transformative voice* from the oral archive, which needs further analysis using sonic retrieval techniques. They recalled childhood and other songs, and they responded with a strong body action-voice to the story of a *machete* (bowie knife). Words that reinforced and extended the archive material included, for example, *mamita* [mommy], *papa* [daddy], *campo* [countryside], *paz* [peace], *pilatunas, sol* [sun], *morir* [to die], *sangre* [blood], *machista* [macho], *mama* [mum], *guerra* [war], *maternidad* [maternity], *manos* [hands], *mujer* [woman], *correr* [to run], *niños* [children], *violencia* [violence], and *cuerpo* [body] (see video 2 as an example of body movement and narrative voice reacting to the oral archives).[43]

In summary, listening to and annotating the oral archives, brought to the project the understanding of testimonial narratives of migration and conflict from Colombia, leading me to propose a structure and aesthetic of fragments, with semantic and prosodic content, to incorporate these into the INTIMAL system, and to be heard by other women.

In the fieldwork, conducting interviews regarding nine Colombian women's listening experiences in native and host lands, and engaging them in online and physical Deep Listening practice—dream awareness, listening body, and improvisatory expression—contributed to distil and catalyze their feelings and the essence of their "migratory journeys." Through body movement, abstract voice and speech, the free improvisatory individual and collective expression of their journeys, invited them to express their unique self, feeling accompanied by the others, who resonated with their stories, and who are physically present in the host land. The integration of fragments of the oral archive, brought different perspectives of listening to women they don't know, and whose stories might touch some collective experiences. These fragments helped them to connect with a shared history, fragmented in itself, and to trigger a reflection on how to listen

43 https://vimeo.com/304189572

to, embrace and connect with these voices of migration and conflict.

Motion capture technologies revealed features to infer emotional links to body movement/voice as well as movements that can be integrated through navigation in the archives and the interaction between theirs and others' migratory journeys. Qualitative observation of data representation (plots) helped to reveal and choose the most salient features that could aid the interaction with the sonic material and with others, physically and telematically, and the aesthetics involved in the design of interfaces for relational listening.

In this paper, I have touched biodata superficially, and only as a material to speculate conceptually what are the most interesting features to use for implementation in the first stage of the project, for instance: movements such as walking and breathing, as metaphors for sense of place and sense of presence, in the context of migration. For implementation, and being the scope of another paper, this data is being studied by choosing specific markers, measuring displacements of participants in space, to act in co-relation with the triggering of the archives, and developing ways of real-time sonification of breathing data to transmit across distant locations.

5. The System

Based on this study for this first stage of INTIMAL, I have found the actions of walking, speaking/voicing, and breathing to be the most meaningful movements toward strengthening the metaphor of performing a "migratory journey." INTIMAL will be tested live in a telematic sonic improvisation between the cities of Oslo, London, and Barcelona in May 2019. To perform a retrieval of the oral archive in co-relation with the individual migratory journeys, the system will *sense* walking, rotation, and voicing, allowing pauses and helping improvisers to locate traces of words and movements in the navigation. This *sensing* feature is intended to interrelate their own migrations, and the voices of the archive. Using machine learning, the system will *process* the co-relations that are established between improvisers' location, rotation, and steps, and the location of the stories in the archive: for instance, in the spheres of migratory memory, co-relating the rotation angle with each category, and bringing together fragments of the archive according to their similarities (how close these are), or differences (how distant these are). Thus, these will be *retrieved* according to the steps and distance travelled by each improviser. The emotional content of the archive, measured according to the three types of identified voices (*disillusioned*, *demanding*, and *transformative*), will help the system trigger an emotionally set of stories for the listener (too many demanding voices, for example, could be emotionally exhausting).

Improvisers' spoken-word responses will be recorded as new layers of memory triggered by the archive. The employment of keywords that resonated with the nine women in this study, as well as references to place, is intended to aid the navigation but also to create a sonic path that the public audiences can hear even as the improvisers engage in the privately shared listening experience. To expand the telematic sonic performance beyond the "figure of sound," and to perceive vibrations in the distance, the system will *sense* improvisers' breathing data and *process* it for sonification, which will be streamed in real time between the distant locations. As a *response*, the audio of the *sonified* breathing data will be heard in loudspeakers, while the audio from the archive will be heard in the headphones by the improvisers. Some keywords from the archive will also be heard through the loudspeakers by the audience. Any performance using the INTIMAL system would then represent a shared listening ritual of collective memory (Figure 6).

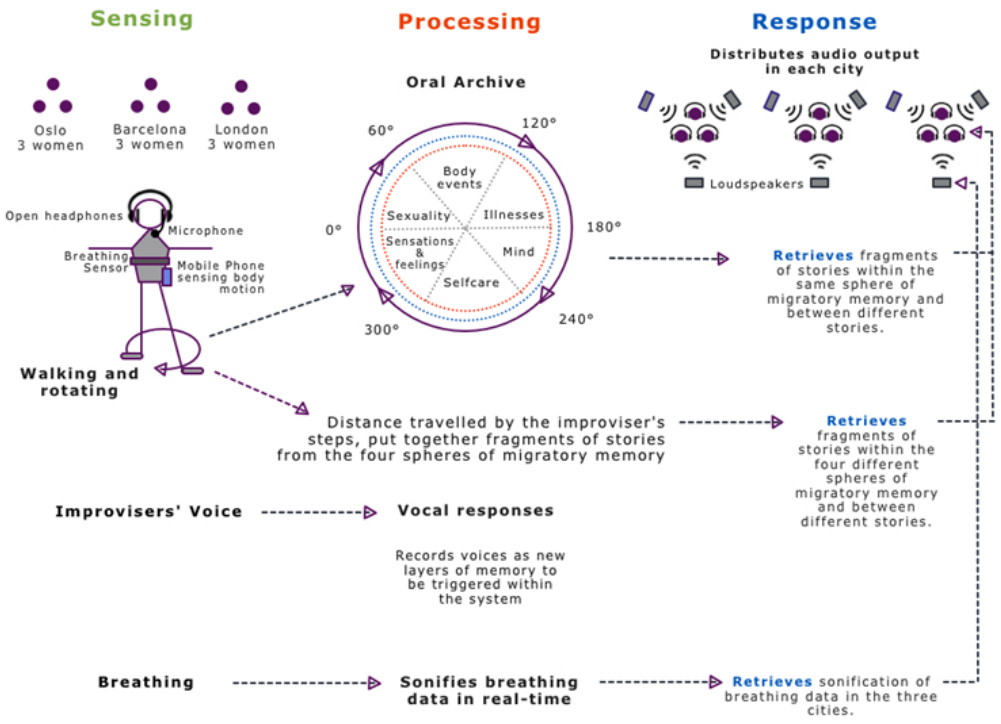

Figure 6: Diagram of the INTIMAL system with sensing, processing and response modes.

6. Conclusions

Upon completing her part in the fieldwork for the project, one of the INTIMAL participants said: "I feel I am not from Colombia, nor from Spain; I am from INTIMAL, from my cells" (SV). This indicates the way in which the empirical study of embodiment can impact the perception and sense of place of migrants, transcending geography in favor of the body. Physical and virtual improvisation can help migrants to negotiate and connect different spheres of migratory memory and expand a sense of presence within the context of migration and loss.

The use of body movement, or *the body as an interface that keeps the memory of place* as a means of interacting with the archive, provides a path toward working on the memory of migration. Walking alone is a powerful metaphor for migration, involving decisions and the search for direction as one seeks one's path. Using also biofeedback, specifically sonification of breathing data in real-time will offer non-verbal and intimate communication, in a co-located form and telematically across locations.

After the technical development of this project, I envision performers connecting telematically from Barcelona, London, and Oslo and becoming involved in a dream virtual space, loosening the rigidity of known narratives of the self and others by transforming them into expanded embodied vocal expressions. Performers (via headphones) will experience listening as an intimate subjective experience and the body/voice as a primal expression for connection and healing. Audiences will listen to paths and rhythms represented in some of the words triggered by the archive, to the body/voice reactions of the women who are physically in the space, and to their sonified breathing.

I propose that *relational listening* brings together the spatiotemporal dynamics of sonic encounters that occur when one listens to one's inner body as a place to ground oneself; listen

to others' body movements, dreams, and voices; and listen to vibrations, which, when amplified with technologies, contributes to an awareness and expansion of our sense of presence.

After the fieldwork, participants decided to continue engaged with the Deep Listening practice physically and online, giving birth to the INTIMAL women's listening community. They have been listening to and sharing their dreams in connection to waking time, as they relate to the four spheres of migratory memory, leading to awareness moments that open healing paths for them, ranging from awareness of body, place, language, land, and options for inner and outer conflict resolution exploring relationships in their native and host lands.

In the context of human migration and historical backgrounds with armed conflict and other violence, the existence of an online listening community, which also engages in public telematic sonic performances, could supply a catalyst for creating new layers in the reconstruction and transformation of memory in the interests of individual and collective *healing*.

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Incorporating Virtual Reality with Experiential Somaesthetics in an Embodied Interaction Course

Cumhur Erkut and Sofia Dahl

Abstract: *Engagement with virtual reality (VR) through movement is becoming increasingly important. Therefore, VR developers should improve their bodily skills and learn how to use movement as design material. To do so, first-person accounts of the development and experience are necessary. Since these qualities are well addressed in experiential somaesthetics, we explore the education space in VR, with attention to the first-person experiences, movement data, and code. We present an approach for teaching and designing VR-based embodied interaction and describe simple projects implemented by the participants. The evaluation of projects indicates that the concepts, practices, and perspectives of embodied interaction were attained in VR. Our reflections contribute to the literature on movement-based interaction education in VR, and its evaluation and validation by first-person accounts, in addition to the data and program code produced.*

Keywords: *embodied interaction, design theory, movement qualities.*

1. Introduction

This article focuses on teaching fundamentals of movement-based interaction in virtual reality (VR) to media technology students, by combining specific activities informed by experiential somaesthetics, including movement exercises and theoretical research material, with technological practices such as motion capture and coding. While the digital technologies of movement are increasingly specialized, the value of somaesthetics is appreciated in designing the complex and effective feedback loops between technology and humans.[1] As an interdisciplinary project grounded in philosophy and aesthetics, the potential of somaesthetics in the education of human-computer interaction (HCI) and interaction design is explained in detail by Bardzell, in his commentary to Shusterman's Somaesthetics entry in the HCI Encyclopedia.[2] According to Bardzell, design professionals need to have the following skills:.

1 Höök et al., "Somaesthetic Appreciation Design."

2 Shusterman. "Somaesthetics," *Encyclopedia of Human-Computer Interaction*.

1. a cultivated ability to read sociocultural signs and trends;
2. a creative and reasoned ability to explore alternative futures;
3. a verbal ability to articulate these activities;
4. a receptiveness to alternative framings and a willingness to explore highly variable alternative directions; and above all
5. a personal identity or coherence that holds all of these moving parts together through a given process.

Shusterman discusses some of these skills in the context of somaesthetics education,[3] and suggests that experiential somaesthetics can provide:

1. pre-warning for feeling and emotions, with impact on learning effort;
2. better control of movements, hence our actions; and
3. more positive attitudes and conduct, since education can be considered as reorganizing or retraining habits of feeling and movement and habits of conduct to which feeling and movement contribute.

Shusterman asks,[4] "In what manner of framework could practical somaesthetics be most effective introduced into the school curriculum at the various levels of primary, secondary, and college education? What reforms of curriculum, institutions, and attitudes would be needed to introduce such embodied education?". In this paper, we try to provide an answer to these questions with a case study in media technology curriculum, as an embodied education (as in the quote) of VR.

Somaesthetics has been previously applied to media technology for body/media relationship,[5] with frequent references to VR. Specifically, the diversity of media forms and the importance of interactivity, as well as the moral, social, and aesthetics problems of the body representation in VR are still very important. The call for experiential somaesthetics[6] encourages people to "transfer their concern from the external shape and attractiveness of the body to improving the qualitative feeling of its lived experience and functioning." Here, we describe and reflect upon our educational activity of such experiential skills directed at developers of media technology.

2. Background and State of the Art

The recent affordability of headsets and content distribution channels have made VR an interesting educational opportunity. Takala and his colleagues provide a good overview of the academic curriculum of VR during the last three decades.[7] High-quality textbooks, such as *The VR Book*,[8] and MOOCs, such as the popular five-course VR specialization created by Gillies and Pan at Coursera,[9] provide learning opportunities for large audiences. All these channels agree on the uniqueness of the bodily VR experience, consider embodiment as one of the illusions

3 Shusterman, "Somaesthetics and Education: Exploring the Terrain."

4 Ibid.

5 Shusterman, "Somaesthetics and the Body/Media Issue."

6 Ibid., p. 45.

7 Takala et al., "Empowering Students."

8 Jerald, *The VR Book*.

9 https://www.coursera.org/specializations/virtual-reality

that make up this experience,[10] and derive interaction design guidelines.[11,12] The illusions in VR are defined as erroneous or misinterpreted perceptions of sensory information that provide direct response to synthetic stimuli, indicating a positive experience of VR. The embodiment illusion (or virtual body ownership) and the illusion of presence (the experience of *being there*) are considered the most prominent illusions in VR. Presence is composed of the place illusion and the plausibility illusion.[13] There are also illusions and distortions occurring on behalf of virtually stationary and moving users. While there is much research on the representational and the experiential aspects of illusions, the first-person accounts of developing and experiencing virtual reality, so ubiquitous in early VR,[14] are not common in the current scientific literature.[15]

Shusterman has previously addressed[16] this issue of a media technology challenge to embodiment mainly by arguing two points: "First, no technological invention of virtual reality will negate the body's centrality as the focus of affective, perceptual experience through which we experience and engage the world. Second, that cultivating better skills of body consciousness can provide us with enhanced powers of concentration to help us overcome problems of distraction and stress caused by the new media's superabundance of information and stimulation." Soma-based interaction design,[17] in a similar vein, recognizes VR as one of the emerging technologies that will have an effect on our lived experience. Depending on its design, it will encourage certain movements, experiences, practices, and awareness of our bodies—while not encouraging others. This, in turn, will affect how we work, play, and communicate in VR. This is why we need to cultivate our understanding of what it means to be a sensing, feeling, and moving body, shaping and being shaped by our lifeworld.[18]

The skills that we see as useful for VR developers in terms of embodied interaction include:

- understanding and describing movement as a sociodigital design material in real and virtual worlds,
- developing the bodily skills needed for technological development,
- understanding what movement qualities are and how they can be extracted from movement tracking data, and
- applying these methods and techniques to real-world scenarios, e.g., games, robots, installations, and for the present paper, in VR.

We consider this list as a practical and thematic rendering of Shusterman's list for media technology, to address the last and the most important item in Bardzell's list: a personal identity or coherence.

How can this need be incorporated in learning and practicing VR, with attention to soma-based, embodied interaction with a strong first-person perspective? Our aim was to inform

10 Slater, "Place Illusion and Plausibility."

11 Gillies, *What Is Movement Interaction in Virtual Reality For?*

12 Jerald, *The VR Book*.

13 Slater, "Place Illusion and Plausibility."

14 Lanier, "The Sound of One Hand."

15 Serafin et al., *Virtual Reality and the Senses*.

16 Shusterman. "Somaesthetics," *Encyclopedia of Human-Computer Interaction*.

17 Höök et al., "Embracing First Person Perspectives."

18 Ibid.

our students in using movement as design material and obtain first-person experiences of felt qualities of movement, both in virtual and real worlds. By "qualities," we refer to the sensation of how (e.g., lightly, smoothly, jerkily) an action is performed, rather than the action itself (e.g., reaching, grasping).[19] These qualities can be described through the first-, second-, and third-person perspectives[20] and sensed through proprioception, in addition to vision and hearing.

Our study on the educational space of embodied interaction in VR included the general overview of VR education by Takala and his colleagues,[21] textbooks,[22] and MOOCs, e.g., Gillies and Pan's Coursera specialization. Although they are very useful learning resources for the technical side of VR, none of these resources have the vivid first-person accounts of developing and experiencing virtual reality, in line with previous descriptions.[23]

Our ongoing embodied interaction course was designed for first-year master's students at Aalborg University specializing in sound and music computing, games, interaction, or computer graphics. In 2016, two students proposed a project that combines the Leap Motion hand-tracking sensor with VR, using the Orion SDK and Oculus Rift and focusing on a drawing application. When this mini-project was integrated with a larger one (which was eventually published),[24] we expected to recruit more students interested in VR. Indeed, the following years have seen an increase in students interested in applying embodied interaction in VR, with five students in 2017 and more than ten students in 2018 (accounting for about half of the class) interested in VR. To meet this demand we performed some rearrangements and changes in the course. The following section will describe in more detail the general outline of the course and the changes implemented.

3. Our Approach: Methods and Interventions

General Course Outline

Our master's-level elective course in media technology requires our students to learn the theory of embodied interaction, together with the use of basic computer vision, creative coding, embodied agents, multi-agent systems, AI engines, and wearables and VR basics. Many of these subtopics were inherited from a curriculum focusing on robotics and embodied conversational agents. Although the curriculum and study plan are the same as the original course[25] (taught also in a different location), we have gradually changed our approach to these subtopics through a lens focused on soma-based design.[26]

As specified in the course description, the successful student must have knowledge about standard methods and techniques in embodied interaction; be able to understand and describe movement as a design material; be able to understand the bodily skills needed for technological development, decision making, steering, and path finding; and be able to understand what movement qualities are and how they are extracted from movement tracking data.

19 Fehr and Erkut, "Indirection Between Movement and Sound."

20 Hornecker, Marshall, and Hurtienne, "Locating Theories of Embodiment."

21 Takala et al., "Empowering Students."

22 Jerald, *The VR Book*.

23 Davies, "OSMOSE." Lanier, "The Sound of One Hand."

24 Gerry, "Paint with Me."

25 See https://moduler.aau.dk/course/2019-2020/MSNMEDM2145.

26 Höök, *Designing with the Body.*

The course consists of ten sessions, either half or full days, in combination with a project (worth 2 ECTS, or two-fifths of the course effort) that students hand in together with a brief paper for the oral examination in June. The students prepare for the first lecture by watching a video prepared by the Universidad de Zaragoza (The embodied mind at https://vimeo.com/107691239) and select their background research literature from the proceedings of the ACM Movement and Computing (MOCO) Workshop (http://moco.ircam.fr/). We believe that every graduate course could be linked to a particular scientific community, and for our course the best candidate is MOCO.

Our general approach is to build the knowledge and skills around theory, technology, and movement. In the theoretical part we introduce students to concepts from interaction design, AI, philosophy, and psychology. We engage the students in learning activities on how the different perspectives aid and affect the design process and outcomes, how our bodies affect perception and action, and how developers/designers use their bodily skills in their craft.

The technological part is focused on tools for implementation and analysis (including motion capture and various toolboxes for VR development and movement analysis). For the movement part we engage the students in different kinds of movement exercises to make them perceive and reflect on the first-person experience of movement. This movement material includes some practical exercises from a previous collaboration with contemporary dance choreographers,[27] which were adopted from Loke's movement exercises,[28] such as playing with everyday movements, e.g., in the act of walking.

Within the general course outline, we typically devote some sessions to workshops on movement, for instance by exploring and analyzing movement with motion capture systems. With respect to technological and analytical tools the students also get a brief introduction to *Laban Movement Analysis* (*LMA*) and specifically Laban's theory on *effort*.[29] Although developed for dance, LMA provides a conceptual framework for describing the quality of movement in a way that can be systematically used to analyze and understand a range of activities. Briefly, Laban proposed to describe the effort of a movement as how it evolves in terms of time (quick-sustained), space (direct-indirect), flow (free-bound), and weight (light-strong), and this systematic way to describe movement quality has been used for dance as well as music and human computer interactions.[30]

Specific interventions in 2017

In comparison with earlier versions of the course, we specifically implemented the following main changes during 2017:

1. **Short, frequently occurring movement tasks.** Rather than the previous two-day movement workshop, we implemented short exercises into the sessions. Examples of such movement exercises are walking through wide or narrow door openings, or the change of viewing perspectives by standing on a desk or crouching under it. In the 2018 edition of the course, we have further experimented with the Finnish health-fitness program ASAHI.[31]

27 Erkut and Rajala-Erkut, "Beyond Command & Control."

28 Loke and Robertson, "Moving and Making Strange."

29 Höök, *Designing with the Body*, Chapter 6.

30 Ibid.

31 http://www.asahinordic.com/en/front

2. **Introduction to soma-based design and first-person perspectives, by reading Höök et al.**[32] Specifically, we present the students with two partly opposing viewpoints, contrasting soma-based design with a more utilitarian view of HCI as problem solving[33] and highlighting the necessity for first-person experiences. Through a debate, the students are challenged to argue for one or the other approach.

3. **No set programming environments.** Rather than introducing and giving exercises to solve in a particular programming environment, we let students choose freely what to use for implementation and concentrate on giving them a solid base for performing choices that make sense in terms of using movement as design material. However, those who develop VR applications univocally chose Unity3D[34] as their programming environment.

4. **One-day practical workshop together with students at the Danish National School of Performing Arts.** In 2017, this proved a very fruitful collaboration, not only because of the specific exercises (presented below) but also due to the feedback and perspectives the students offered each other. Our students also practiced trusting their autobiographical,[35] first-person experiences in developing their mini-projects. In 2018, we had a graduate student from the Danish National School of Performing Arts following the course and preparing occasional choreography for our participants. In addition, we have conducted practical motion capture workshops in a workshop setting.

Details of joint workshop (strengthening the first-person experience)

On March 23, 2017 the whole class visited the Danish National School of Performing Arts, which offers an international graduate program in contemporary dance, for a full-day workshop. The title of the workshop was "Making Sense of Technology for Performing Arts," and its learning objectives stated that participants should be able to:

- discuss the use of technology subjectively and objectively, regardless of their discipline;
- evaluate the use of technology from existing artworks;
- make appropriate technological choices for their artistic/technological projects; and
- collaborate with participants outside their discipline to create an artistic idea/sketch/task involving HCI.

The participants, who were equally distributed from the Danish National School of Performing Arts and our students, gathered in the studio, and during a short greeting and introduction the performing arts students were briefly informed about the course and the projects of our students. After a short warm-up session, all students engaged in movement exercises proposed by the performing arts students. All exercises related to the experience of

32 Höök et al., "Somaesthetic Appreciation Design."

33 Oulasvirta and Hornbæk, "HCI Research as Problem-Solving."

34 https://unity3d.com

35 Höök, "Transferring Qualities from Horseback Riding to Design."

movement qualities such as body limbs moving in straight lines as opposed to curves. Another exercise mapped the movement effort and viscosity of the imaginary matter to the width and length of the dance studio, respectively, and instructed the participants to experiment with different trajectories. After a break, our students presented their project ideas in more detail in a "speed dating" exercise. Here the two groups of students formed two concentric circles where the students in the inner circle quickly explained the main idea of their project to the students in the outer circle, which was rotated every five minutes. This exercise, which is used in soma-based interaction design,[36] allowed the students to refine and sharpen their own idea by repeating it. After this, students from the two institutions paired up and "body-stormed" about the project ideas. That is, the students acted out the movements and how the interaction could work out. With adequate reflection, discussion, body-storming, and resting, the explorations continued for the entire day. The session ended by setting a date for the performance students' visit to the media technology venue to experience and try out the mini-projects.

4. Outcomes: Self-reports and Evaluation

The VR-related mini-projects submitted by students as part of their examination are outlined in this section, resembling *annotated portfolios*.[37] The structure of our presentation is as follows: we first describe the projects in their creators' own words (in italics), then reflect briefly on the perspective and movement qualities in relation to experiential somaesthetics. Specific to the VR projects, we requested the students to reflect upon the three important illusions in VR, as introduced in the Background section of this paper, namely the place, plausibility, and embodiment illusions.[38] They all showed good understanding of these illusions, both in their reports and presentations.

Projects 1 and 4 were individual projects, whereas P#2 and P#3 were completed by groups of two students. All projects except P#3 were tried out by one of the authors in a lab setting, wearing an Head-mounted Display (HMD) and headphones, and project source codes were also examined. P#3 required the fixture of a wearable prototype, which was time consuming; therefore one of the students presented the interaction, and the evaluators watched the virtual environment from a big screen.

Until 2017, the grading basis was pass or fail; a project that addressed most elements of the course learning objectives and ran in real time was evaluated as passing. Therefore, all projects below had a passing grade. Starting in Spring 2018, the course has been evaluated on a 7-scale grade, and we currently assess to what degree the learning objectives were met.

P#1: TaijiJian VR

In this project, a virtual experience was created, in order to explore the possibilities of an embodied cognition and interaction approach of sound effects synthesis in real time, responsive to the virtual body of the user and his movement. The experience consists of a Taijijian simulator, a Tai-chi modality with a Chinese Jian sword. The HTC Vive system was used for the visual display and movement tracking, processing the data collected in real time in both Unity 5 and Max 7, including 3D binaural sound rendering.

In the real world, the presence and movement of human bodies and objects make changes in the

36 Höök, *Designing with the Body*.

37 Gaver and Bowers, "Annotated Portfolios."

38 Slater, "Place Illusion and Plausibility."

sound environment that surrounds them and how it is perceived. Therefore, to improve the illusion of presence in virtual reality experiences, it is interesting to investigate and develop new techniques and frameworks for creating sound design systems responsive to the presence and movement of the user's body and virtual objects. Furthermore, these systems should be compatible with 3D sound rendering methods to give them spatial meaning from the user's perspective.

Figure 1: Top: Taichi Jian beginning scene. Bottom: Entering the cave and holding the torch. Pay attention to the animal paintings on the walls.

Evaluation of TaijiJian VR

The slow, completive movements of Tai-chi practice (Figure 1, top) offered a useful premise to discuss the movement qualities, and the meditative nature of the audio/visual environment (mountain view and subtle wind) sparked high expectations in evaluation. The report, however, was written in third-person perspective and explained mapping of the sounds and their relation to presence in VR (not the movement) from a cognitive point of view. While the project focus was on the functional outcome, the student demonstrated several subtle, nuanced movement qualities in the use of the sword. However, the first author's trial needed exaggerated movements to make the sword sounds audible, and this negatively affected the soma-based experience.

P#2: Cave Exploration—Rock Paintings

This project focused on the design of a virtual reality experience of ancient rock and cave art. It relies on embodied interaction to relive a virtual ancient cave. The interaction design invites the user to navigate and explore a virtual cave by interacting with a virtual fire torch. Based on the user's movements in the virtual cave, synchronized sonic and light events are triggered. The interaction design utilizes the Oculus Rift CV1 and the Oculus constellation system to track a user in the physical world and transfer the movements of the user into the virtual environment. The Oculus touch controllers are used to substitute for the user's hands in the virtual environment. The programs are used to develop the virtual reality, likewise the mapping of fire particles to the virtual fire torch and the triggering of events.

The embodied interaction design was informed by movement-based game guidelines:[39] *we focused on a specific movement guideline from the category of "movement requires special feedback" as a framework for designing the movement feedback … The category "celebrate movement articulation" encompasses the choice of giving feedback to the user's movement quality moment by moment. Importantly, it is not merely a question of if and when, but especially how the movement is performed.*[40] *The fire particles are rendered with the Unity particle system. The dynamics of the system are influenced by properties of birth and properties of lifetime. The speed of the user's movement is directly reflected in the emission and spread of the fire particles from the virtual fire torch. Slow movements produce a trail of spread fire particles leading to attention on the surroundings. Fast movement produces a narrow flame with no trail of fire particles.*

Inside the cave is a hidden history; the revelation of this depends on how much a user invests herself in VR, meaning moving away from the starting center point and exploring the space. The user can trigger four events that provide enhancement of the symbolic cave paintings in the form of soundscapes and light effects. To incorporate a gradually unfolding of the cave paintings, a user must discover the cave to trigger the sonic events paired with the visuals of the paintings. Four soundscapes are mapped into four areas in the cave that are paired to the four cave walls. The soundscapes provide more vivid descriptions of the cave paintings in terms of sound effects, e.g., wild animal sounds paired to the related cave painting. Four spotlights in distinct colors turn on with the related sonic event.

Evaluation of Cave Exploration—Rock Paintings

This project creatively utilized many guidelines coherently in a high-quality production. It described some of the development and implementation choices in first-person perspective. The code contained four iterations of the concepts, all of which were calibrated by the designers'

39 Isbister and Mueller, "Guidelines for the Design of Movement-Based Games."

40 Ibid.

own movements and explorations. Both the report and the presentation had frequent references of movement qualities. Especially in the presentation, Laban dimensions (see Section 3) were used to describe the movement qualities. The visual and auditory elements were very skillfully constructed, and the narrative was engaging and captivating. Rock Paintings was the highest-quality production we have evaluated in several iterations of the course.

P#3: Arm Constraint—Pseudo-Haptics

The ability to modify and reshape the physics of a virtual reality creates countless opportunities, yet not all controllers allow for suitable human interaction. This project investigated an alternative approach to the bubble technique[41] in a virtual environment using pseudo-haptic feedback. The method exploited physical affordances of stretching an elastic band to represent the imaginary tension one would feel when extending the arm to boundaries that are physically impossible (see Figure 2).

Our initial focus was to investigate the acceleration of hand motion while reaching out and grabbing an object. We assumed that a quick acceleration of your arm would be the most promising way to eject some grabbing device in a virtual space.

This assumption was considered from a third-person perspective,[42] by discussing the imaginative movement of grabbing an object out of reach. Yet after actually performing the movement ourselves, it was discovered that a quick stretching motion not only felt unnatural to do but also decreased how well you aimed toward the object. When reaching for objects in the real world, a much slower and fluent movement is performed than first anticipated. This might be caused by having to use multiple motor skills and visual cues, in order to maintain a certain precision needed to grab objects. We have to judge the distance to the object, control the speed of our arm and other body parts such as torso rotation, and determine when and how to grasp the object with the hand. We are naturally good at this within our reaching limits, as we know exactly where our limbs are in relation to our body. However, when you are able to reach beyond this limit it becomes an unfamiliar motion that may cause some cognitive confusion. As can be seen (Figure 3), the apparatus allows for two states: one in which the elastic cable is loose, resembling normal reach within the VR environment (left), and the other having high tension, resembling reaching beyond normal reach (right).

The virtual hand (Vh) follows several measurements depending on the distance between the shoulder point and the real hand (Rh), and the chosen threshold of the rubber band (Figure 3). If users have their Rh stretched further than the rubber hand threshold, the Vh will move in the direction of a vector represented by the shoulder and hand joint (VSH). The speed of the Vh is determined by how large the magnitude of VSH is compared to the rubber hand threshold. If users have their Rh stretched less than the threshold, the Vh will move toward the Rh, where the speed is determined by the duration of the state added to a bias. When the user's hand and the Vh are positioned at the same location, the Vh will completely follow the Rh.

Evaluation of Arm Constraint

The students have completed a VR engineering project with little resemblance to experiential somaesthetics, including the movement qualities and first-person experiences. Yet they have solved a practical HCI problem[43] and contributed to a state-of-the-art VR interaction. Fortunately, during their demonstration they referred to Laban dimensions and explained how the wearable

41 Dominjon et al., "The 'Bubble' Technique."

42 Loke and Robertson, "Moving and Making Strange."

43 Oulasvirta and Hornbæk, "HCI Research as Problem-Solving."

apparatus changed the movement qualities in typical reaching tasks.

Figure 2: Wearable apparatus

Figure 3: Left: The two states of the wearable apparatus. Right: The states in a virtual environment.

P#4: MoCap with Rokoko Smartsuit

This project was a special assignment to learn how to use a recently acquired Rokoko Smartsuit[44] to capture subtle movements in a practical somaesthetics workshop. While the project focus was on the functional outcome, the student tried to apply the embodied design ideation framework of Wilde and her colleagues[45] to the observations he made on the wearer of the suit, and on his behavior when observing the avatar on screen (see Figure 4). We outline his account as an example of the third-person perspective.

By wearing the suit and viewing one's movements as an avatar on screen, the user is disrupted in his or her habitual behavior. This destabilizes the user's understanding of how his or her bodily movements look from a different perspective and changes the proprioceptive perception of one's limbs. A natural curiosity emerges to see how well the avatar responds to one's own movements, as it acts like the user but looks different. This embodies the potential for exploring possibilities of real-time motion capture technology.

Evaluation of MoCap with Rokoko Smartsuit

By being present at a two-day practical somaesthetics workshop, the participant gained a lot

44 https://www.rokoko.com/en

45 Wilde, Vallgårda, and Tomico, "Embodied Design Ideation Methods."

of first-person perspective in movement and interaction design. The special nature of the assignment did not allow for reflection on these, yet the student provided examples of some movement qualities from the recorded videos and motion capture data. Based on his work, in the current (Spring 2018) edition of the course, we used the Rokoko Smartsuit extensively in our movement and computing exercises.

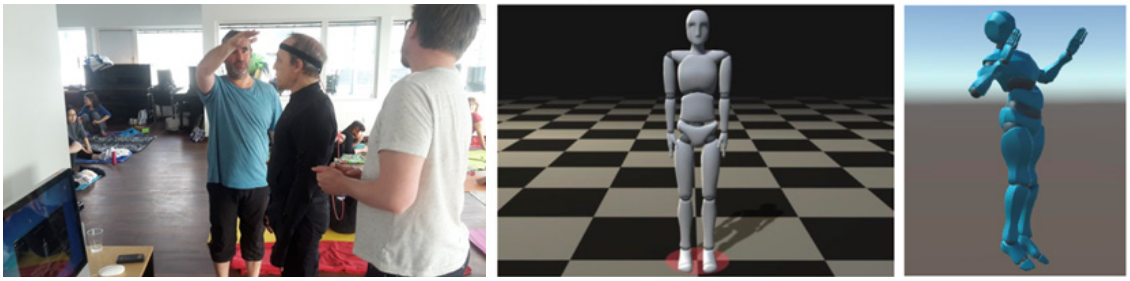

Figure 4: MoCap with Rokoko Smartsuit. The actual situation (left), the Smartsuit Studio representation (middle), and the virtual on Unity (right).

5. Discussion

The course activities briefly outlined above—movement exercises; theoretical research material; and practical motion capture, coding, and designing embodied interaction—constitute our approach to make students well equipped for being good designers of movement-based interactions, also in VR.

The mini-projects submitted by the students demonstrate their knowledge of three important illusions in VR, namely the place, plausibility, and embodiment illusions, the last being extended toward human-centered embodied interaction. Students were able to discuss perspectives of movement[46] and quality in terms of Laban effort,[47] and in our opinion, developed "a personal identity or coherence that holds all of these moving parts together through a given process," with reference to Bardzwell's list in the introduction. These projects were made available to the new students in Spring 2018 for inspection, try-outs, and reflection from a first-person perspective.

Taijijian VR proved the technical possibility of using VRTK for different headsets and desktop prototyping. This is important since the increasing number of VR projects put pressure on our labs, in terms of logistics. It also proved the potential of interactive, procedural sound generation in tandem with VR interaction. While it focuses on instrumental interaction with a sword—a popular controller for fast-paced and adrenaline-driven VR games—the project provides an alternative framing for slow, contemplative movement and paves the way for experiential somaesthetics. Taijijian VR also challenges the design guideline that auditory feedback may be distractive for somaesthetics appreciation[48] and proves that skillfully designed interactive sound can, on the contrary, strengthen the action–perception loop.

Cave Exploration VR integrated many guidelines from VR, games design, narratives, and embodied interaction into a high-quality application. It provided an example of what we want to achieve in embodied VR interaction. It will be a running demo in our lab and a case study for future editions of the course.

46 Loke and Robertson, "Moving and Making Strange."

47 Maranan et al., "Designing for Movement." See also Section 3.

48 Höök et al., "Somaesthetic Appreciation Design."

Arm Constraint proved a useful practice for us to understand the engineering side of multimodal interaction in VR. The passive device prototype has a potential to be actuated with haptics. The project has obvious references to the body, embodiment, and familiarity/unfamiliarity with the movement and its cognitive effects (*However, when you are able to reach beyond this limit it becomes an unfamiliar motion that may cause some cognitive confusion*). Yet bringing these closer to the enacted first-person view of interaction will require iterations.

MoCap with Rokoko Smartsuit became a standard part of our course in Spring 2018, and together with somatic exercises it had the most profound impact on the student projects since then. Based on this implementation, some participants in the Spring 2018 edition could put a transparent sphere around a moving body, indicating its immediate reach, or visualize the traces of the arm movements in an assignment after the first class. We are currently researching and developing this aspect for the 2019 edition.

6. Conclusions and Future Work

We have presented an approach for incorporating VR elements in teaching embodied interaction. The activities are conducted to guide the participants toward the felt qualities of movement, in real and virtual worlds. We have reflected upon the structure, activities, outcomes, and recent changes in the current phase. We have identified two factors that have the most impact on student projects: somatic exercises and hands-on work with motion capture including the data produced. We recommend the somatic exercises to any program that enters into new design areas. Höök discusses five techniques[49] for further training somaesthetic skills: 1) focusing on change and interest, 2) disrupting the habitual, 3) Laban movement analysis, 4) autoethnographies, and 5) engaging with other somaesthetic connoisseurs. We continuously experiment with new tools, techniques, and guidelines to design for and through movement qualities, and we hope to contribute to this list, as well as to interaction design, VR, and programming education in general. Likewise, motion capture training is very valuable for VR, and we hope to work with more advanced tools and techniques in the future.[50]

Before we could work with the tools and exercises, we had heavy theory on the history of HCI and VR, as well as embodied cognition and enaction. In addition, some projects spent a lot of time trying to solve emerging technical problems. We address these as follows: By showing and not telling, we introduce the current students to the field by the previous years' projects, our evaluations, the program code from a private repository, and inviting the students who had good projects or solutions to technical problems. As tutors, we provide our examples on the Unity 3D game engine, but the students are free to choose their platforms to work on their projects.

Our future courses in embodied interaction will include less theory and a more substantial experiential component. The participants will evaluate their designs in terms of an account of the intellectual, emotional, and physical characteristics felt by themselves in the making of the application, and an account of the felt experiences of those who tried their applications. The first-person perspective would then cover all aspects of movement and computing, acknowledging the realities and idiosyncrasies of the development process as it evolves. Data and program code could be molded into our design as personal design material to be felt and subjectively experienced—unlike the movement interfaces, games, and virtual and augmented reality

49 Höök, *Designing with the Body*.

50 We look forward to integrating the Virtual Production workflow in the course 2019 onwards: https://www.rokoko.com/en/explore/blog/virtual-production

applications of today, where they are hidden in software/hardware abstraction layers.

We have introduced the elements of practical somaesthetics at the end of the second-cycle graduate education. While this might be considered late, we aimed for full understanding and mastery of third-person design and evaluation methods before encouraging the student to trust his or her soma from a first-person, experiential point of view. We have aimed for "a personal identity or coherence that holds all of these moving parts together" that would inform our graduates during the onset of their professional career (Bardzell's commentary to Shusterman's Somaesthetics in the HCI Encyclopaedia).[51]

Our effort was not without challenges. We now comprehend what Shusterman[52] means when he asks "What reforms of curriculum, institutions, and attitudes would be needed to introduce such embodied education?" From curriculum design through practical logistics about the movement space, equipment, cameras, MoCap, etc., all the way to examination, there were lots of issues that needed solutions when extending a college-level learning activity beyond the classroom. However, with a correct attitude from the students and staff about the importance of experiential somaesthetics in designing for VR, our solutions worked for our initial effort, and they can be excelled in the future. As for curriculum reforms, we are introducing our positive experiences to earlier semesters, e.g., to second-year BSc students, as a flipped class, so that they experientially learn somatic practices at our university.

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Ensemble, Entrainment, and Movement in the Mess of the Matter: Non-anthropocentric Design of Responsive-Media Environments

Garrett Laroy Johnson, Todd Ingalls, Britta Joy Peterson and Xin Wei Sha

Abstract: *In this paper, we describe an experimental approach to the study of coordinated group activity (ensemble) through the development of a responsive media system and enacted movement-based research. Interested in how ensembles emerge, we take into account the material conditions of phenomena associated with coordination and entrainment. To this end we share about the development of a responsive media system and as well as a series of movement experiments with the system. As a unframing tactic, we suspend ontological assumptions which occlude, mask, or ignore relation and event as emergent and unprestateable. This tactic belies both our observations of event as well as the design of responsive behaviors in the media environment apparatus. Our investigations yielded insights for us about embodied experience with respect to technicity.*

Keywords: *digital-physical hybrid systems, group activity and ensemble, material computing, responsive media, movement research, research-creation.*

Als das Kind Kind war,
ging es mit hängenden Armen,
wollte der Bach sei ein Fluß,
der Fluß sei ein Strom,
und diese Pfütze das Meer.
Als das Kind Kind war,
wußte es nicht, daß es Kind war,
alles war ihm beseelt,
und alle Seelen waren eins.[1]

-Peter Handke, from "Lied vom Kindsein," featured in *Der Himmel über Berlin* (1987), directed by Wim Wenders

1 From Peter Handke's "Song of Childhood," featured in the 1987 film by Wim Wenders *Wings of Desire*: "When the child was a child / it walked with its arms swinging, / wanted the brook to be a river, / the river to be a torrent, / and this puddle to be the sea. / When the child was a child, / it didn't know that it was a child, / to it, everything had a soul, / and all souls were one."

1. The Problematic of Ensemble, Entrainment, And Material Creativity

A small table found in a 2014 blog post by Adrian Freed[2] enumerates words beginning with prefixes co-, sym-, and syn-. In this "semblance typology of entrainments," as he titled it, each word is complete with a short definition, and many words are attached to examples: "Morris dance", "twisting together," "three-legged race", "melting together." Freed's typology unfurls the term entrainment from traditional understandings bounded by discipline. Semblance here can be read here as uniting these disparate notions by what Wittgenstein called their "family resemblence" (this unity Wittgenstein might also approvingly label "true enough"). Freed's list invites us to unfurl notions of togetherness bound together as corporeal gesture coordinated across messy assemblages of bodies and stuff: a group preparing a meal, a crowd's distributed movements through urban spaces, or children playing tag, holding a conversation while walking downtown. We call these notions of togetherness "ensemble".[3]

Like ensemble, the term entrainment seems to have never belonged solely to any one context. Christian Huygens found that pendulums would synchronize their phase when connected by a single medium (harmonicity in classical physics). In musicology, to entrain to a beat is to fall into a groove (or at least to play in tempo). Biological entrainment describes the syncing of an organism's circadian rhythms with an environmental rhythm. Prosodic entrainment is the mimetic matching of patterns of speech in group conversation. Perhaps the most poetic notion of entrainment comes from the morphology of physical and geological systems: solids or liquids perturbed by flow. Aeolian or fluvial flows lift sediment from the seafloor or the sands of a desert, creating patterns of ripples and waves.

In these examples, the temptation may be to understand entrainment as the assimilation or adaptation of one system to another. The preposition *to* is important sign post of the kinds of relationalities we're interested in. It's not so simple as tuning a guitar *to* an electronic tuner, or playing along "to" a drum machine. It is not a relation of pure identity but rather of *summing*; the better pronoun for entrainment is to entrain *with*.

Because we will say more about media systems, we'll provide the aeolian harp here as an example. Traditionally this was a stringed instrument installed outdoors. Gusts of wind blow through the instrument, and if the frequency of the vortex turbulence on either side of the string matches the frequency of the string or one of its harmonics, the string will vibrate. (Other "environmental" instrument variations use pipes, bells, or chimes.) Some contemporary engagements with this atmospheric instrumentality are found in Harry Bertoia's sonambient steel-rod instruments. The wind is replaced by the sea in Eduardo Chillida's *Peine del Viento* in San Sebastian or the Sea Organ by Nikola Bašić in Zadar, Croatia. These seaside plazas are built with pipes that lead out to the ocean, through which the surf rushes up to create a roaring, noisy yet pitch-resonant sound. In these examples, the material configuration constitutes a potentiality which are activated in irreducibly complex ways by energetic forces. What's more, the instruments *do not care* where the forces come from; they may be coupled with atmospheric, non-human material, or anthropogenic energies.

As mentioned above, we don't need to include the human to speak of entrainment or

2 https://adrianfreed.com/content/semblance-typology-entrainments Last accessed [2019-02-19]

3 What we call ensemble could also readily be encapsulated by other philosophical concepts such as the Deleuzoguattarian *assemblage* or the Whiteheadian *societies of actual entities*. No doubt the power of these process theoretical notions are behind the inspiration for this project and the reader may expect more appearances by such figures in the final part of this essay. Rather than get deep into the metaphysical architecture of Deleuze or Whitehead, we take notice of those resonances and return to the problematic of ensemble, "attending to the phenomena" per Husserl's injunction, via empirical experiment. To venture to risk being too open-ended and shrouded in naivety, to ask without embarrassment like the child in the poem from *Wings over Berlin,* "warum bin Ich Ich, und nicht Du?"

ensemble. To this end our project begins in the mess of the matter of ensemble—and ends there too—there is always more to be unpacked from cultural, physical, chemical, and affective strata, novel vectors to pursue. Accordingly, we do not set out to create a definitive account of what we mean by ensemble, but for us a foothold. It acts for us as a problematic in the style of Gaston Bachelard[4] propelling forth a question: How can we condition enacted experience for ensemble to emerge? At least to the extent that creation must be considered technical (in the sense of ancient Greek techne), we hold that this is a fundamentally sociotechnical question.

Agent-based simulations in computational media try to get at complex systems and movement, whether in the case of architecture and the built environment and the movement of cars and pedestrians, economies and the flows of capital, flocking of birds and so on. All of the various movements are described as the activities of so-called autonomous agents.[5] These computational agents are autonomous in the sense that they plan their movement based on local conditions and according to pre-given rules which dictate speed, proximity to other avatars, avoidance etc.

It should be said that on behalf of these algorithmic descriptions of complex behaviors that there are quite good reasons for applying them to various domains, namely that they adequately approximate ensemble and crowd behavior. What's more, they afford many practical advantages over enacted experiment, notably w.r.t. scale. Media artists have been using these techniques for almost half a century to produce impressive eye-candy.[6] But, how can we say that processes afforded by subjectivity (in this case, movement planning, spatial awareness) may be contained within discretized human bodies? And how can we venture to represent these worldly processes by digital logical operators?

On the side of pragmatics, an enacted approach leverages embodied knowledges as well as the physics of the world without collapsing relations into topological graphs. In other words, we do not need to train avatars to walk in order to understand the dynamics of a crowd moving through an airport, we look to in-situ examples of people moving through an airport.

In what follows, we share a project in speculative engineering, experimental movement research, and artistic creation which seeks to clear away presuppositions about what we think we know about ensemble and group coordination, to dispense with the notion of the agent (no more than an ontological bracketing of subjectivity and corporeality), to sidestep reductive accounts of relationality as interacting sets of coded logical behaviors. What follows is a concretized proposition, which points to embodiment as processually constructed and thus conceive of the body which doesn't necessarily end at the skin.

2. *Lanterns*: Development of an Apparatus and Experimental Ensemble Practice

The *lanterns* system is a sandbox for exploring a variety of interest areas, including human interaction in physical-digital systems, experiential approaches to dynamical systems, and corporeal entrainment between matter and biology. The Lanterns are tangible pendant objects with responsive sound and lighting behaviors. The lamps are suspended from hacked GameTrak

4 Patrice Maniglier, "What is a Problematic?"

5 Craig Reynolds, "Flocks, Herds, and Schools: A Distributed Behavioral Model"

6 Gary William Flake, *The Computational Beauty of Nature: Computer Explorations of Fractals, Chaos, Complex Systems, and Adaptation*; Przemyslaw Prusinkiewicz et al., *The Algorithmic Beauty of Plants*; Daniel Shiffman, *The Nature of Code: Simulating Natural Systems with Processing*.

joysticks tracking the lamps' movements. Each lantern consists of six dimmable LED with plastic diffuser,[7] sockets, and a bundle of six cloth-covered electrical wires. Suspended from a theatrical grid, the cluster of bulbs and sockets hovers only a few feet above the ground (Figure 1).

Theatrical hardware yields computational control over the brightness of each individual light bulb. We employ some simple mappings for sonification and animating the lights, which can be seen in documentation videos.[8] We will discuss how we arrived at these mappings and their implications after we have given some background on how we arrived at this configuration for our system.

Figure 1: Interaction with the Lanterns system

Through the free interplay of movement-based experimentation (Figure 2), design iteration, and artistic creation, we developed aestheticized movement practices *alongside* our experimental engagements with the system. As we went along, artistic creation informed research questions and experimental design. In turn, both of these activities informed the development of the *lanterns* system (Figure 1). This meant the design of the hardware (on the scale of months) and responsive media software (on the scale of minutes, hours) was retooled as we went along. Below, we will give some background on the process of developing the system and the influence of the co-developing experimental practice, and the aesthetic achievements (dance works and an installation environment) and the way in which our work always refracted back through the questions we were asking about ensemble.

The system developed iteratively alongside in-situ experimentation about rhythm and ensemble. In preliminary experiments, we began not with lanterns, but balloons. We created an on-the-fly system for ensemble coordination using some cheap latex balloons which we worked together to keep above the ground.

7 The plastic diffuser and LED technology make the pendants extremely durable.

8 Three Lanterns videos: Movement games with early prototype https://vimeo.com/193831344; dance performance https://vimeo.com/216553103; group etudes (experimental performances) https://www.youtube.com/watch?v=Evm1z-Kjllg.

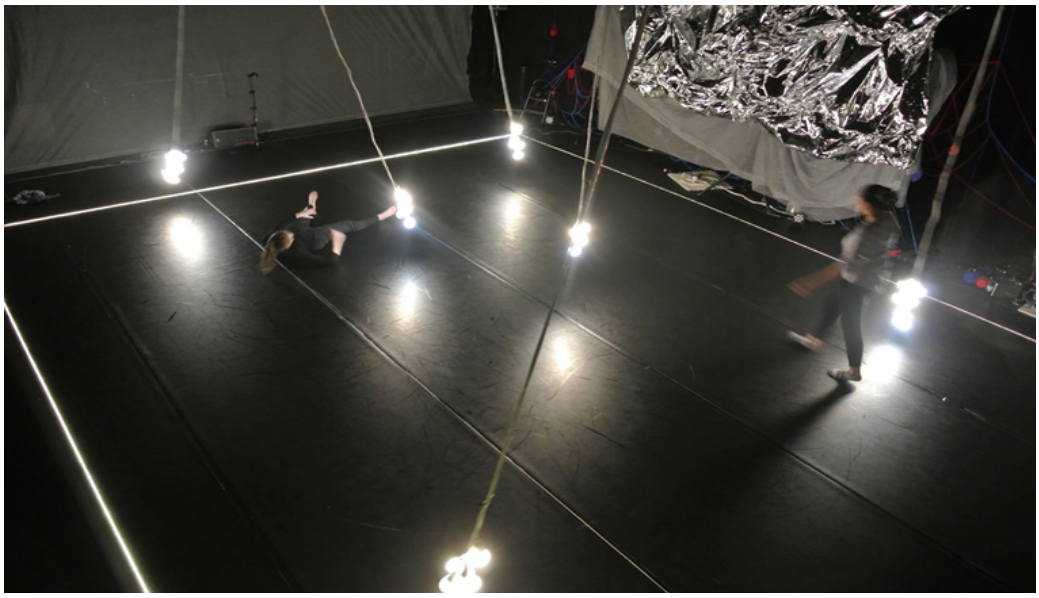

Figure 2: Dancers in free play with the Lanterns system

We made two important observations in these experiments. First, that the oblong shape of the balloon and its related material constitution introduced indeterminacy into the activity (the initial spark for our interest in *the role of matter* in movement and ensemble). And secondly, that our collective modes of playful engagement *continuously shifted* as we changed variables (adding balloons, people tiring, etc.). We found that most attempts to determine roles ahead of time quickly fell apart. Speech was too slow to coordinate our action, but as we practiced our approach changed in order to accommodate the contingency of the balloon physics.

With these balloon games on the mind, we began to work on a single lantern. The first prototype strongly resembled the final iteration in terms of physical design and the media behaviors were similar but not as refined (and obviously absent any group dynamics).

We made two observations from working with this system. First, one significant difference is that the first prototype used spherical glass bulbs with incandescent filaments. We noticed immediately that interlocutors took a long time to get used to moving the lantern because they regarded it as fragile and delicate (In the end we did break many bulbs, which led us to switch to LEDs with plastic diffusers). Furthermore, we began to find the movement resonances that were composed into the lantern itself. By resonances we mean the patterns of movement which recurred throughout our play, like circling and swinging. Both of these observations point to what we mean by *composing conditions for activity* (instead of determining outcomes or steering behavior).

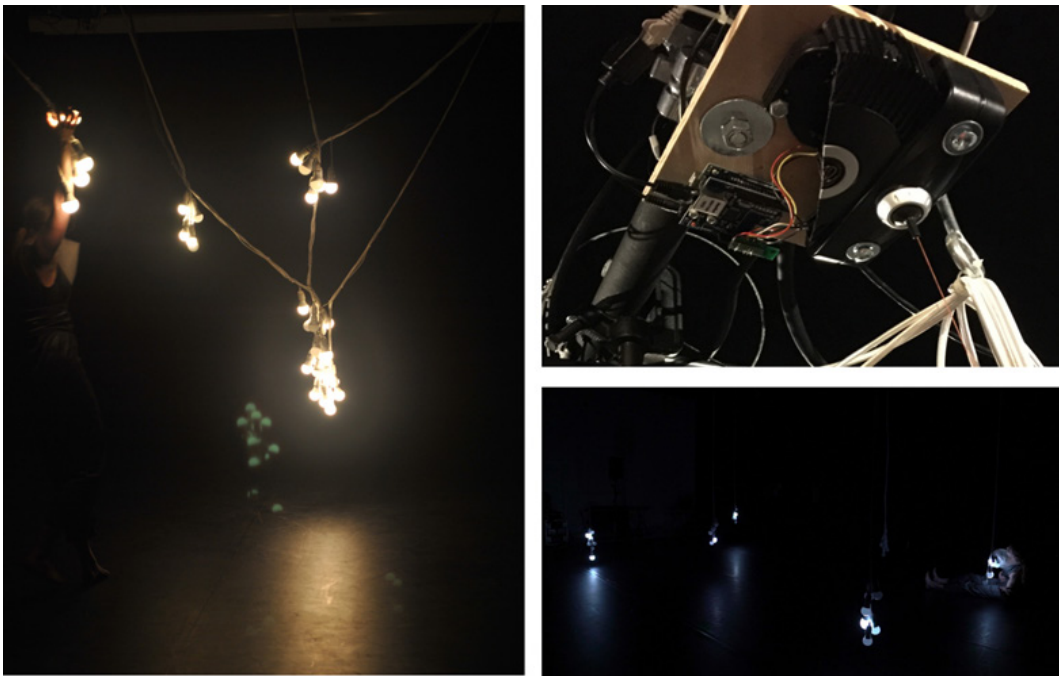

Figure 3: Instances of the final Lanterns system

Like many of the proposals contained here, we advocate a movement away from discrete considerations of media towards continuous ones. The design ethos of responsive media, a particular way of composing systems with media, sensors, and computation, is attuned to processual aspects of experience, such as rhythm, atmosphere, affect, and ensemble.[9] Continuous approaches to computation in digital domains might be said to emulate the analog or the material in some way (consider the aeolian harp example above). In the case of the *lanterns*, much of the computation is *already done by the analog physics of the system*.

We employ simple analyses of the position data to create simple media behaviors; we extract the speed of each lantern from the joystick data vector as well as a measure of each lantern's proximity to other lanterns. Their proximity is determined heuristically by calculating the total distance of each lighting pendant to the group's centroid. Each lanterns position data are mapped to banks of filtered noise which are tuned to various pitch collections. Their speed and acceleration control playback speed and tuning of a bank of samples, fluttering the lightbulbs as they sound. Sound is spatialized across a multi-channel sound array to track the lantern's position through the space.

The total distance from the pendants' centroid controls the pitch and amplitude modulation of sub-bass oscillators; as the lanterns gather together, the oscillators pitch into an audible range and pulse more frequently. The amplitude of this synth maps to the amplification of the light's control data.

In the case of the final swarm of swinging lanterns (Figures 1-3), the simplicity of the media behaviors aims to highlight the prebaked, kinematic rhythmic character of each individual lantern as well as their relationships to other lanterns. The spatially diffused sounds, pulsing lights, and moving pendants constitute an experientially rich set of inter-penetrating fields of media and matter. Instead of algorithmically injecting variance into the interaction, we aim for a reproducible sonifications and lighting behaviors which leverage the rhythms, movements, and

9 Sha Xin Wei, *Poiesis and Enchantment in Topological Matter*.

energies directly from moving human bodies and analog matter. In this way, Lanterns' responsive sound and lighting de-emphasize algorithmic virtuosity. Instead virtuosity is always already relational, social, and lived. Tightly coupling sound and light to the movements of the physical system also works to de-center the human's hierarchical footing by destabilizing "interactive" design frameworks in which humans control over media through sensors are not slaved to the human body or extend as prostheses.

A key aspect of our approach to experimental phenomenology is to rely not on models of "psychological" or "cognitive state" but instead to use semantically shallow models to drive the computation,[10] described in [Sha 2013]. This design principle results from an abductive approach to studying rich experience with the least possible commitment to theoretical models of experience. In particular, we have developed rich responsive media systems that leverage the embodied physicality and physics, but eliminate the need for modeling "user" "psychology" in code.[11] *Lanterns* draws on these methods, techniques and design principles. Material computation or natural computing in foundations of computer science and engineering, and new materiality in cultural studies signal a turn to the design of responsive environments and computational media paying as much attention to material qualities like elasticity, density, wear, and tension as to social and cognitive experience. This demands thinking about and designing computation in a non-reductive way that spans formal divides between symbolic-semiotic, social, and physical processes. One radical context for the *lanterns* work is the investigation of hybrid physical-digital models of computation, especially those that blend digital microprocessors instantiating Turing computation with the physics of analog matter. Following Stepney and our own previous work, we generalize computation as the reproducible transition from state to state of a structure (physical, biological, informatic) under some deterministic scheme.[12] Previously we observed that sound computing already exemplifies a rich history of hybrid physical-digital computation, where the processing of sound leverages both the physics of the analog and algorithmic (the code) parts of a computational electronic-musical "instrument." Most importantly, we consider the human to be part of the system, following human-in-the-loop design common in AI research motivated by augmentation rather than automation (replacement) of human activity. *Lanterns* radically simplifies the complexity of the dynamics of the parts to clarify the relation among the physics, the digital computation, and the human performers. We single out temporal (generalized rhythmic) aspects of activity such as cadence in swing, body and sound, as described below. The basic observation is that simple ballistic physics of the lanterns allow the performers to play most creatively to invent ensemble gestures that would be impractical to model and embed into code in advance.[13]

3. Tactics for Engagement: Experimental Results

In this final section, we synthesize insights about ensemble from the experiments with the system itself. The following table summarizes the activities and inventions generated during experimental working sessions led by four professional dancers who have worked together for

10 Ibid.

11 Brandon Mechtley, Julian Stein, Christopher Roberts, and Sha Xin Wei "Rich State Transitions in a Media Choreography Framework Using an Idealized Model of Cloud Dynamics". For more examples, visit www.synthesiscenter.net.

12 Susan Stepney, "The Neglected Pillar of Material Computation," Navid Navab, Doug Van Nort, Sha Xin Wei, "A Material Computation Perspective on Audio Mosaicing and Gestural Conditioning".

13 As Stuart Kauffman argues, this is always the case with living systems because living systems have open rather than closed configuration spaces, but at the very least, this is a practical insight for building rich media systems for improvisatory activity. Stuart Kauffman, *Humanity in a Creative Universe*.

years. The first column describes various recurrent pendant movements which we discovered through improvised and unstructured play (the resonances to which we referred in the previous section). We made these patterns objectives for some playful exercises which were repeatable which could be varied (column two). An important methodological point was then not to instruct each other how to make this happen. Instead unexpected coordinations emerged as a collectively and processually, transforming the relation between dancers, between the moving pendants, and between humans and pendants (column three).

From a systems perspective, the first column corresponds with different *perturbed states* of the media system (whereas the unperturbed, equilibrium state would be the pendants resting at a standstill) and in the second column variations of these states are permuted. The final column lists the variations of the human ensemble's movement state space when the media system's state is farthest from equilibrium. By far from equilibrium we mean for instance when the lanterns all swing together the inertia of the system will slowly dissipate until reaching equilibrium. This phase space is similar for states "circling" and "twisting." (This is also true for "gathering", but the system seems to enter a different state of equilibrium if the lanterns are knotted together as shown in the image above).

LANTERNS STATE	DESCRIPTION and VARIATIONS	COUPLINGS
Swinging	Lanterns swing like a pendulum; In phase/anti-phase, etc.	Run alongside swinging bulbs; Catch and release (using sight, using hearing); Grouping people w. lanterns, number of humans/lanterns
Circling	Lanterns swing like a circular pendulum; In phase/anti-phase; Moving in the same or opposite direction	Run alongside swinging bulbs; Catch and release (using sight, using hearing); Grouping people w. lanterns, number of humans/lanterns
Twisting	Lanterns wrap around each other; Number of lanterns to group; How many may be touched	Throw a pendant around another; thread them together
Gathering	Bring all the lanterns together	Gather and release (seated); Twisting or wrapping them to hold them together.

Table 1: Lanterns experiments and etudes

Our movement experiments with the *Lanterns* system points to insights about the relationality between coordinating human bodies and the material counterparts via fields of media. What's notable about these tactics is that we changed our relation to the *lanterns*, and in turn their relation to each other, to us, shifted. This suggests a looping relation between the humans and *lanterns*, but there is a lingering slippage in positing a relation between humans and the material system; clearly the humans are coordinating with each other to work with the lanterns, but the pendants do not coordinate back in a way that is familiar to us. This impetus

to collaborate is one-way; as far as we can say, the media system does not wish or desire to participate. The indifference of the system's non-living matter seems obvious. This was quite apparent to the dancers, who, despite their training to navigate complex spatial pathways and anticipate movements, frequently caught a stray lantern to the face, or were scraped by the zip ties which bundled the threads together.

It is tempting to conclude with this indifference as evidence of the intrinsic asymmetry between living and non-living systems (difference in kind). Andrew Culp has proposed asymmetry as a generative diagram for mapping this difference which can be applied to this situation if we replace "terms" with "systems": "asymmetry works to impede reciprocal relations and prevent reversibility. It diagrammatically starts by constituting two formally distinct terms as contrary asymmetry. It is maintained by concretely establishing a relationship of incommensurability between their sets of forces."[14] Culp juxtaposes asymmetry to complexity, which he calls "flattening," and an "equalization of inequality," which amounts to a kind of reductive scientific mysticism. It seems that by reviving Deleuze's concept of the irreducible inequality (here a productive operator generative of difference), Culp's gesture would lead us to space in which the non-human system could speak for itself on its own terms, even if there's no sense to be made of its speech act.

Figure 4: Instances of the final Lanterns system

While Culp's provocation inoculates us against the flattening of difference, his reading of Deleuzian metaphysics furnishes no system by which we can account for the lived experience of ensemble. This is not surprising given the nature of Culp's shadow work, imploring us to dispense with Deleuzoguattarian concepts adjacent to ensemble such as assemblage, becoming, and even experience for their affirmative, joyous, and connective connotations. Asymmetry only takes us as far as understanding difference as the continuous substrate and irreducible inequality as a primordial mechanism of creation. Humans and non-living systems are organized *differently.* We can understand this non-human/human ensemble as asymmetrical; forces such as desire,

14 Andrew Culp, *Dark Deleuze* (Minneapolis: University of Minnesota Press, 2016): 33-37.

intention, anticipation are incommensurate with the physical forces acting upon the material of the lanterns.

To speak to our lived experience of ensemble with lanterns, to describe the encounter between a human and a non-human system, why and how this ensemble falls apart, we come to the question of organization. and indulge a traditionally affirmative reading of the relation of metallurgy to music in Gilles Deleuze and Felix Guattari's a Thousand Plateaus. They write:

> *Matter and form have never seemed more rigid than in metallurgy; yet the succession of forms tends to be replaced by the form of a continuous development, and the variability of matters tends to be replaced by the matter of a continuous variation. If metallurgy has an essential relation with music, it is by virtue not only of the sounds of the forge but also of the tendency within both arts to bring into its own, beyond separate forms, a continuous development of form, and beyond variable matters, a continuous variation of matter: a widened chromaticism sustains both music and metallurgy.*[15]

There are affinities between the lanterns' physical system and the molten metal as a physical system, just as there are affinities between the media behaviors of the lanterns system and musical texturality. This is not just because the lantern pendants are made of copper threading at its core, or that their movements are sonified, but because they are constructed in a manner which accords with both the *continuous* variation of matter *entangled* with media. This entanglement is a function of digital-physical computation strategies mentioned in Section 2.

Given the asymmetry of the lanterns systems and human beings, how then can we speak about ensemble? Or entrainment *with*?

In his essay "Nonorganic Life," Manuel Delanda writes that: "a centuries-old devotion to 'conservative systems' (physical systems that, for all practical purposes, are isolated from their surroundings) are giving way to the realization that most systems in nature are subject to flows of matter and energy that continually move through them."[16] So while we can understand the biological organism of the human as a organizationally closed autopoietic system, and the group of humans speaking, gesturing and walking together as a closed semiotic system, **we need not draw thick lines around humans** when considering the *lanterns* experiments as a movement system. So, "warum bin Ich Ich und nicht Du?" No doubt the humans retain their biologically organized boundaries, but when these systems become coupled in this way, maybe words like "I" and "You" and "It" lose their meaning. In the spirit of Simondon, it may simply be less interesting or enlightening to speak in terms of biological organizations or subjects.

Deleuze and Guattari write that "the musical smith was the first 'transformer'" but no doubt the musical smith was also *transformed* just as the movers in these experiments adjusted their relation to the *lanterns* in order to point the media system towards a state of perturbation. That some of the examples we've cited produce static concretized artifacts may also occlude what is interesting about the *lanterns*. The canal, the arrangement of metal filings, the wave patterns in the seafloor sediment—what is interesting about these is not the result of course by the process. As a movement system, the lanterns don't produce durational artifacts, but rather produce *gesture*. These gestures are co-produced by the physical system of the pendants, the energetic,

15 Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, translated by Brian Massumi (Minneapolis, MN: University of Minnesota Press, 1987): 441.

16 Manuel Delanda, "Nonorganic Life," in *Zone 6*, eds. Jonathan Crary and Sanford Kwitner (New York: Urzone, 1992): 128-167.

somatic system of the human movers, *and* the computational media schema continuously driving spatialized sound and the electric flows to the light bulbs. Like music, gesture is ephemeral, mechanical reproduction notwithstanding. Per experimental jazz saxophonist Eric Dolphy: "When you hear music, after it's over, it's gone in the air; you can never recapture it again."

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What allows us to kinesthetically empathize with motions of non-anthropomorphic objects?

Kensho Miyoshi

Abstract: *The physical movements of designed objects not only have utilitarian purposes but also make us experience the diverse kinetic sensations. Such an imaginative projection of one's own embodied sensation to observed movements is called "kinesthetic empathy". Despite the majority of its research focused on observation of human movements, little is known about how kinesthetic empathy works with the movements of everyday, non-anthropomorphic objects. Through my close observations, I propose a new concept of "kinesthetic elements" that help us understand the kinesthetic potential of object motions beyond somatic dissimilarity.*

Keywords: *kinesthetic empathy, kinetic design, kinesthetic element, design research.*

1. Introduction

Kinetic movements appear in diverse scenes of designed objects and environments—for example, in the tick-tock of clock hands; the rotation of fan blades; pop-up toasters; the swaying of curtains; and the sliding, revolving and folding of automatic doors. Each movement not only has its utilitarian purpose, but also takes on unique aesthetic qualities through its forms, dynamics and contexts. Some movements appear light, effortless and graceful, while others seem heavy, stiff and awkward.

My PhD research began with my initial interest in such qualitative aspects of object movements. The motivation derives from my background in human-robot interaction (HRI) research, which focused on autonomous aerial robots[1,2,3] and practices in kinetic art.[4,5] The aesthetic, poetic and empathic experiences in observing physically dynamic objects in various contexts triggered an interest in exploring the qualitative aspects of object movements and their potential application beyond art and engineering, and into the realm of design. My foundational studies afforded me the possibility of deeper exploration into the area where *kinesthetic empathy*

1 Miyoshi, Kensho, Ryo Konomura, and Koichi Hori. "Above Your Hand: direct and natural interaction with aerial robot." In *ACM SIGGRAPH 2014 Emerging Technologies*, p. 8. ACM, 2014.

2 Miyoshi, Kensho, Ryo Konomura, and Koichi Hori. "Entertainment multi-rotor robot that realises direct and multimodal interaction." In *Proceedings of the 28th International BCS Human Computer Interaction Conference on HCI 2014-Sand, Sea and Sky-Holiday HCI*, pp. 218-221. BCS, 2014

3 Balloon 2 Blimp. 2013. http://diydrones.com/profiles/blogs/ballon-2-blimp?xg_source=activity

4 Hamon Clock. 2013. Available: https://miyoshikensho.com/en/ham.html

5 Puwants, in collaboration with Kosei Komatsu. 2014. https://miyoshikensho.com/en/puw_n.html

meets *kinetic design*.

Although the definition of kinesthetic empathy varies depending on the context,[6] it essentially refers to our innate capacity and sensitivity to simulate the sense of movement of the entities one observes, such as humans, animals and objects. The notion of kinesthetic empathy was a research theme in a recent research project, *Watching Dance: Kinesthetic Empathy*, which is documented in a book titled *Kinesthetic Empathy in Creative and Cultural Practices* by Reynolds and Reason.[7] Despite their primary focus on human movement in dance and theater, as opposed to designed objects, the concept provided me with a perspective to understand what I had attempted, but failed to articulate, regarding the aesthetic experience of watching movements. This paper presents my recent findings, which build upon my preceding exploration.[8]

2. Background

Kinetic design

I deliberately use the open term *kinetic design* to mean designed objects such as products, furniture and interior in which physical movements serve either practical or aesthetic purposes. The notion of movement in my research, despite its designerly purpose, follows what Gabo and Pevsner called "movement itself" in their *Realist Manifesto*[9] in 1920. "Movement itself" refers to the physically dynamic movement of objects, rather than to the movement of Futurism, which attempted to recreate the sense of motion by using physically static media and optical effects.[10]

Kinetic design consists of objects with a variety of motions, such as automatic and continuous (e.g. mechanical clocks), automatic and reactive (e.g. automatic doors) and manual (e.g. non-automatic doors), among others, although these categories are neither discrete nor comprehensive. Everyday objects such as pop-up toasters, mechanical clocks and fans are typical examples of kinetic design. The potential of this type of design has been explored in many ways, including aesthetic,[11,12,13] interfacial,[14,15] communicative[16] and emotional.[17] The *kinesthetically empathic* potential of object movements, however, has rarely been considered. Through the lens of kinesthetic empathy, our empathic and embodied response to the behavior of objects can be revealed, which will provide a new perspective on how we "feel" them bodily, as opposed to how

6 Ibid.

7 Reynolds, Dee, and Matthew Reason, eds. *Kinesthetic empathy in creative and cultural practices*. Intellect Books, 2012

8 Miyoshi, Kensho. "Where Kinesthetic Empathy meets Kinetic Design." In *Proceedings of the 5th International Conference on Movement and Computing*, p. 32. ACM, 2018

9 Gabo, Naum, and Noton Pevsner. *The Realistic Manifesto* (1920). Aspen, 1967.

10 Rickey, George W. "The morphology of movement: a study of kinetic art." *Art Journal 22*, no. 4 (1963): 220-231.

11 Yoshimoto, Hideki. "Pulse and rhythm: exploring the value of repetitive motion as an element of design." PhD diss., Royal College of Art, 2015.

12 Niedderer, Kristina. "Exploring elastic movement as a medium for complex emotional expression in silver design." *International Journal of Design* 6, no. 3 (2012).

13 Moloney, Jules. *Designing kinetics for architectural facades: state change*. Routledge, 2011.

14 Ishii, Hiroshi, and Brygg Ullmer. "Tangible bits: towards seamless interfaces between people, bits and atoms." In *Proceedings of the ACM SIGCHI Conference on Human factors in computing systems*, pp. 234-241. ACM, 1997.

15 Parkes, Amanda, Ivan Poupyrev, and Hiroshi Ishii. "Designing kinetic interactions for organic user interfaces." *Communications of the ACM 51*, no. 6 (2008): 58-65.

16 Ju, Wendy, and Leila Takayama. "Approachability: How people interpret automatic door movement as gesture." *International Journal of Design* 3, no. 2 (2009): 1-10.

17 Weerdesteijn, Jeske MW, Pieter MA Desmet, and Mathieu A. Gielen. "Moving design: To design emotion through movement." *The Design Journal* 8, no. 1 (2005): 28-40.

we process them intellectually. Whereas the contemporary scholarship on kinesthetic empathy is mostly concerned with observing human movement,[18,19,20,21,22] not much is known about the ways in which kinesthetic empathy works with movements of non-human entities.

Kinesthetic empathy with non-human entities

The origin of kinesthetic empathy dates back to 1873 when Robert Vischer, a German aesthetician, used the term *Einfühlung* (later translated into English as empathy) to denote the aesthetic experience of projecting oneself onto an object.[23] Kinesthetic response was considered to result from a conscious attention to objects of various kinds. Sixteen years later in France, according to Popper's thorough book on kinetic art,[24] Paul Souriau, who was a French philosopher, established the first and in-depth study into the aesthetics of physical movement of humans and animals. Although the term was not used explicitly in his book *The Aesthetics of Movement*,[25] kinesthetic empathy was, in effect, the crux of his method of aesthetic observation and reasoning. Souriau explores various aesthetics of animals' movements through his imaginative projection of himself onto them, beyond the gap in the somatic structure. Later, Michael Polanyi, who is known to be the father of the well-known concept, *tacit knowledge*, also explored *indwelling*, which refers to the tacit perception of objects and events through the medium of our body.[26] While these views share a similar focus, a disagreement remains in terms of the controllability of kinesthetic empathy. Vischer argued that kinesthetic empathy results from conscious effort and imagination. In contrast, for Polanyi, *indwelling* was a type of tacit knowing, "which we are quite incapable of controlling."

Several studies have explored kinesthetic empathy with inanimate objects, such as chairs in a visual installation space,[27] human-scale objects inhabited and animated by performers,[28] and interactive environments,[29] among others. While these studies provide detailed consideration of each case, their transferability to design remains open. Laban Movement Analysis,[30] one of the most pioneering frameworks for motion analysis, was expected to be of some use. However, being heavily grounded in the structure of the human body, it was not possible to easily apply the framework to non-anthropomorphic objects.

In addition to these insights from philosophy and aesthetics, recent studies have provided

18 Reynolds and Reason (2012).

19 Parviainen, Jaana. "Kinaesthetic empathy." (2003).

20 Moen, Jin. "KinAesthetic movement interaction: designing for the pleasure of motion." (PhD diss., KTH Royal Institute of Technology, 2006).

21 Reason, Matthew, and Dee Reynolds. "Kinesthesia, empathy, and related pleasures: An inquiry into audience experiences of watching dance." *Dance research journal* 42, no. 2 (2010): 49-75

22 Jola, Corinne, Lucie Clements, and Julia F. Christensen. "Moved by stills: Kinesthetic sensory experiences in viewing dance photographs." *Seeing and Perceiving* 25 (2012): 80-81.

23 Vischer, Robert. "On the optical sense of form: A contribution to aesthetics." *Empathy, form, and space: problems in German aesthetics* 1893 (1873): 89-124.

24 Popper, Frank. *Origins and development of kinetic art*. (New York Graphic Society, 1968).

25 Souriau, Paul. *The aesthetics of movement*. (Univ of Massachusetts Press, 1983).

26 Polanyi, Michael. *The tacit dimension*. (University of Chicago press, 2009).

27 Cuykendall, Shannon, Ethan Soutar-Rau, Karen Cochrane, Jacob Freiberg, and Thecla Schiphorst. "Simply spinning: Extending current design frameworks for kinesthetic empathy." In *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction (*ACM, 2015), pp. 305-312.

28 Gemeinboeck, Petra, and Rob Saunders. "Movement Matters: How a Robot Becomes Body." In *Proceedings of the 4th International Conference on Movement Computing* (ACM, 2017), p. 8.

29 Reynolds and Reason (2012).

30 Bartenieff, Irmgard. *Body movement: coping with the environment.* (Reading: Gordon and Breach Science Publishers, 1980).

scientific understandings of kinesthetic empathy. First, there is a strong parallel between kinesthetic empathy and the mirror neuron system, originally discovered in the 1990s.[31] Mostly by using the fMRI technique, recent neurological studies have identified humans' empathic responses to non-human and non-anthropomorphic objects such as character animations,[32] vacuum cleaner robots,[33] and abstract animations.[34] Second, kinesthetic empathy is also informed by several fields such as perceptual psychology,[35,36] ecological psychology[37] and embodied cognition.[38,39] The concept of affordance in particular has an intricate relation to kinesthetic empathy. It has been indicated that internal kinesthetic stimuli can occur when a certain action is invited by the external objects or environments, even if no explicit action results.[40] Affordance invites imagining how to move in order to touch or grasp an object, for example, whereas kinesthetic empathy consists of projecting oneself onto an object and imagining how it would "feel" kinesthetically. While different types of simulation exist, they are difficult to distinguish on the phenomenological level. This confusion has also occasionally been observed in my ongoing participatory practice where designers learn about the concept of kinesthetic empathy and apply it to analyzing and designing the quality of object movement. Third, anthropomorphism is a concept that closely resembles, and is often confused with, kinesthetic empathy. My studies so far indicate that the degree of anthropomorphism can affect kinesthetic empathy. The critical difference between the two concepts is that kinesthetic empathy is about internal kinesthetic stimuli in the observers when they empathize with an observed movement, whereas anthropomorphism is about how we find human-likeliness in objects.[41,42,43]

These scientific theories are expected to be relevant to my research; however, the specific meaning in my research gradually becomes clear through practice. Overall, the concept of kinesthetic empathy is highly interdisciplinary, yet its connection to design is largely unexplored. This paper presents the early stage of my exploration into the following research questions. What can designers learn about humans' empathic and embodied reaction to object movements through the lens of kinesthetic empathy? How can designers apply the knowledge to analyzing and exploring the quality of object movements?

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31 Polanyi (2018).

32 Power, Patrick. "Character Animation and the Embodied Mind—Brain." *Animation* 3, no. 1 (2008): 25-48.

33 Hoenen, Matthias, Katrin T. Lübke, and Bettina M. Pause. "Non-anthropomorphic robots as social entities on a neurophysiological level." *Computers in Human Behavior* 57 (2016): 182-186.

34 Engel, Annerose, Michael Burke, Katja Fiehler, Siegfried Bien, and Frank Rösler. "How moving objects become animated: the human mirror neuron system assimilates non- biological movement patterns". *Social neuroscience*, 3(3-4), (2008): 368-387.

35 Bartley, S. Howard. "Principles of perception." (1958).

36 Arnheim, Rudolf. *Art and visual perception*. (Univ of California Press, 1974).

37 Gibson, James J. *The ecological approach to visual perception: classic edition*. (Psychology Press, 2014).

38 Clark, Andy. *Supersizing the mind: Embodiment, action, and cognitive extension*. (OUP USA, 2008).

39 Blakeslee, Sandra, and Matthew Blakeslee. T*he body has a mind of its own: How body maps in your brain help you do (almost) everything better*. (Random House Incorporated, 2007).

40 Freedberg, David, and Vittorio Gallese. "Motion, emotion and empathy in esthetic experience." *Trends in cognitive sciences* 11, no. 5 (2007): 197-203.

41 Blythe, Philip W., Peter M. Todd, and Geoffrey F. Miller. "How motion reveals intention: Categorizing social interactions." (1999).

42 Bartneck, Christoph, Takayuki Kanda, Omar Mubin, and Abdullah Al Mahmud. "Does the design of a robot influence its animacy and perceived intelligence?." I*nternational Journal of Social Robotics* 1, no. 2 (2009): 195-204.

43 Mori, Masahiro, Karl F. MacDorman, and Norri Kageki. "The uncanny valley [from the field]." *IEEE Robotics & Automation Magazine* 19, no. 2 (2012): 98-100.

3. Approach

My research belongs to what Phillips and Pugh call *exploratory research*, where little is known about the problem at hand and researchers have to develop new methods and theories and examine whether the existing methods are applicable.[44] Christopher Frayling differentiated three types of research in art and design: research *into, for* and *through* art and design.[45] Though all three are present in my research, it is research *through* design that largely contributed to the development of my research.

What follows is my exploration into kinesthetic empathy with the movements of physical, non-anthropomorphic objects and the process in which I developed two original concepts: *kinesthetic representation* and *kinesthetic elements*. The methods of making, observing objects and reflecting on my own practices[46] were used. For simplicity, in the following discussion I define *direct* kinesthesis and *indirect* kinesthesis (kinesthetic sensation) as follows. A *direct* kinesthesis arises from people's own bodily movements, whereas an *indirect* kinesthesis refers to a sensation of kinesthetic empathy with external motions.

4. Kinesthetic representation

Kinesthetic empathy is, essentially, an association of an observer's own kinesthetic sensation, whether a real memory or imagination, with observed movements. However, even if observers experience kinesthetic empathy, its sensation is often difficult to verbalize, which became an obstacle to exploration. Through trial and error, I developed a method of communicating the sensation of kinesthetic empathy through body gestures, which I termed *kinesthetic representation*.

Figure 1 presents my first attempt to express my own kinesthetic empathy with the spinning motion of a cone-shaped sculpture in an embodied, non-verbal manner. My static posture, leaning sideways, was aimed at expressing the body posture, which gave me a *direct* kinesthetic sensation similar to the kinesthetic empathy with the sculpture—the tensional feeling of balance and imbalance. This translation from internal sensations to external postures proved to be an effective tool to communicate with other people the ineffable sensation of kinesthetic empathy.

Figure 1: Left: my sketch of the cone-shaped sculpture; *Careful I* (2009) by glass artist and researcher Heike Brachlow.[47] Middle: my sketch of the sculpture in motion. Right: my body posture that expresses my kinesthetic empathy with the movement.

44 Phillips, Estelle, and Derek Pugh. *How to get a PhD: A handbook for students and their supervisors*. (McGraw-Hill Education, 2010).

45 Frayling, Christopher. "Research in art and design." (1993).

46 Schon, Donald. "The reflective practitioner." (1983).

47 Careful I (2009) by glass designer and researcher Heike Brachlow. Video available: http://www.heikebrachlow.com/HB_Frameset.htm

To better articulate kinesthetic empathy sensations, dynamic body gestures were attempted. Figure 2 ilustrates an example of kinesthetic representation, which I performed (on the right) with the aim of expressing my kinesthetic empathy with *Balance Machine*, a kinetic sculpture I created (on the left). The hammer attached at the top is lifted by the motor and released. It then hits the body of the sculpture and makes it literally "almost fall over." It was created to gain an in-depth understanding of the movement and mechanism of *Machines That Almost Fall Over*[48] (2008), the kinetic sculpture by Boston-based artist Michael Kontopoulos, by replicating the movement from scratch. I performed the specific body gesture, which provided the *direct* kinesthesis closest to the sensation of kinesthetic empathy with the sculpture's motion.

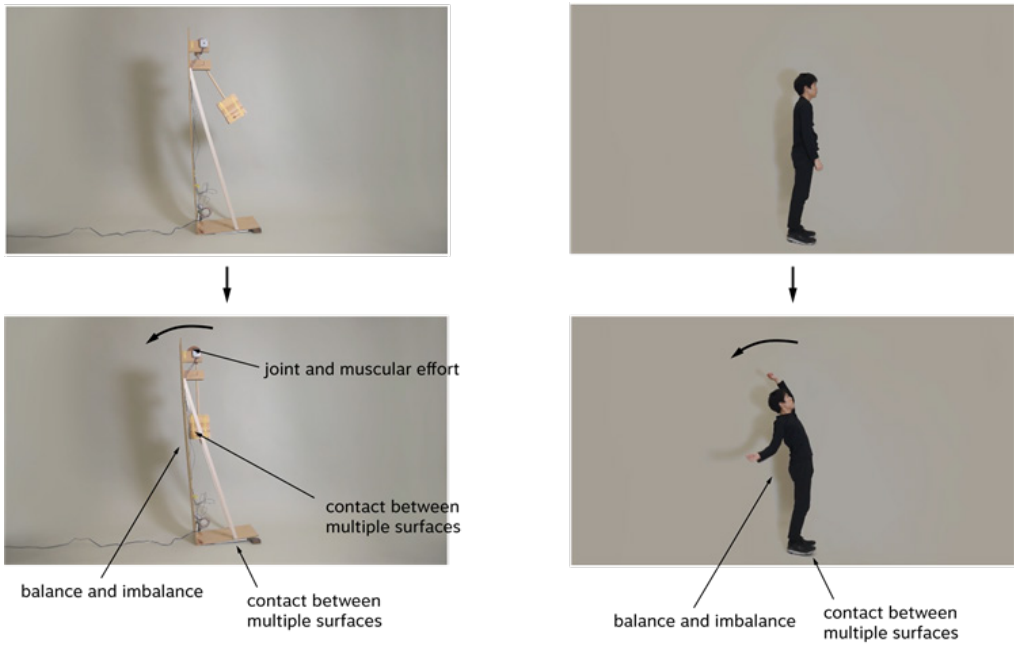

Figure 2: Upper-left: *Balance Machine* standing upright. Bottom-left: *Balance Machine* tilting to the left. Upper-right: my kinesthetic representation with the sculpture standing upright. Bottom-right: my kinesthetic representation with the sculpture tilting. The annotations are my observation and reflection that led to the idea of kinesthetic elements.

Another type of kinesthetic empathy exists between one who performs a kinesthetic representation of an object motion (Observer-A) and another who observes A's kinesthetic representation (Observer-B). Figure 3 depicts the three kinds of kinesthetic empathy present in the communication enabled by kinesthetic representation. Observer-B compares his/her kinesthetic empathy, both with Observer-A's kinesthetic representation and with the object movement, to explore the kinesthetic potential Observer-A is attempting to communicate. This communication should be further clarified by using verbal discussions between A and B than merely relying on the gestures.

48 Machines That Almost Fall Over (2008). http://www.mkontopoulos.com/portfolio/machines-that-almost-fall-over/

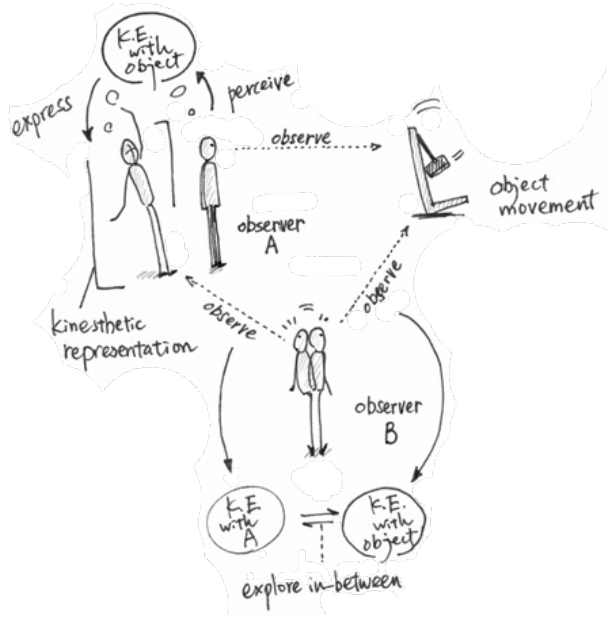

Figure 3: Multiple types of kinesthetic empathy present in the system of kinesthetic representation; "K.E." in the illustration means "kinesthetic empathy."

The *direct* kinesthesis experienced while performing the kinesthetic representation and the referenced *indirect* kinesthesis are not exactly the same. However, the exploration through bodily movement enabled me to articulate various aspects of my kinesthetic empathy with the sculpture. Borrowing Schön's terminology,[49] I explored by performing the action (reflection-in-action) as well as reflecting on it by watching the video recording of my own movement (reflection-on-action). Through this process, four facets of kinesthetic senses were identified.

First, and most obviously, the sense of balance is present. My kinesthetic representation features balance and imbalance by leaning backward to the point at which I nearly fall over. The nuance of kinesthetic sensation exists even in the choice of the direction of leaning—backwards, not forwards. The sculpture supports itself with the base stretched to the right, but, on the other hand, the left side is empty and defenseless. This reflects the human ability to better resist imbalance forwards more than backwards, because of the direction of the feet stretched out from the heels.

Here, the attention shifts from balance to tactility. The sculpture wobbles after regaining balance, and the oscillation gradually decreases. The physical contact between the base and the floor is reflected in my kinesthetic representation where my feet are touching on and off the floor. These two senses of contact are similar but never the same because of the gap in materiality, weight and dynamics.

While these two aspects—the balance of leaning and the tactility of the base—are reflected in my kinesthetic representation, there are other sensations that are not clearly articulated. One is the slightly painful collision between the hammer and the body of the sculpture. The others are the sense of effort in the motion of lifting the hammer and the sense of articulation in which the weight is received by one specific point (the joint supporting the root of the hammer). As a combination, the movement reminds me of the sense of muscular effort around the shoulder when lifting a heavy weight held by hand and keeping the arm extended.

49 Schön (1983).

Here, kinesthetic representation becomes a useful tool to explore the kinesthetic empathy experienced with not only the artifacts I created but also existing practices and natural phenomena. A possible confusion, that needed to be avoided, was that kinesthetic representation could be interpreted as a superficial imitation of the object movements or mere *kinetic* (without *esthetic* = sensory, perceptual) representation. I needed to make my intention clear each time I presented kinesthetic representation in textual, digital or oral form.

I used kinesthetic representation to analyze the movement qualities of over 50 types of objects. While conducting this research, any objects in motion such as everyday objects, natural phenomena and existing kinetic artworks became the targets of observation. When I found something especially intriguing, I attempted to create similar mechanisms myself to extend the observation. While kinesthetic representation was conceived as a tool to communicate with other people the experienced kinesthetic empathy, the comparison between direct and indirect kinesthesis allowed me to understand kinesthetic responses at a higher resolution. Further analysis revealed several commonalities between the fragments of kinesthetic empathy sensations, which I termed kinesthetic *elements*. These elements were identified in an organic and reflective manner, where one element served as the lens to construct others. That kinesthetic representation has failed to cover some elements does not mean a real failure but a process of exploration.

5. Developing kinesthetic elements

When identifying the elements, I often referenced anatomy[50] and perception[51] to learn about the mechanisms of human organs and senses. Perceived kinesthetic qualities cannot be fully reduced to the workings of the organs; however, they are mutually inseparable. At the beginning, four types of kinesthetic elements emerged: *balance, articulation, tension* and *haptic.* The formulation of this idea was inspired by the so-called "five senses." Although I find this phrase misleading, as it sounds to some as if humans have merely five senses, I wondered whether, if at all, something equivalent to the "five senses" existed in kinesthetic empathy. Through this question, the four elements emerged from the accumulation of my observations.

Balance

We have a tacit understanding of how objects balance and stand on the ground, just as we know how to stand upright and remain stable. Balance is of high necessity for human perception, both physically and psychologically.[52] Observing an object at in equilibrium, for example a cuboid placed upright on the floor (Figure 4, left), may not make us experience explicit kinesthetic empathy. Once the cuboid becomes imbalanced (Figure 4, right), however, we can easily understand the sense of imbalance and imagine the kinesthetic sensations of keeping a similar posture.

What strikes us is the accuracy and immediacy of our intuitive, perceptual ability to sense balance in observed objects.[53] The kinesthetic empathy experienced here may be compared with, for example, the feeling of leaning in a direction, being pushed off-balance suddenly without warning, or sitting on a chair and trying to balance on the legs of the chair.

50 Saladin, K. *Anatomy and physiology: The unity of form and function*. 2007. (Ohio: McGraw-Hill, 2010).

51 Bartley (1958)

52 Dondis, Donis A. *A primer of visual literacy*. (MIT Press, 1974): 22.

53 Ibid.

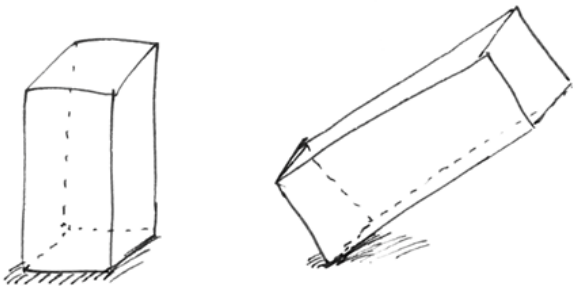

Figure 4: A cuboid standing upright (left) and tilting sideways (right).

The sense organ with which we perceive the condition of our body in relation to the gravitational field is called the vestibular system.[54] It is the non-auditory part of the inner ear that functions as the sense organ for this mechanism and detects the two major aspects of the gravitational force: change in motion, or acceleration, and the static posture of the head. The vestibular sense is often integrated with other parts of the body: vision, the tactile sense and even auditory sense.

Articulation

Our bodies have various articulations: shoulders, backbones, wrists, fingers, knees and necks. An articulation, also called a joint, is a connection between bones in the body that link the skeletal system into a functional whole. They are constructed to move within certain degrees and directions.[55] Each joint contributes to a unique kinesthetic sense as it comprises of different components, such as tendons, and it also connects with different muscles. Nonetheless, we all have a coarse understanding of what the movements of joints feel like which can be projected onto movements of similar structures.

In sports science a double pendulum, a pair of rigid bodies joined with a hinge and hanged from either side of its edges (Figure 5, left), is used as a dynamic model of our limbs.[56,57] Out of the chaotic movements that the pendulum creates, several patterns appear to be kinesthetic empathic. One familiar pattern of motion appears when the pendulum falls from a high position in a folded shape, reaches the bottom in a stretched condition, and then suddenly bounces up. We might project the action of swinging a golf club or a tennis racket, which embraces the kinesthetic sense of speedily stretching an arm to the point where the elbow can no longer bend. It is the impulsive pause and the sense of skeletal limitation in the elbow, the centrifugal force in the whole limb, the feel of the blood being pushed to the edge and the elasticity in bouncing the arm back. It is also noticeable that we do not necessarily experience explicit kinesthetic empathy with all the moments of the pendulum movement. A degree of similarity and dissimilarity, and thus how vividly we can kinesthetically empathize, seems to exist.

54 Bartley (1958): 365

55 Saladin (1998): 247

56 Bazargan-Lari, Y., A. Gholipour, M. Eghtesad, M. Nouri, and A. Sayadkooh. "Dynamics and control of locomotion of one leg walking as self-impact double pendulum." *Control, Instrumentation and Automation (ICCIA)*, 2011 2nd International Conference (IEEE, 2011): 201-206.

57 Yamada, N. *What makes the movement of top athletes different: The secret of the eminent athletes revealed by sports science* (title translation by me). (Kagaku Dojin. Published in Japanese, 2011)

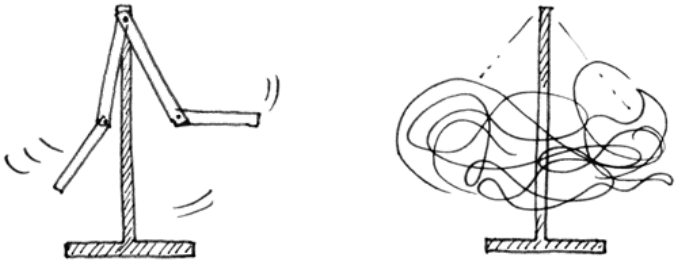

Figure 5: A double pendulum (left) and the trace of its chaotic movement.

Tension

Elastic structures can contain physical tension in their bodies through deformation. "Whether we are dealing with a bent steel blade, a sheet of rubber, a funhouse mirror, an expanding bubble, or the rising emotion of a heated argument, there is always a forceful deviation from a state of lower tension in the direction of tension increase."[58] We understand the elasticity of the material through touching, holding, bending, twisting and so forth. However, it is also possible to estimate the amount and nature of tension by simply watching the behavior of the material that results from either external force or its own weight. The more familiar the material is to the observer, the easier this estimation becomes.

One could project the sensation of muscular tension—one of the major sources of kinesthetic sense—onto an observed elastic, transformative movement (Figure 6). Muscular tension and release are present in a great diversity of our daily movement, such as respiration, locomotion (walking or running) and the manipulation of tools (gripping a pen, rotating a door knob or flipping food in a frying pan). All sensations of this kind create the repertoire of our kinesthetic sense of *tension*.

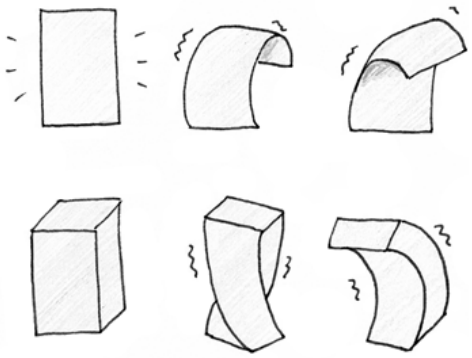

Figure 6: Transformation of 3D objects. Different forms have different ways of accumulating and releasing physical tension.

Bending Sculpture[59] (Figure 7) is one of the artifacts that allow us to perceive the *tension* element. If one taps softly on the sphere, the fiber continues to bend up and down for a while because of the balance between the weight of the ball and the elasticity of the rod. Given the flexibility of the motion, our kinesthetic sense closest to this increase and decrease in the fiber's tension could be the muscular tension along the backbone, for example the tension on the back

58 Arnheim (1956): 428

59 Video available: https://www.youtube.com/watch?v=G33W2rn1hlI

in bending the upper body forwards. The slightly anthropomorphic shape of the sculpture might affect the kinesthetic empathy response.

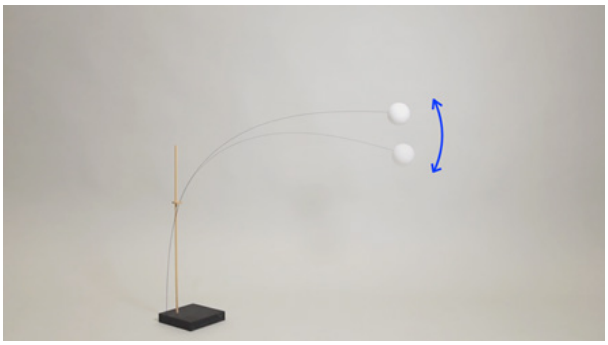

Figure 7: *Bending Sculpture*, made of carbon fiber, a foam sphere and a wooden base. The blue arrow indicates the movement.

Haptic

While the previous three elements are mostly about internal stimuli, this element, haptic, concerns physical contact between surfaces. By seeing and hearing the touch between objects (e.g. a glass falling onto the floor or a door slammed shut), we can tacitly imagine the sense of materiality, dynamics and shapes of the colliding surfaces. Figure 8 depicts a simple visual experiment in which collisions of various abstract shapes and surfaces can allow us to simulate diverse types of *haptic* empathy. In the case of the *Balance Machine*, one may perceive the *haptic* element in observing the collisions between the bottom of the sculpture and the floor and between the hammer and the wooden structure.

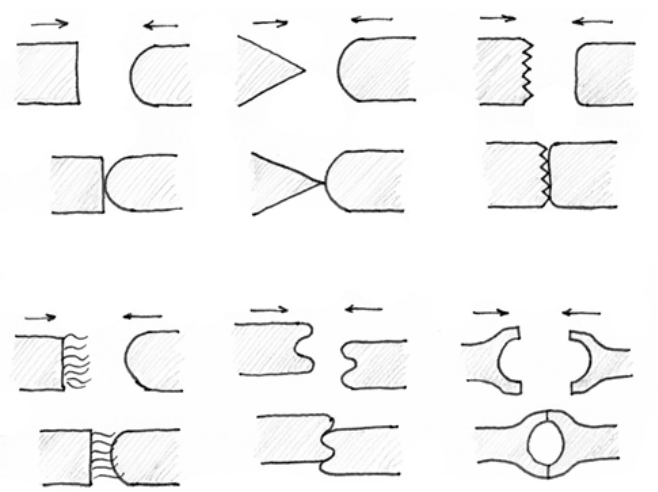

Figure 8: Simple visual experiment of the *haptic* element. Imagining two surfaces colliding can allow us to simulate various haptic sensations.

A number of studies have revealed that a human observer can easily simulate the haptic sensation an observed person is experiencing. For example, "watching the movie scene in which a tarantula crawls on James Bond's chest can make us literally shiver—as if the spider crawled on our own chest."[60] Caravaggio's *Incredulity of Saint Thomas* (1601) can allow viewers to feel as

60 Keysers et al., (2004): 335.

if their skin is penetrated.[61]

In addition, the study by Keysers et al.[62] provides scientific evidence that we also experience a vicarious haptic sense when observing non-anthropomorphic objects. The parts of the brain responsible for sensing bodily sensations such as pressure, pain, or warmth, are activated as if our bodies were subjected to tactile stimulation, not only when we are touched, but also when we observe two non-living objects touching each other are shown (rolls of paper towels and binders being touched by a stick were used as examples). The extent to which similar neurological reactions could be triggered by other objects and contexts remains open. Nevertheless, at the very least, it supports the views such as Vischer's *Einfühlung* and Polanyi's tacit knowing.

6. Reflection

The four elements explained a wide range of kinesthetic empathy with object movements, but how did they emerge at all? It is difficult to explain the exact process of the conception, as it was intuitive rather than logical. In fact, it is one of the greatest leaps that occurred in this research; however, I could post-rationalize the process as follows.

In my PhD research, the observation of movements was no longer an intentional act conducted as "research" but embedded in my everyday life. Especially since encountering the work by Reynolds and Reason,[63] I searched for a pattern in the kinesthetic empathy with object movements. At the same time, this exploration itself has presumably made myself more perceptive to the kinesthetic aspects of motions. I accumulated the tacit understanding of kinesthetic movements through kinesthetic representations but could not yet externalize it in a manner that makes sense to myself or others. Finally, the idea of "five senses" inspired me to identify a pattern, which turned out to be the four kinesthetic elements. It is clear that my thinking was based on literature regarding perception,[64] embodied cognition[65] and anatomy.[66]

According to my observation, it is fairly common for multiple elements to be perceived when observing one movement; this finding is also supported by the result of my ongoing workshops. The idea of kinesthetic elements becomes an important key to understanding kinesthetic empathy beyond somatic dissimilarities. The elements are, as it were, fragments of our embodied memories, whether real or imagined, that could spark when we find similar features in observed physical phenomena, just as mirror neurons work.

The problem of the four elements concerns the dynamics of movements. The *balance* element derives from the change of attitude of an object, while the *articulation* and *tension* elements derive from the transformation of an object; the *haptic* element derives from contact of multiple surfaces. None of these elements were meant to specifically articulate the kinesthetic empathy that results from observing a change in speed/direction of objects that neither change their attitude, transform, nor touch other objects. For example, looking at an object that is moving in a certain direction at a constant speed and then suddenly decelerates and stops (e.g. a door's movement[67] in Figure 9), observers may similarly feel the sense of a sudden stop or even physical

61 Freedberg & Gallese (2007): 201.

62 Keysers et al. (2004).

63 Reynolds and Reason (2012).

64 E.g. Bartley (1958) and Gibson (1979).

65 E.g. Blakeslee & Blakeslee (2007)

66 Saladin (1998)

67 A sliding door suddenly decelerates. https://www.youtube.com/watch?v=TIZXYiYQhkI

effort to cushion the sudden inertia. This could be likened to the sensation experienced when one is cycling and suddenly brakes.

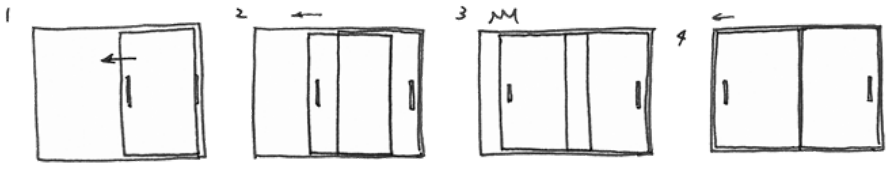

Figure 9: A sliding door.

The limitation of the four elements became clearer as I continued my observation and applied the elements to various object motions. This has led me to the next phase, considering the possibility of new kinesthetic elements for dynamics. This does not necessarily require new objects to observe; those I used for prior observations can be observed through a new perspective, which would lead to finding more clues about the aspect of dynamics. In terms of the benefit of such a generative way of articulating kinesthetic elements, the bottom-up approach allows the framework to be grounded in the phenomenon in question rather than borrowing a framework developed in another context (e.g., Laban Movement Analysis). Also, it perhaps reflects my own sensitivity to the kinesthetic dimension of physical phenomena. This indicates that the sensitivity is what designers can "learn" to acquire and potentially use for designing movements—the educational potential of the framework.

7. Conclusion

In this paper, I proposed a new space for exploration where kinesthetic empathy meets kinetic design. I also illustrated my first, yet substantial, step through my observations. As the literature review suggests, movement has received an increasing amount of attention in the areas of design as well as robotics and Human-Computer Interaction. However, its embodied and empathic potential is much less explored than the communicative and functional aspects. Kinesthetic empathy, despite its current connection to bodily performances, is a highly potential lens through which designers could start to rethink the aesthetic qualities of movements beyond utilitarianism. My exploration into the kinesthetic potential of object motions was initially difficult because of the structural gap between humans and objects. Nonetheless, by attending to the internal sensations rather than external appearance of movements, the seemingly disconnected two "bodies" began to be bridged, especially owing to the idea of kinesthetic elements. The elements identified are highly dependent on my own observation rather than objective, universal facts. Therefore, they function best when they are considered as a lens through which people can observe physical phenomena differently and build up their own observations. My ongoing PhD research has continued my observations and tested some of the elements to determine the impact they might have on designers' creative practices. These practices and kinesthetic elements grow concurrently; the change of one affects the other. The comprehensive overview of the new knowledge on this novel design approach, which I term "kinesthetic design", will be available in my upcoming doctoral thesis from the Royal College of Art.

Acknowledgement

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Action, Body, Technology: A study of cave, "The Man Who" and hands

Monica Yadav

Abstract: *The study of technology opens up a possibility of reformulation of the concepts and practices of the triad body, brain, and environment. Technology, as a surface, produces in reflection an encounter of the triadic relation of body-brain-environment with itself. Through a conjunct study of three disciplines - philosophy (through the Plato's allegory of cave), theatre (through Peter Brook's* The Man Who*) and science (through neurological case studies), I seek to propose that the triad is in both a material and virtual relation, where material and virtual are "allelic" pairs.*

Keywords: *body, technology, environment, brain, the virtual.*

Introduction

Technology often engages in the production of a newer perception and experience. Actions and possibilities of actions through technological enhancement and prosthesis open up new modes of behavior. The act of attaching the body to technology gives an invitation to look at the *material* and the *virtual* by/in the body. Technology in my paper is a surface; a bounded one of reflections in a close relation, unconcealed and arranged for interaction. It is a surface where the triadic ecology of body-brain-environment encounters its own relationship. The triadic relation in other words is brought closer to itself. This migration closer to itself mediated by technology is a new way of structuring the relationship and its material ecology. Here, technology is not merely a medium to execute a task but is also a creator and animator which attends and is orientated towards varieties of triad formations that cannot be presumed beforehand.

The triadic relation of body-brain-environment implies that each is haunted by the other; sometimes evading, sometimes capturing. To elaborate, an individual does not merely live in its environment, controlling or mastering it, but also as an entity that gets excited and stimulated by it. The excitations and stimulations cannot be consciously intended or controlled or manipulated. The excitations and stimulations also reach the brain which acts as a mediator between organs and transfers it to the tissues and the other contact surfaces. By mediator, I imply that it acts both as an adjunct and as an intervener between two body parts. The body organs or parts receive excitation from both directly outside and through the mediation of the brain. Perception and experience hence, are not entirely determined by and in the neural networks of the brain but also by the sensory stimuli received from the environment. Visual or auditory hallucinations are an example of experiences produced directly by the brain. The brain generates images and sounds

that the eye sees, and the ear hears, while acting with/in the environment. These hallucinations, in turn, affect the way a body behaves in its environment. Direct stimulation of the body happens during a situation such as sudden event in the environment like a natural catastrophe, a war trauma like of torture, rape, and economic trauma such as sudden unemployment or homelessness. The suddenness is felt as trauma which cannot be immediately, directly and easily deciphered by the brain. On the other hand, the body acts out in the world, a doing which acts upon the body and the brain too. Environment, body, and brain thus respond to each other and work in relationship with each other.

As I use the term *body*, I have full cognizance of the body-mind bifurcation that exists in the discourse of philosophy and that is aroused by the usage of the concept. I do not discuss mind in my paper. My interest in the paper is to address the dichotomies of body-brain, body-environment and brain-environment and discuss the triad ecology of body-brain-environment that emerges, flourishes, interacts with and through the reflection of itself as created by technology. Technology, here, is an active surface that builds a possibility of capturing, recording, reflecting and revealing the brain of the triadic relationship and putting what it captures into the triadic ecology. Technology thus is not a passive reflector. Each technology is a surface that is unique and particular in terms of how its reflection organises the triad. It is unique, that is its mystery. By the sheer nature of its uniqueness, the effects, or results of reflections created and superimposed by technology, cannot be pre-determined.

To find another kind of knowing pertaining to the triadic relation, technology by bridging the split between the *material* and the *virtual* brings an attitude of freshness towards the relationship. From bringing an instantaneous familiarity in the triad of its relation through the reflection from technology's surface, the relationship passes onto a new life. Technology here is not an interface. Interface, according to the Oxford English Dictionary, means a point where two systems, subjects, organisations meet and interact. An interface connects two different systems; two different spaces. What will be an interface when a connection within one system and with itself is elaborated upon? The technology expands the relationship from within which opens a reality revealed only when the interaction of the body, brain and environment encounters a surface that blocks their movement and offers itself in the formation of the triadic relationship. The swamps of surface produce a jarring encounter of the triadic components otherwise concealed in inactivity with each other. To explore in more depth a deeper understanding of such a surface that explicates the virtual and the material nature of the triad of brain-body-environment, I would study Plato's cave parable followed by an analysis of Peter Brook's *The Man Who* and an examination of a few case studies from neurology.

1. In the Shadow of Plato's Cave

In the cave allegory,[1] the prisoner's world of knowledge and light lies outside the cave. The cave is a prison of appearances, understood to be a copy of those which exist outside. Instead of going by this understanding, I would like to speculatively analyse the aesthetics of the spectacle created in Plato's cave. The cave is a cave of appearances densely populated with prisoners and shadows and yet in another sense is devoid of the density and of the concreteness of Plato's ideas and knowledge. The emptiness of the cave's dark space is filled with the activity of this world. The prisoners are continuously in motion producing and watching the images projected onto the wall. In this regard, the spectacle of the cave is a sequence of images being projected onto

1 Plato, *The Republic*, Book VII, trans. Benjamin Jowett, available online at http://classics.mit.edu/Plato/republic.8.vii.html

a surface watched by an audience who is itself projected as a spectacle. The sensations that the spectator receives directly stimulates the brain. There are maps of the body in the brain, so stimulation in a certain region of the brain excites the corresponding body part. The excitation of the body part and the stimulation of the brain is mapped on the wall. The mapping on the wall further stimulates the neural connections of the spectator.

The wall picks up the movements and the "inner" experiences of the prisoner such as the decision to move. The manipulation of the environment through such movements of the body determines the prisoner's perception of itself. The body, its actions, its "inner" experiences are (on) the wall/ stage. This wall of activity is grasping and immersive involving the prisoner completely. The observation of the spectacle is an integral feature of the cave parable and brings us in an analogy with science which is guided by human observation. Light exposes that which is in the cave. It brings the cave to light, rendering it visible and hence knowable. The appearance in the cave is hence not to be treated as a temporary referent to the reality but as that which creates a perception of the object/ideas. It creates a visual field for the idea of an object to appear. The field transforms sensory objects (of bodies) into virtual objects (of shadows and their movement), and by linking the two formulates them for a new and different avatar. The new avatar is the audience immersed in the spectacle, creating that which it watches and engages with. This new avatar is both sensorial (bodily experiencing and creating the spectacle) and virtual (itself the spectacle which is an allele to that who watches it).

Virtual in common parlance is understood as something that does not quite exist. The word gained this meaning with the development of computer technology in the 1960s. It was used for something that is "made to appear to exist physically" in reference to virtual memory and virtual machine. "Virtual memory is essentially a matter of extending and enhancing the physically real, by "fooling the machine" into believing its memory is greater than it is, something particularly useful in the early days of computers when physical memory was expensive and, by today's standards (megabytes and gigabytes), very small (measured in kilobytes, or 0.001 of a megabyte)."[2] This understanding of the virtual was later expanded in the 1990s to virtual reality which is an environment that allowed experiences and interactions without it existing materially. The effects created thus, were real. It is in accordance with this meaning that I use the word virtual. Virtual is that which does not have a material existence yet produces an effect in the material. It may not exist in material nonetheless is mediated through material therefore is also in association with the material.

In Plato's cave, the virtual exists as a default allele to the bodily or the material because of its intimate interaction with body, brain and environment (the cave). It is an allele in the sense of inheritance with the material like the gene variation. The *virtual* in the material is the transcendent living contingent. The virtual imitates the material, and the material imitates the virtual. They are indissociable. Together, they create a movement that is invisible and transforming, like the prisoner freed that leaves the cave and comes back. The prisoner in Plato's cave is indissociable from her existence in the cave or rather from the cave (or the environment). The cave is also a space that cannot be escaped from or rather is not meant to be escaped from. It creates and produces sensations to which the prisoner, once free, keeps coming back to (and responds to). The visible elements of the cave i.e. the shadows and appearances are ghosted by the physical bodies of the prisoners, their behavior, their movements and their neural firings. The prisoner that goes out of the cave and enters Plato's world of ideas does so by exceeding its

2 Steven Pinker, editor's introduction to *Digital and Other Virtualities: Renegotiating the Image*, ed. Antony Bryant, Griselda Pollock (London: I. B. Tauris, 2010), p. 11.

"prisoned" self. The prisoner had followed the light of this world to exit the cave, and she returns to the cave with a voice of itself. The prisoner returns to the cave to share that which the self has learnt outside. In the coming back of the prisoner, there is a confluence of knowledge (light) and the immersive, spectacular world of/in the dark cave.

The luminosity of the world outside is a witness to the immersive environment of the cave. A cave that is eternal that supports life as a mother does in her womb. The cave offers anonymity to its dwellers who are untouched by the world outside. The darkness of the cave is creative with its dwellers in continuous interaction with their virtual allele as a spectator. The walls are like mirrors but are not mirrors. Mirrors that project outward (into the cave) that which falls upon them. The light and the cave mediates the formation of shadows and images (of the prisoners) on the walls and their projection back into the sensory field of the prisoners. Without the cave (so as without the light and the prisoners), the glistening allele of the virtual often engaging in a production of a newer perception and experience the material could not have emerged. Hence, the same cave, which seemed to be the prison for individuals, is the space of freedom - where freedom is realised, experienced and shared. Freedom to go out, to explore, and to break the shackles of prison. Freedom to perform to oneself, to watch and enjoy a spectacle, to create a spectacle collectively. In the 'not so visible' cave, the only order is that of prisoner's breathing. I let this breath guide us to a further exploration of the surface, which in the cave parable is the cave wall, and in Peter Brook's play is the recording technology, to establish an understanding of the triadic relationship that is neither purely material nor purely virtual.

2. On the Stage of *The Man Who*

I now enter into the domain of theatre to further investigate into the intimate allelic nature of *material* and *virtual* and understand it through the interactions between virtual-material triadic ecology of brain-body-environment and technology. I would study Peter Brook's *The Man Who* (*L'Homme qui*, 1993),[3] written in collaboration by Peter Brook and Marie-Helene Estienne, and is based on Oliver Sacks' book *The Man Who Mistook his Wife for a Hat*. It opens a new unknown landscape of human and brain in a lucid and sympathetic manner.[4] It is a play with four actors (David Bennent, Yoshi Oida, Sotigui Kouyate, and Maurice Benichou, the latter replaced by Bruce Myers in the New York production), a musician (Mahmoud Tabrizi-Zadeh), a video camera, two television monitors, and minimal props (like chairs) on a raised square wooden platform stage. I have referred to both reviews and articles about this play and Brooks' interviews as well as a production of the play by the Duke University Theatre Studies department directed by Kari Barclay.[5]

The play displays exchanges between a doctor and a patient where each actor becomes either character interchangeably. Simple exchanges of questioning by the doctor and the patient's reply to them demonstrate a mode of perception and behavior that is very different. Some fail to recognise a side of their body as their own; some have devastatingly weak memory; some are

3 It is one of the first play of the trilogy of Peter Brook on cases of neurological disorders. The second was *I am a Phenomenon* (*Je suis un phénomène*) (1998) and the third was *Valley of Astonishment* (2014). All three productions are under two hours each.

4 Peter Brook found in neurology a basis for his theatre when Oliver Sacks took Brook around in neurological wards in New York. Peter Brook and the company did field research by visiting many mental hospitals of Paris and London, meeting various inmates and saw several videos. They found cases equivalent to the ones Sacks discusses in his book. For the first couple of months they studied cases and extracted the relevant material. The script was written after many years of research and experimentation and consultations with physicians and neurologists, including Oliver Sacks himself.

5 Peter Brook, *The Man Who*, directed Kari Barclay (1993; Durham: Duke University Theatre Studies department, 2014), Video. The production was designed by Austin Powers. The actors were Samuel Kebede, Faye Goodwin, Nick Prey, and Cynthia Wang.

prone to painful, violent tics; some cannot recognise things visually. Two patients are shown an image of rolling waves on the television monitor.[6] When asked about it, one said that the image is that of horizontal lines and the other says that it is a spot of color. When the sound of the waves is added to the film both remarked that it looked like the sea. These patients suffered from visual agnosia where they had no identification and recognition of objects by sight.[7]

The use of a camera and its interaction with the patients becomes the turning point of the play. The camera records the exchanges between the doctor and the patient. The doctor shows the recordings to the patients. In this encounter with themselves in the recording, the patients are taken aback. The technology to record and replay becomes an important tool to present onstage the disorienting sensory encounters of the individuals. The dissociation of each gesture from its meaning comes out starkly. For one of the patients, the doctor records his recitation of a passage from Thomas Gray's *Elegy* and then made him listen to the recording. On hearing nothing but jargon, he starts to cry. For another, the doctor uses a mirror to show to the man to his astonishment that he has only shaved one side of his face. To another elderly patient, the doctor asks, "How old are you?" The patient replies, "I'm 23." The doctor gives him a mirror to look at himself. He asks horrified and astonished, "What's happened to me, doctor?" The play then ends "with vivid close-ups of the cerebral cortex projected on screens. Three doctors watch in silence. A patient sits apart, eyes closed, lost in his own inner space. Each in his own way contemplates the infinite mysteries of the brain, that "valley of astonishment," as Brook calls it, which they can never fully fathom."[8]

The play demonstrates the brains of people, who suffer from neurological disorders, through their association with their body and language. Through their actions and utterances, the play depicts the inner landscape of the patients to which their everyday behaviors belonge. Through their encounter with mirror, sound recorder, and video recorder, the patients are horrifyingly brought closer in familiarity to their living life. The echoing of their behavior by the recording technology serves as the origins of their living behavior. The encounter of the patients with the recording technology is an encounter with their own brain. The image of their behavior and activities, that the recording technology reflects back, is discordant with the image of their acting-hood that they thought to have realised. The doctors use technology with the intention to introduce the patients to the reflection of their own actions and behaviors when recorded and replayed. The technology powerfully creates the brains of the patients through their actions and behaviors and proposes to the patients a connection to themselves through this encounter via technology. The process of differentiation that technology seemingly creates between the material or the bodily behavior and the virtual or the diagnosis of the brain is also the same process that redeems material and virtual from an oppositional dichotomy and establishes them as necessary correlatives or allelic pairs. The use of recording technology and the projection of that which is recorded makes the stage (like the walls of Plato's cave makes the cave) a platform that displays the intimate, living, intricate relationship between bodily and virtual. A relationship that is continuous, imitative and mutative, revealing a new kaleidoscopic pattern each time. The sparkling patterns are nothing but virtual webs on which materiality descends upon taking a form.

6 Peter Brook, "A journey into the brain," Peter Brook Official Website, May 6, 2014, accessed May 2018, http://www.newspeterbrook.com/2014/05/06/un-voyage-dans-le-cerveau/.

7 Gautam Dasgupta, "Peter Brook: The Man Who...," *Performing Arts Journal* 18, no. 1 (1996): 81-88, accessed April 20, 2018, https://muse.jhu.edu/article/25573.

8 Philippa Wehle, "The Man Who Mistook His Wife for a Hat," *American Theatre* 12, no. 4 (1995): 20.

The piecewise indifferent narrative of history-less behavior, brought to the stage by the actors, leaves the spectators taken aback by the pathos, pain, strangeness and courage of these individuals. The actors played the characters without evoking any particular social, cultural or economic background. The actors demonstrate modes of behavior that have a uniquely different relationship with the body and hence with the environment. "It was as if the actors were not acting, but simply existing onstage. As such, this kind of performance was a rare example of acting in the here and now. The quietness of the actors, the economy of their movements, the authenticity of gesture, and the serenity of the playing suggested a meditation on the fragility and vulnerability of all human beings—all damaged souls."[9] Yoshi Oida, one of the actors of *The Man Who*, writes in his book, *The Invisible Actor*,[10] that the only way he was able to play a character with a neurological disorder was by a very careful and detailed development of each action. Earlier he could not even relate to the character and found it illogical to portray. But as he developed each action, as he focused at the smallest details, at the tempo, he felt the damaged individual emerge. He writes that he was terrified at realising the possibility that he could easily become the damaged without even knowing about it.

As evident from Oida's account, it is through the body (of the actors), the brain (of a patient with neurological disorders) becomes formed as the actor, when it becomes active through the behavior (action) of the character. In other words, through the detailed display of body movement and behavior, a diagnosis of a brain or neural connections is put on display. Brain here is not merely an organ with electrochemical workings. It is a mode of behavior that the play presents through minimal theatricality by bringing to stage the materiality of a human being with neurological disorders, to reveal the hidden folds of the brain. By emptying the gestures of their theatricality, and by making them as simple and minimal as possible, the actors try to play a "pure brain". Hence, the formation of the brain is contextual and emergent. In this emergence, theatre becomes an instrument to represent the damaged in/through the activity and the interactions of the body; and it is only through a disorder of some type that the deep valleys of the brain are revealed invoking incomprehension and astonishment.

If the technology is to expand/contract the limits of mobility or of perception of the body, it can also reflect the limits of the body back to the person who has been recorded. In the context of such a projection, there seems to lie no difference between the recording technology that showcases to the patients their behavior (and also indicating their brain mechanisms) and the walls of Plato's cave that reflect back their actions and neural workings. By such a logic, the cave wall is as much a technology as a camera or a sound recorder. The solidity of the wall has a mechanism of opacity through which it reflects back, while a camera and a sound recorder have a mechanism of recording by which they reflect back that which it "watches." The brain-body-environment triadic ecology is mapped onto these technologies. Technologies hence, are surfaces that can capture, record, reflect that which it touches or touches it. What the technology reflects is the virtual brain-body-environment ecology to the material brain-body-environment triadic ecology. This encounter of the material and the virtual is allelic in nature. To elucidate it, I have here separated the material from virtual, but in reality, the two are indissociable, so much so that it is difficult to tell what is purely material and what is purely virtual. As technology becomes the surface to reflect the triadic relationship through behavior and activities, it becomes pertinent to analyse action or activity in order to understand its role in the emergence of this ecology. Hence, to gain an understanding of the body-brain-environment relationship demands

9 Margaret Croyden, *Conversations with Peter Brook, 1970–2000* (New York: Theatre Communications Group, 2009), 273.

10 Yoshi Oida and Lorna Marshall, *The Invisible Actor* (New York: Routledge, 1997).

articulations of both behavior and activities, including reflections of behavior and activities via technology onto the triadic relationship.

3. At the Hands of Action

In Plato's cave, the origin of knowledge is in a deed; sudden act, a sudden turn that a prisoner makes. Although for Plato, what destroys ignorance or appearance is the true knowledge of ideas and not the turning of the head from appearances to ideas; the knowledge is produced by its own accord, and the turning of the head is an accidental factor. I instead propose that it is this accidental factor of action in the non-existence of true knowledge that stimulates a pursuit of true knowledge. An action thus becomes the beginning point. An action of a material body and on a material body. The prolonged duration of this action (or movement) or in its repetition (behavior) develops forth a virtual-body allele within the backdrop of a surface as seen earlier through the examples of Plato's cave and Brook's *The Man Who*. A material action is needed for creating a virtual bodily existence. It is in action that there is a collusion between existence and the environment. In that instance, a new form of existence is composed in the world. The form is material and finely distilled with virtual characteristics. The force of this existence is connected to the environment that overflows with the contingent, unforeseen, multisensory provocation. A form is born out of action and is sustained by the environment.

An accidental action or rather an impulse, makes a person do what it had never done, or it thought it could never do. In one of his case studies, Oliver Sacks discusses a case of sixty-year-old J. Madeleine[11] who had never used her hands in her life. She was congenitally blind with cerebral palsy and was taken care of by her family. She found her hands to be completely useless and felt as if she had no hands. Her hands could not recognise any object neither did they care to explore. In Sacks' words, there was no interrogation in her hands. They were inert and inactive. She had to be coaxed into action, but to no avail. Her first hand movement occurred whilst hungry; impatiently she suddenly reached out her arm, groping for a morsel, and fed herself. Sacks calls it the first impulse that induced movements in her hands and gave birth to perception in her hands. Her hands were perfectly fine with no sensory deficit. The question arises as to what was it that rendered them functionless to the point of their non-existence? This is because she was "taken care" of and that she never learned the use of her hands as infants do. Yet she could acquire active use of her hands in her sixtieth year despite never having used them before. She could now easily identify with her hand. Until then, no meaning, no thinking, no talking or no intelligence could change the (virtual) association[12] that she had with her (bodily) hands, as she previously identified herself as having no hands.

Virtual as non-material is not independent of material. The virtual of the body is malleable and mutable. It manifests in the mode of behavior. The virtual can get altered by the use of the material (body or specifically hands in the case discussed earlier) whereas the use, an action or a movement of the body, can create a new virtual (association), and hence a new body. The change in virtual determines the change in material, the hand not a hand becomes a hand. In Madeleine's case, despite the existence of hands, she had no hands in her conduct in/with the world hence

11 Oliver Sacks, *The Man who mistook his wife for a hat: And Other clinical tales* (New York: Simon & Schuster, 1998), 59-66.

12 Here I attempt to argue is that even though Madeleine has physical hands, her relation to her hands is not determined by the materiality of the hands but something like a virtual association that arises with the material or physical hand only in its use. Use, movement, action, behavior in that sense is a bridge between the virtual and the body or rather the material (for the body has been understood to be as a material entity only). What I hence argue is that it has an allelic pair in virtual, that is, the body is also a virtual entity. The virtual and the material linked through action. It is the virtual of the body through the material of the body that creates different modes of behavior.

denoting she acknowledged her body without hands or rather she was a body without hands. Her association changed due to the use of her hands. The use made her associate with her hands as being her own hands, with her body now endowed with completely functional hands. This indicates that an individual although mediated by the physical body is not limited within and by the material of the body but is determined by the virtual of the body. Madeleine could extend to include an object, a tool, a machine or in her case her own limb or contract to exclude the given body parts from the virtual of the body and hence the body. If, for example, a person were to use a machine to enhance its mobility such as an electric wheelchair, the wheelchair could be understood as analogous to a (prosthetic) limb. This technology that enhances mobility for a human is where the virtual association with the wheelchair as the limb or body is established. The technology here is a creative surface for the formation of virtual association and the form of a body to emerge. Behind the virtual (association) reoriented by an action lurks the creative power of the technological surface; the sheer force of formation. Technology gives rise to new form of assimilation of the virtual with the material and recognises their allelic pairing.

Doings pus in perpetual movement the triadic relationship of body-brain-environment. Another example that shows this rapidly changing relationship is the rubber hand illusion which was discovered by psychologists in Pennsylvania at the end of the last century. This illusion can be experienced by keeping an inflated rubber glove on a table in one's field of vision and hiding the real hand away behind cardboard. The "fake" hand and the concealed "real" hand are both stroked and tapped using identical movements. The strokes and taps should be the same and synchronous on both hands which are placed in the same position. With the continuous looking and stroking of the "fake" hand for some time, the person begins to associate and recognise the "fake" hand as the "real" hand, whilst losing any sense of attachment or association with the actual "real" hand.[13] As the hand is no more a part of the body, it no more can be used as before. Such illusions have been seen in cases of stroke patients when they do not associate with their paralysed limb as their own and sometimes instead develop an association with someone else's limbs as belonging to themselves. Under this illusion, the brain is no longer geared to use the real limb with which it has lost connection and association.

Another group of scientists conducted an experiment with a fake hand but blindfolded participants to see if vision played an important role or not. The scientist moved the participant's left index finger to touch the "fake" hand and simultaneously touched the participant's "real" right hand in exactly the same fashion. According to their findings, within 9.7 seconds of the illusion, it was demonstrated that by touching the "fake" hand the participant felt it was touching their own hand.[14] This experiment shows that the rubber-hand illusion is not produced by vision. It depends on the synchronous tactile and simple proprioceptive[15] signals from two body parts.[16] This is sufficient enough for the body to recognise the fake rubber hand as its own and derecognise its real hand. Multisensory signals play a crucial role in the reformulation of the body.

13 "Body illusions: Rubber hand illusion," *New Scientist*, last modified March 18, 2009, https://www.newscientist.com/article/dn16809-body-illusions-rubber-hand-illusion/.

14 H. Henrik Ehrsson, Nicholas P. Holmes and Richard E. Passingham, "Touching a Rubber Hand: Feeling of Body Ownership Is Associated with Activity in Multisensory Brain Areas," *The Journal of Neuroscience* 25, no. 45 (2005): 10566.

15 Proprioception comes from Latin word *proprius* which means "one's own" perception. It is also referred to as the third sense (where the other two are- six exteroceptive (by which the outside world is perceived) senses are sight, taste, smell, touch, hearing and balance and interoceptive senses (by which the pain and the stretching of internal organs is perceived)) that tells of the relative position of body segments in relation to other. Proprioception can get impaired when one is tired or during epilepsy or injury in one of the joints.

16 Ibid., p. 10569.

The rubber hand illusion depicts the significance of sensory perception that is the stimuli received from the milieu and its capacity to bodily transform a virtual relationship. Virtual ensures multiple differentiation due to its malleable and manipulative nature. The participant begins to identify with the fake hand as its own. The multi-sensory signals, received through the body from the environment, redirects the brain to associate and recognize a new body as its own. This experiment shows that the limits of the body in relation to the brain are not limited to the physical body given since birth. The body can be fake hands; it can be a prosthetic leg; it can be antennas attached to the head; it can be the body in a video game. Practice is the starting point that generates characteristics of both material and virtual, reorganised through sensory perception onto the backdrop of a surface,[17] to create a form of the triadic relationship. The acting body immersed in a milieu of sensory stimulation mediating the movements and stimulations to the brain through technology is a body in conjunction with brain and environment.

Conclusion

The body-brain becomes the embodied means of practice in a complex relationship with the environment. Within this context, Brooks' play offers a significant platform to understand the triadic relationship and to further contemplate on the body-virtual allele of the prisoner in the cave, by bringing to picture an explosive interjection with technology. Exploring more deeply into the triad, technology is a necessity which brings a sheer effectiveness in explicating the triadic relationship that is united through the contraries of the material and the virtual. Theatre, by creating onstage very specific and particular theatrical images of individual behavior, brings to light the basic universal materiality of human behavior, becomes a laboratory space that through pure demonstrative gestures gives the audience a peek into the body and its intricate relationship with the brain facilitated by technology.

Theatre, in conjunction with the neurological research and psychiatric case studies on action, establishes the virtual to be a cause of multiplicity of existence and causes existence in the reflexivity of the body-brain-environment relationship through technology. The virtual causes the material to be immersed in the milieu that coils around and percolates through in a manner that both are non-differentiated. If the material is visible in form, virtual is a characteristic indicated through form. The material always carries the virtual within itself. What the virtual of the material indicates is the physiological forms of the material. The virtual is then the projection of many uses and functions; and hence many ways of life that can be explored, lived and codified. It is a speculation of the existence of a relationship of body-brain-environment which is dynamic and transformative.

The virtual-material allelic relation places the triad at the juncture of the clinic (biology), theatre (culture) and parable (philosophy). The triadic relationship is a virtual relationship whose continuous wiring is embedded in acting and plays out in reflection though technology. It seems thus that technology has an indispensable importance in shaping the virtual, expanding the material and defining the allelic nature of the material-virtual pair. Any action or any habitual movement can reassert or strengthen the relationship. Each action and each movement free from everydayness is also sufficient to break through the old virtual linkages to establish new ones. With action in forefront breaking and orienting virtual linkages, technology in the background destroys all that is human in order to witness a new formation of humanity in/through a triadic

17 This surface is like dirt particles on which water droplets condenses to form snow crystals. The dirt particle is without which no condensation surface will be available for the development of crystals.

ecology of body-brain-environment. This formation, as abstract as it may be, is through pure movement ready to realise form as best as it can. In the constraint of each form lies a possibility of courage to exercise freedom to form again. The devotion of the triad to what it encounters makes it what it is, thoroughly a servant of movement. The question then arises with which I conclude whether the triad relation exercises a sense of discrimination in its association to what crosses its path?

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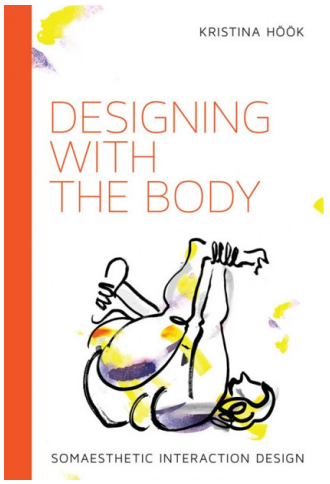
Designing with the Body

Interview with Kristina Höök on Somaesthetics and Design

Dag Svanæs

Abstract: *In this dialogue with Dag Svanæs, Kristina Höök discusses topics covered in her book "Designing with the body: Somaesthetic Interaction Design". She explains how she has made somaesthetics relevant to design, both as a theoretical foundation for embodied Interaction Design, and practically through the application of Feldenkrais and other soma practices to design practice.*

Keywords: *body, interaction design, soma, somaesthetics, design ethics.*



On a windy winter day in Florida, I sit down on the beach with Professor Kristina Höök from the Royal Institute of Technology (KTH) in Stockholm to discuss her latest book *Designing with the body: Somaesthetic Interaction Design.*[1]

Dag Svanæs (S): Congratulations with your new book.

Kristina Höök (H): Thanks.

S: The title of the book is "Designing with the body: Somaesthetic Interaction Design". For those of our readers who are not in the design field, what is Interaction Design?

1 Kristina Höök. *Designing with the Body: Somaesthetic Interaction Design*. MIT Press, 2018

H: Interaction Design is the discipline that designs digital interactions. We build web pages and mobile apps, but also physical interactive artefacts where the digital is an important part of the interaction.

S: What has been your motivation for writing the book?

H: I come from Computer Science and have moved towards Interaction Design, step by step. I came to somaesthetics because I was designing systems to be worn on the body, wearable interactions, and I was very unhappy with how those designs came about. The process and the end result felt very reductionist. In my research group at KTH, we were measuring data from the body and then portraying it back to the end user so that they could adjust and be healthy and happy. That was all well, but it felt like we were missing out on a huge part of what it means to have a body and to move and interact. Consequently, I was looking for a different theoretical foundation for our work. That is how I came to somaesthetics and to other theories of the body that we combined into what we now call soma design.

S: When did you first learn about the work of Professor Richard Shusterman?

H: I first read his work around 2011, and became very interested in finding ways to bring somaesthetics to my field of research. At the time, in 2012, I happened to be the technical chair of the international conference on Human-Computer Interaction, and invited Shusterman to give the keynote talk.

S: What theoretical foundations were already there in 2010, and what did somaesthetics bring to the table?

H: Interaction Design, to simplify, has been very much about looking at new technical materials, new use situations, and new ways for people to live with technology. When the interaction mainly took place through a screen, we could do with cognitive psychology and certain philosophical theories, but as soon as the interaction started moving into mobile devices and onto the body, we had to find other ways of designing. At that time, in 2010, we already had various theories around embodiment and what Dourish' had coined *embodied interaction*.[2] Inspired by phenomenology, embodied interaction start out with how we are in the world with our tools; that the tools extend us and our way of being, and that we should design from that perspective. That was already in my field and I could use when doing design. The problem was that a lot of that work had focused on the social side of embodied interaction. There was not much talk about the actual physical body in the theories around embodied interaction. There was no pulsating, living, interesting body in those theories, oddly enough. And to some extent, if you look at the philosophy of Merleau-Ponty,[3] he does speak about the body, but only in the abstract. He is not speaking about how my sitting bones feel now that I am sitting here in this chair, or any of those more down-to-earth physical bodily realities of how embodiment is enacted through our human morphology. This is what I was missing. So, I went shopping for theories that could extend on my understanding.

2 Paul Dourish. *Where the action is: the foundations of embodied interaction.* MIT press, 2004.

3 See: Dag Svanæs. "Interaction design for and with the lived body: Some implications of Merleau-Ponty's phenomenology." *ACM Transactions on Computer-Human Interaction* (TOCHI) 20.1:8. 2013.

S: Shopping?

H: What you need to know about Interaction Design and Human-Computer Interaction is that we do borrow from all sorts of fields. We are not scared of borrowing from the arts, from philosophy, from psychology, from sociology, from ethnography and so on.

S: With "borrow" you mean apply?

H: We read up on a theory, and then we try to make it actionable in our design processes so that we can design better interfaces and better interactions for the end users. Digital devices are currently everywhere in our everyday lives; in our kitchens, on the bus, in our cars, and in our pockets. Interaction is everywhere. That is why our field had to move on from caring only for the cognitive side of interaction. We had to care also for the social side of interaction, and for the fact that digital products are now close to our bodies. This is what makes somaesthetics so relevant.

S: What aspects of somaesthetics did you start out with?

H: When you are looking at a theory, you are looking for concepts that together form a worldview that you can turn into something actionable – helping you in the practical design process. We look for concepts that open a generative creative path to new interfaces. It leads to new ways of thinking about design that leads to new methods for doing design, that leads to new and hopefully better designs. What I found interesting in somaesthetics was that Shusterman dared to talk about and engage *ideals* in human action and human pleasures. Also pleasures that go beyond shallow pleasures, to the very ideals for what it means to live a good life with your body, with your emotion, with your sociality, with your whole self.

This said, somaesthetics did not answer all my questions. I also looked at neurology, evolutionary biology and a whole range of other academic endeavors. I found, in particular, another philosopher called Maxine Sheets-Johnstone[4] because I needed to come very close to the body. I was looking for answers to questions like "What does it mean to move a muscle?", "Where does meaning making arise in movement?", "Why are certain experiences aesthetically pleasing?". Maxine Sheets-Johnstone looks at this from an evolutionary biology point of view. She writes about the morphology of the human body and how we are in the world and with other people, with and through our bodies.

S: In the book, you write about how you made somaesthetics actionable in your design work, beyond providing a new theoretical perspective.

H: Both Maxine Sheets-Johnstone and Richard Shusterman build their work on movement practices, and both attribute their understandings and ways of reasoning to how those movement practices have shaped their understanding of the world. Sheets-Johnstone was a choreographer and a dancer and Shusterman is a Feldenkrais practitioner. If you look at how others have imported ideas into our field, into Interaction Design, they have done it through using these bodily practices as the place where they

4 Maxine Sheets-Johnstone. *The primacy of movement*. Vol. 82. John Benjamins Publishing, 2011

can start experiencing and innovating, where their creative ideas can arise. In this sense, it was not enough to read a book about somaesthetics. Somaesthetics is part of pragmatism and the whole point of pragmatism is to act in the world, not only talk about it or write about it.

S: Pragmatism.

H: Yes, the philosophy of John Dewey, William James and others. What I do now, based on my understanding of pragmatism, is not only to observe people moving, but move in order to create in and through movement, with my own emotion experience, as it is spurred by movement and through movement, with other people. And by movement I do not mean only that you move a limb, but complex processes. In fact, emotion is a form of movement. The word emotion originates from the French word *esmotion* – to set in motion, move the feelings. There are many different ways you can do this. One way is to slow the movement down in order to understand what is going on as you are moving or experiencing something. You can make something strange by doing a non-habitual movement to make the habitual movement clear to you and thereby design for both the habitual and the non-habitual. You can also simply attend to your senses, register every little detail, ward off other interests, and deepen your experience and understanding of what you feel.

But your own movement is but half of what we design with. The other half in a designer's world, is the materials we use to create artefacts. In interaction design you have to touch and feel and taste and interact with the digital materials. And that might sound really odd to readers of this journal.

S: Can you give an example?

H: Say you have an accelerometer that registers how you are moving, and you want to use that as part of a design project. Then you need to know what it can do and what it feels like when you get feedback from it. Or you can use certain algorithms to process the data from the accelerometer. Then you need to understand what it feels like when that algorithm is modelling you, or following you, or doing something for you. An interaction design process is one that unfolds between yourself, your movement using techniques like slowing down or making strange or engaging in some specific body practices like something Feldenkrais or something else, and the other half consisting of the digital (and physical) materials. We prepare our digital materials. We shape them and give them rudimentary form so that we can feel them. Then we use that in our creative processes and brainstorming. I call it "slow-storming" because it is not about the brain, but about the whole body because that is where the ideas arise.

This soma design process is not easy. You need to engage repeatedly over and over in order to craft and hone and feel how a particular interaction might unfold. It is not a one-off thing. It is a back-and-forth where the material changes with what I do. That is the point of interaction, that it is inter-acting with you, changing with you. It takes time. The shaping of a design is a slow process. It is a process of feeling, of touching, of interacting, of shaping. And then, step-by-step as you feel and interact and shape through your first-person experience, you bring out something that you can then invite others to touch and feel and interact with.

S: This gets a bit abstract now.

H: Yes, very abstract.

S: Could we forget about the digital for a while?

H: Yes.

S: Say that you want to design new kitchen utensils for IKEA. How is this done today, with a user-centered approach, and what would typically be a somaesthetic approach to this?

H: Most design today is done pretty rapidly, and often as variations of what already exists. Let us instead imagine that we are trying to design something entirely new, some that we have not seen before. What you have to do then is to bring out a multitude of ideas. You must start somewhere. There is some need perhaps, like stirring a hot liquid. You then bring out a lot of different solutions and let those solutions help you see what the problem is. It is a backwards process of sorts where the solutions define the problem. This is what we call *design thinking*.[5] Rather than defining the problem and then letting the solution come as a consequence of a defined problem, you start by bringing out many different design solutions, and then you define the problem through the solutions. This is the way design is done today. And then we bring in other users than ourselves because we need to have potential users in our design loop to make sure that we are catering for their needs. We bring in potential users to try out our ideas, our rudimentary prototyping ideas that might not be fully functioning yet. That is user-centered design,[6] where you bring in the users, sometimes even to the extent that to teach the users about the material that the products are built from.

S: Which is participatory design?[7]

H: Yes, where you educate your end-user about what the material affords and enable them to help you design, because they are the experts in their own practices. If you are designing kitchen utensils for chefs, you might invite chefs and teach them about all kinds of fancy new digitally-enabled materials that are available and then design together with these chefs over a long period of time.

S: But this sounds fantastic?

H: Yes, it is amazing and it gives you a lot of fantastic results. And I am not arguing against user-centered or participatory design. I think these can be combined in clever ways, but what somaesthetics provides you with beyond what we already get from user-centred design is a very deliberate engagement with your own experiences. Let us assume that our design challenge for the IKEA kitchen was to look for a novel fork design using a new kind of material that you had been working on. As we start shaping this entirely novel fork, every little tiny detail in your hand movements matters. How

5 Tim Brown. *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation*, New York: HarperBusiness, 2009.

6 *ISO 9241-210:2010 Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems,* 2010.

7 Jesper Simonsen and Toni Robertson. *Participatory Design: an introduction*. Routledge international handbook of participatory design. Routledge, 2012. 21-38.

exactly you are gripping this material. How does it feel in your hand? How do you touch the food with this novel fork? How do you move food with it? How is the heat transported or not transported through the fork, and so on? And to get to that level of detail you need to really attend to your senses and to all the different aspects of what this new fork material can give you.

S: So, "you" in this case is the designer?

H: Yes, the designer. You might do this whole careful soma design process as a participatory design process. You might have other people there who do the same thing. Together you have to slow down or disrupt or engage in a manner that allows you to deeply feel, articulate and imagine new experiences that come in the meeting between you and this new material of the fork.

S: You talk about slowing down.

H: Or disrupting.

S: Disrupting, yes. Husserl talks about epoché,[8] the phenomenological reduction, which is about making the familiar strange. Is this a process similar to epoché?

H: Yes. As an adult person you move in certain ways. You move in habitual ways. You walk in certain ways. You sit in certain ways, and you live in a world of artefacts that you recognize. There are chairs, there are tables. And in this kitchen you have these forks that we were talking about and they look a certain way. You have habits for how to eat with forks. To really liberate yourself from those deeply engrained practices you have to put yourself into a situation where you can experience something new.

S: You break the habit? And through that you also become aware of the background of the habit?

H: Yes. And then you might go back to designing for something that is extremely familiar, because now you know what it is. But if you don't break out of it you don't see it. You don't feel it. You don't know it. In the fork example, let us assume that there is a new steel-like material that we are going to use. It has properties that we don't know exactly what can give us. We have to touch it. We have to feel it. We have to bend it and work with it in order to extract all the possible affordances of the material. Dewey speaks about this as emptying the material of its potential. Making the different parts come together as a whole. I think this is a key part of soma design with interactive materials. Digital materials are quite new to us as designers. What does it mean to touch and feel and extract them and empty the material of all its aesthetic potential and affordances? That's where soma design can play a role.

S: The title of the book is "designing with the body". What is that in contrast to?

H: This is a bit difficult to talk about because I don't fully understand it. I think it is

8 See: Søren Overgaard. "How to do things with brackets: The epoché explained." *Continental philosophy review* 48.2 (2015): 179-195. and N. Depraz., F.J. Varela, and P. Vermersch. *On becoming aware: A pragmatics of experiencing*. Vol. 43. 2003: John Benjamins Publishing.

going to take the rest of my research career to think through these questions. When you design with your body, when you design with movement, motion, experience, with sensual aesthetic impressions, it is with a body that is ancient. From an evolutionary point of view our bodies are old, right?

S: Yes.

H: We very often cheat in our design process. We use language and that is a shortcut – a way of cheating. Bypassing movements and instead relying on read-made solutions communicated through our brilliant language skills can be very, very fast. But designing with the body, to really design something that sits well with the movement or with the body or with sensual pleasure or engagement, it helps you become more aware of your habits. It takes time. So, you are designing yourself and your own movement as much as you are designing a new product.

S: This has similarities to dance improvisation,[9] then?

H: Yes definitely. What I find interesting about dance, apart from the fact that they're improvising and they're doing new possibilities in the moment, is that this in turn changes them. It changes their bodies. It changes their nervous system reactions. It changes what they can do and what they can experience. They get a richer palette, a richer repertoire of possibilities through improvised movements or through movement in general. So, if you've never done my favorite activity horseback riding you haven't had that experience. If you've never had anybody close to you die, you haven't had the experience of grief. There are so many experiences that we haven't had and that we need to cultivate and understand and slowly design with. And once we have them, they change us. Through engaging in the way that we have done with soma design, not only have we created new systems that are innovative and interesting in that they have different shapes and forms and ways of interacting, we have also changed ourselves.

S: As designers or users?

H: Both. I changed myself, my own body, to be able to appreciate the finer details of the design processes that we do. But as the resulting designs are picked up by end-users and made to be part of their everyday lives, they will also change.

S: Developing new skills and sensitivities?

H: Yes, and bodily movements. And nervous system reactions. You know how plastic the whole nervous system is, especially of course the frontal lobe interactions. But even the other parts, the slower parts of our brain, the slower parts of our bodies, can be changed. If you look at me you can see I am a horseback rider.[10] You can see that I have muscles in certain places. When I sit on the horse, it looks a particular way because I have trained myself for years to get that kind of balance and get those muscles and get

9 See: Thecla Schiphorst. "Self-evidence: applying somatic connoisseurship to experience design." *CHI'11 extended abstracts on human factors in computing systems*. ACM, 2011.

10 See: Kristina Höök. "Transferring qualities from horseback riding to design." *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries.* ACM, 2010.

those nervous systems reactions that make me balanced on top of a horse. And it is the same thing here. The process of designing changes me as a designer and also changes the end user. And we know this already. You use your mobile phone and it trains your eyes at a particular distance. It is not necessarily good for you because you need to be able to look far away as well. And it changes your way of socializing and changes your way of moving around the dinner table when everybody is using those screens. Any technology, any tool, any fork or whatever we put into human culture changes us, changes our movements, changes our practices, our routines, and our habitual movements. And that in turn chances our muscles and our nervous system.

S: In the book, you give some examples of projects that you have been doing at KTH. Which one of these projects could be a good example of how soma design made the product differently from what it would have been without the soma approach?

Figure 1: The Soma Mat (copyright: Royal Institute of Technology)

H: The problem is they wouldn't exist, I think. I don't know. I will give you one example. We designed this mat. We call it the Soma Mat.[11] As you lay down on the Soma Mat on your back and close your eyes, you can get many different feedbacks. We give you verbal instructions to focus on different body parts, and as you do, the mat is heating up underneath those body parts. It helps you to become more aware of where your different body parts are. But it also helps you recognize different temperatures of your body; skin temperature, inner temperature, the temperature of the air around your body and so on. And after a while the voice disappears without you even noticing. It just continues with the heat coming and going underneath different body parts for a while. We put it up for use during three months in four different families. As it turned out people changed from using this. We had a 13-year-old girl in one of the families, saying that it made her more self-confident. When she was giving a talk at school, she would think about how she would lay on the mat, what it would feel like and her breathing and her posture. It made her more aware of her own body and who she was. It made her feel

11 Anna Ståhl, Kristina Höök et al. "The Soma Mat and Breathing Light." P*roceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. ACM, 2016.

more confident when she was giving a talk in school.

S: During the design of this product, what did somaesthetics bring to the design process that was not already there in what you were talking about with user-centered and participatory design?

H: First of all, we had to cultivate our own understanding of our own bodies. We decided to go with Feldenkrais. We could have used some other body practice and in fact we tried a bunch.

Figure 2: From a soma design workshop at NTNU in Trondheim, Norway in 2018 where members of both Höök and Svanæs' research groups learn Feldenkrais from Richard Shusterman

S: "We" is the design team?

H: Yes, we were four or five people. We would meet at least once a week and have a lesson. Sometimes it was Kung Fu. Sometimes it was Feldenkrais, or contact improvisation dance or other movement-based practices. We would work very deliberately with this. We always filled in a so-called body sheet – a description of our experience of our own body before doing the exercise and after doing the exercise. And what we could observe from the progression in those body sheets is that there was always something happening. A big change from before to after. We found that absolutely super interesting. We also found it very interesting that when we shared our experiences we often had had completely different experiences. But despite this, we could understand one another because we had been doing the same movement. Even though somebody else had had a completely different experience. I could understand what had been going on.

This was one strand of work in this project. Engaging with our own bodies, changing our own bodies, changing our ability to somaesthetically appreciates stuff. The other strand of work was bringing in digital material. We were testing all sorts of ideas. We had tubes of hot and cold water wired around our body limbs to see if we could do something with that. We had vibration feedback. We had a bunch of different ideas. And the idea of doing it as a mat was just one of the ideas. We had a bunch of other ideas about sitting on certain materials that would change shape and push us, or we would

have a lamp changing its illuminance. We had a bunch of different materials that we tried. And again, we had to engage with all those materials slowly and deliberately. We were looking for a kind of marriage between our bodies, changed by the somaesthetic experiences, and the design materials, and shaping them into orchestrated experiences, unfolding over time.

I would like to add something to this. To describe why this fascinated me so immensely. That was because I had new experiences that I have never had before. By doing certain movement practices and disrupting and doing them slowly and so on, I could learn new stuff about myself. I am fifty-four years old and I still had new amazing experiences of my breathing, of my lungs, and of my inner organs. With the digital materials, the same thing. I thought I knew what they were, and then suddenly we could shape entirely new interactions. We were using heat. We have been using vibration. We have been using interactive lights and so. Materials that I thought I knew, that I understood their affordances. And then suddenly I could shape these into quite different experiences. The sheer joy of discovering that there are new things for me to learn. There are new and very interesting experiences for me to have in this world. Of course, in some abstract manner you already know that in some way. But in another way, it was such a revelation. The world is so rich and the limited digital design world has over-focused on symbols and language and icons and graphical interfaces and we have forgotten about this rich, rich soil that the body and movement offer to our design processes. And then of course, this is obvious if you look around you. Design and human culture and how we express ourselves is of course not only addressing the visual senses as in graphical, symbolic, language-oriented arts, but also all the other senses and it is stupid to assumed that we can ignore that aspect of what it means to have interesting experiences. My experience was playful. It was enjoyable. It was just fun. I have fun at work when I do these designs and our end users love it. It is not without pain or effort. But it gives pleasure at a deep level.

S: This is an aspect of somaesthetics as philosophy that Shusterman writes about. That philosophy has to be lived. It is not just a matter of reading and understanding through language but at some point, you need to…

H: Moved to be moved.

S: You need to actually do something practical or engage in some of these bodily practices?

H: Yes, and it's just to make it clear again: I do think that there are infinite possibilities. Infinite number of experiences that we can have. It is not only one repertory of movement that a human being can do. I don't know how much you've been horseback riding.

S: A little.

H: We learn through our whole life. Every time I go to ride I learn something new. And it is a new experience every time. And if you haven't been riding you don't know what I'm talking about. The horses have different gates that they can do, walking and stuff. I find it just absolutely fascinating. These movements, these gaits. The rhythm of their movements and the synchrony you can get into. The corresponding relationship with your movements and their movements. I don't think you can understand what

I am talking about until you have been riding yourself. You don't understand what it means to be moved by a horse's movements. I can describe this to you, and I can write poetry about it. I can write novels about it. I don't still think that you have an embodied understanding of what it is until you do it.

S: Returning to somaesthetics, would you have been able to do your design research just with the practical exercises that to a large extent already existed in dance and elsewhere, or was the reflections and philosophical understanding that Shusterman brought in necessary for you to understand how to make use of it and apply it to your design practice?

H: I don't know the answer to that. I just know that unlike a design practitioner the role of the design *researcher* is to articulate. To bring out knowledge, and to articulate knowledge so that we can build on one another's works. Articulation does not have to be in words. Or in text on paper, but it needs to take shape and form in the world. For me, doing a body practice like Feldenkrais is not enough. I need to do design work. I need to bring in those digital materials and show what can be done. That is new knowledge to my field. I also need to be able to articulate what is in that design. With the Soma Mat it is not enough that we built it. I also have to extract and explain and point to what is novel in the design and describe it to my peers so that they can use it in their design practices. The way we express knowledge in my field is through methods and particular design examples, but also through concepts and through explaining how those concepts link together with what it means to be human, for example. And this is where somaesthetic theories, the concepts that Shusterman, Sheets-Johnstone and other people introduce are needed in order to tie everything together into a system, into a theory, into something that provides us with a particular theoretical lens by which I can understand those design examples methods and design concepts. This is this is how I see it. I don't think that you have to have all of those concepts and words and theories in order to be a good soma designer. I think you can learn these things through the practical work.

S: For actual design work, you think that it is much more important to engage in these bodily practices than to read up on somaesthetics theory?

H: Yes, but as an academic it is my role is to show how everything ties together and why it works and how to explain it and how to explain these phenomena. And that is where you need a system of concepts and theoretical ideas that link it together.

S: What are the implications of this for design education?

H: When I started working with soma design, I assumed that this is how design is taught at art schools. I knew that they engage heavily with their materials and touch them and work with them and turn them into different shapes and forms to see what they enable. If you have plastic, you work with plastic for a long time before you do something super interesting and innovative and new, right?

S: Yes.

H: What we are doing with soma design is that we are taking some of that with us into engineering schools and we are sort of saying: "well you are creating these products for people to use in their everyday lives, on their bodies or around their bodies or in the kitchens and whatnot. So, you also need to bring in these kinds of practices in order to understand what you're designing and how you're designing for people. It's not enough for you to study other users. You also have to feel this. The felt dimension of digital product needs to be in your repertory."

S: Looking back at this. In art schools, students have drawing classes where they learn to improve their skills in drawing and visual design and seeing. Should Feldenkrais and Tai Chi be part of Interaction Design education?

H: I don't think Feldenkrais should be part of it. I think that you can translate these methods into methods that engage with the digital materials in various ways so that you figure out a way of feeling and touching with digital material. A fusion of perhaps of Feldenkrais with some digital material, or Kung Fu with some digital material. It does not have to be Feldenkrais.

S: But there is room for some activity that teaches the designers appreciation for the bodily aspects of design?

H: Yes, experiencing – bodily, sensually. To give an example, we did this design class last year. We worked with Electrolux, a Swedish company. They asked us to do soma design for cleaning your home, doing your laundry, or air purification. What we made our students do was to go home to their own kitchen, slow down their movements, make stuff strange and feel and touch and interact in ways that spurred new ideas for what you could be doing in the kitchen and what kind of tools that you could have around yourself. And also to take existing products, like the blender for example, and then touch and feel and interact with that in order to redesigned it entirely. If I deconstructed this product, what could I do? We started out more generic with body practices, such as Feldenkrais, contact improve and slow walking in the forest behind KTH. We did a bunch of different body practices. We also did bodily movement exercises in the settings that they were aiming to design for it. In the kitchen and these environments, engaging with vacuum cleaning and doing your laundry. But we asked our students to do those everyday practices in ways of "making strange", disrupting, slowing down, or doing it playfully. Deconstructing movement and sensual engagement in order to be able to construct something entirely new. We had in total nine student projects and they were really innovative compared to what we typically see at an engineering school. If we had asked them to use their normal user-centered double-diamond design approach, we would have gotten the typical everyday ideas that we see all the time anyway – robots and various Internet of Things design. Instead, our students' designs had a much more reflective aesthetic quality to them.

S: In the last chapter of your book you go into the ethics of design.

H: Yes, I hesitated before I wrote that chapter. Some people told me I shouldn't have written it, or they were worried about me writing it because it was like opening a can of worms. But the thing with somaesthetics to me is that it is also an ethical project.

You can't attend to your senses and your ability to appreciate through your senses and aiming to live a better life without this also being an ethical project – of your life. Soma design engages with issues like dualism, feminism, privilege and class as all of those are enacted with and on our bodies. All of these things become acutely *there* when you are designing with a somaesthetic approach because there is no way of distancing yourself from yourself.

S: How technology alienate us from ourselves?

H: Yes. Overemphasizing certain aspects of what we are and underemphasizing other aspects of what we are, and thereby stopping us from feeling our own reactions and our own bodily ways of being in the world, – making us less aware. Somaesthetic design has to care and make you more aware.

S: How did do you bring the ethical aspects back into the design process? Is it sufficient just to do somaesthetic design as you have described?

H: I opened this can of worms and I don't know whether I addressed it. I guess I have to go on the rest of my life and work with this. If you do these kinds of design processes, there is no way you can ignore for example that the fact that we have different bodies. Your body is different from mine or my body today is different from the one I had when I was 15. These things are overtly there, in your face, in our soma design processes. But whether there is any guarantee that just because you do somaesthetic design that you would necessarily only design stuff that is good for all people? I don't know. I am still battling with for example the selfishness in turning this much attention inwards and getting to know myself so much better. Is that is that the only way by which I can be a better attending to someone else's needs. The whole idea that if I if I don't know myself, if I don't know my own emotional reactions, my own bodily reactions to stuff, then I can't really be there for you either. Right? So, the whole idea is like in Buddhism that if I live this way then I can more generously be in the world for other people. But, there is this risk that it makes you even more individualistic and even more selfish. I think. As with any method you have to know what you are doing when you apply a method. Using a method is no guarantee that you come to these insights. It makes it more likely perhaps that you do.

S: So, you open up a can of worms and in addition you do something that is a lot of people would maybe hesitate doing, and that is making a design manifesto.

H: Yes. (hehe)

S: Based on a someaesthetic approach, you have a design manifesto of seven points. If you should try to do an elevator pitch of this manifesto, what would be the essence of it?

H: The essence is really trying to capture the fundaments of engaging with somaesthetics. It is going back to the idea that you need to engage with your passions, with your emotions, with yourself, with your with your body in order to design good stuff. The first one, and I remember them because I use them quite a lot, the first one says basically to design for *this* life not for the *next* life. And for our field, to interaction design, it

has been the case that we have been hunting seconds and milliseconds to make every usage situation as fast as possible in order to save time. The question then is what do we save time for. For the next life or for what? To me this speaks directly to the division between Aristotle and Plato argues that you have this ideal world and you come to that afterwards, but where Aristotle says no, let us live a good life here and now. Let's improve our senses here. This is what I think interaction design should be worrying about. We should not be saving seconds by making everything as efficient as possible. We also need to care about the aesthetics of it and we shouldn't be solely working to promote an "attention economy" making people addicted to our technologies, but also with what is a good life and what improves life for all of us. How can we live together and live a sustainable life together? The whole manifesto is breathing these values. Another of the statements is we design slowly. This is a very strong reaction against the commodification of designerly thinking where we are putting out ideas rapidly and aggressively quickly jotted down on some Post It notes. Then we believe we have done innovative design. To me it is cheating. It is a shortcut to simple ideas and to the easiest targets. It is not the path to thoughtful, careful and sustainable design for people.

S: All these things live very happily in your lab. In that academic setting.

H: Well not always happily, because it is also demanding. People in my lab and in my group have had to talk through several times how close we come to one another or how annoyed we get by one another and so on because it becomes very intimate.

S: Sure, but out there in the real world with …

H: … capitalism and deadlines and tech companies and…

S: … the tech giants and start-ups that need funding. Is there room for this in the 21st century?

H: I don't know yet. I think that in the long run, with the kind of awakening that our field and the whole world is going through, we cannot put more shit stuff out there. We have to be way more reflective on how we build our society now if we are going to survive on earth and if we are going to survive without stressing the hell out of one another. I do believe that a sustainable business is one that has sustainable work processes, sustainable design processes, and puts out products for end users that has those qualities.

S: But if it isn't it a paradox that you try to change the world by building products? Are there any examples of this actually happening? We know that things change for the bad, but do you have any good example of digital products that were intentionally made to make the world a better place, and then actually made the world a better place?

H: I do think there are products where a lot of care has gone into the design. Let me take an example, and it might sound contradictory, but the desktop interface. It really shifted interaction from being a language-oriented skill that only engineers can process what they had to know a bunch of commands into an interaction that could be more bodily. You were moving stuff around on the desk as if you were moving stuff in the

physical world, and this enabled a whole bunch of people to be able to use computers and later mobile phones. And though there are many negative consequences of course of computers and mobiles, there are still amazing positive consequence. Enabling communication, enabling better business processes, enabling poor people to get more educated and be less poor. Learning processes and so on. Amazing opportunities that come out of your ability to use these technologies right. I think we are heading towards a society where experience rather than possessions are going to be important. We are liberating ourselves from stuff and moving into services and experiences. To me this kind of design is crucial in that it liberates ourselves from things. Whether one spurs the other, I do not know. Is it the changing times and the crazies that we are standing in front of that makes us more aware and more interested in experiences rather than things? I don't know. Is it that somaesthetics comes as an answer to that? I don't know. I just know that that's what I want to contribute. I believe that we can we can do what graphical user interfaces did for computers and how that liberated us from time and space and connect us to one another and in positive and negative ways. And what is interesting is how Alan Kay[12] came to the ideas of the desktop interface. He was looking at some tennis instructor teaching a woman to play tennis in only one lesson. Have you seen that video?[13] It's amazing. It is really about body and movement. By distracting her conscious, critical mind, the tennis instructor made her simply imitate his movements and she learnt how to serve, play forehand and backhand. Kay did the same for computer interfaces. Instead of learning a bunch of commands, he shifted them into simple movements, such as dragging and dropping.

S: Yes, he explained to me when I had my sabbatical at Apple Research in the mid 90s.

H: I wouldn't say that there is anything in the soma design methods that I describe that protects them from being misused by psychopaths or people longing for power. Of course they can be used like that. Power is inflicted onto the body. Inequalities, like feminism and so on, is done onto the body. It's the body where it's enacted. You can use these methods to know more and thereby be persuasive or oppressive or all of those things. I'm sure.

S: Could you say more about feminism?

H: Feminist to me… If you are designing with the body and with your experiences then it becomes obvious that your body is different from mine. And your experiences are different from mine because you are male and I am female. We will move differently, we will experience differently – and both of our experiences are as true and important. Instead of downgrading the female experience, it comes to forefront. It spurs ideas such as designing for menopause and female health, for example. Designing for a whole range of human experiences. Feminism here not only concerns the male and female body, but all sorts of bodies, all sorts of experiences that are shaped by our physical, bodily ways of being in the world.

There are of course many different feminist theories, here I am very much talking about the feminists interested in how our bodies are corporeal realities and how that shapes

12 One of the main innovators of the desktop interface at Xerox Parc.

13 https://www.youtube.com/watch?v=50L44hEtVos

our experiences. Like Elizabeth Grosz[14] writing about how menstruation and breast feeding and menopause and so on shape my experiences in the world. As well as queer ways of being in the world, and male ways, and young bodies ways of being in the world, or old bodies ways of being the world. Experience and possibility for design is filtered through that particular body.

S: To be a little bit more personal, do you think it is a coincidence that it is you as a female in the male-dominated field of Computer Science who have been doing this?

H: It is definitely noticeable that when we have workshops on soma design, it attracts a lot of women. Some of the strong proponents for this way of designing in interaction design are women. Not all of them, but perhaps more than what we see otherwise in design.

S: Is that relevant in any way?

H: I don't know. I don't think that this is a female privilege at all. I just think that it happens. Some of these experiences have been used to oppress women. Have been used to downgrade female experience. The whole history of male vs. female, rational vs. irrational. rationality or mind vs body, the associations go back to the old Greek society. We haven't liberated ourselves from those dichotomies. Females are associated with body and emotion and movement and dance in our society. There's no reason for that. It is just as stupid as associating women with fire and dangerous things as they did in Australia because the women were the ones carrying the coal.

S: Like Lakoff[15] wrote about.

H: Yes. To me, and I guess to a lot of women, we ask why are our experiences downgraded and put as low status all the time when obviously these experiences are there for both men and women? Why is the female body not spoken about in philosophy? Why is menopause such a taboo subject when 50 percent of the population go through this phase in their life? It is a huge thing in women's lives. A huge transformation.

S: Is it coincidence that this happened in Stockholm, maybe the most gender equal city in the world?

H: Women researchers in Scandinavia, are perhaps so strong because we are brought up in a more equal society. We are not scared of doing research in this area, while in other parts of the world a lot of women would be super-scared because they need to break into old hierarchical male-dominated organizations, and they have to take on the topics that are objectively seen as the most important topics to do.

S: Last, is it a coincidence that this happened at KTH?

H: Well, there is the participatory design movement that was done at KTH and other places in Scandinavian countries, like Århus in Denmark. But somaesthetics is also

14 Elizabeth Grosz. *Volatile bodies: Toward a corporeal feminism*. Indiana University Press, 1994.

15 George Lakoff. *Women, fire, and dangerous things.* University of Chicago press, 2008.

strong in other places, like Australia and even China.

S: Thank you for taking the time, and again, congratulations with the book.

H: Thanks.

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A handful of takes on the body

Max Ryynänen

In 2019, 20 years after the publication of "Somaesthetics: A Disciplinary Proposal", one can say that somaesthetics has become *the* low-threshold platform for discussing the philosophy of the body. It has likewise become the most multicultural philosophical discourse on the soma when one thinks about its roots, where no philosophical traditions are absent.

I keep on meeting people who criticise the somaesthetics discussion for lacking philosophical rigour and depth. As rigour and depth for many professionals of philosophy mean that the discussion craves heavy background studies, and that all discourse has to come with long footnotes on the history of philosophy, I have started to think that the "lack of rigour and depth" is the strength of the discussion. It provides a window into philosophies of the body for those who are not that deep into the discipline. In this way, it has also become an interdisciplinary platform.

What I conceive as the philosophical ground of the debate, i.e. John Dewey's philosophy of the body and experience, and Richard Shusterman's contemporary reading and application of it, does have rigour and depth, anyway. Interestingly I often find that discussions on somaesthetics somehow lack a connection to this base, which could reward more attention.

The problem is also visible in the fresh *Aesthetic Experience and Somaesthetics* (ed. Richard Shusterman), where 13 authors discuss somaesthetics and the progenitor of the theoretical movement, Richard Shusterman, comments on the texts in the introduction. The book is based on a four-day conference held in Budapest in June 2014, but has been expanded later with new authors.

Shusterman, in his introduction for the book, addresses somaesthetics to be "the critical study and meliorative cultivation of the body as the site of sensory appreciation (aesthesis) and creative self-fashioning. A field that seeks to integrate theory and practice, somaesthetics argues that our sensory perceptions (…) can be improved by cultivating one's somatic capacities that include both sensorimotor skills and powers of body consciousness." (p. 1) He accentuates that behind the whole debate and practice we find the philosophical analysis of aesthetic experience.

Most art has a somatic side, but Olafur Eliasson's art is definitely a special case with its optic (use of glass and colours), ambience-based nature. Else Marie Bukdahl, the artist's former teacher, interviews Eliasson in "Olafur Eliasson, Art as Embodied and Interdisciplinary Experience". It is sheer enjoyment to read the dialogue, especially the parts where the two discuss for example ice blocks or the praxis of art as concrete learning and doing (pp. 68-69). The discussion about passive consuming and the way artists have wanted to activate the audience (p. 62) also includes many fresh takes, although I must say, that I myself am for a "leave the audience alone too" type of approach, as the majority of artists today, at least in my territory, want to "wake up" and

"activate" people.

There are, though, passages which made me raise my eyebrows, and which I hope the two could go back to rethink. At one point (p. 64), Eliasson says that the body has not been much discussed in the art world. I am astonished. I hear and see body talk everywhere, not just when I work with dancers and choreographers, but also when I meet people from the visual arts. Where does Eliasson's experience come from? Is it real, or is it an echo of an art world which we have already surpassed? Are Eliasson's networks and the scenes where he works so different?

When the two discuss the issue of experience economy versus art's "lost and found" attitude (p. 67), by hierarchically putting the experience economy below art, my own note would be that Eliasson's career partly stems from the way in which his work also functions well in the experience economy. One can digest his work with all the might of sensitivity, attitude and focus gained from artistic education, but most "fans" probably seek an "Erlebnis" or something to post on Instagram/Facebook. The selfie success of Aarhus' Art Museum (AROS), where Eliasson has worked out a colourful glass corridor on the roof, shows this. Could one use the term "bilateral art" (Ted Cohen) here, as might work well in both contexts?

Yanping Gao's unorthodox text on the Central European founder of European antiquity, Johann Winckelmann, takes the body into a discourse about gazing and glancing. Gao points out that Winckelmann clearly made a difference between glancing, which is more of an eye-thing, and the gaze (p. 72), where the eyes become "quiet", and the encountered aesthetic object overcomes the ego (this reminds me of Indian rasa theory where the bliss of art overcomes the ego through the strong senses of sight and sound).

According to Gao, Winckelmann attended the lectures of Baumgarten, the founder of the discipline of aesthetics. Gao claims, though, that Baumgarten was antisomatic, and this is a passage I have a hard time digesting, as Baumgarten worked so much on the optic, instrumental side of how we can and should approach art. As Winckelmann's somaesthetic passages are an issue even in the manifesto of the discussion, "Somaesthetics: A Disciplinary Proposal", I think Gao should have somehow explained his view.

The news is anyway grand: the fact that Winckelmann was actually working on a somatic framework in his discourse on the gaze, as this way of looking, he thought, engages the whole body. Herder wrote (according to Gao, p. 77) that eye turned into hand in Winckelmann's work, and Winckelmann himself wrote of some statues, like the *Apollo*, that they are "tactile" (78), so actually overcoming the visual. Gao also makes interesting notes on the way Winckelmann writes about sensuality, for example hair in statues (81-82). Here one could have asked, could a small leap into Dewey's and Shusterman's thoughts on engagement have provided a theoretical framework for Gao? I.e. was Winckelmann's gaze a form of Deweyan engagement, and if so, in what way? And, what is the cash value of gazing in Winckelmann's way?

Elisabetta Di Stefano, who is one of the foremost philosophers of the everyday in Europe today, discusses cosmetic practices, neatly following the problematics Gao touches upon in his article. She studies well the strain of philosophical notes classical authors in Central and Southern Europe have been making on the issue. In "Cosmetic Practices: The Intersection with Aesthetics and Medicine", beautification becomes an idea of historical matters.

The text starts, though, with a take on seminal contemporary artists such as Mona Hatoum, Stelarc and Orlan. Why? I am not sure if this in the end helps in understanding the very everyday-centred notions on looks Di Stefano works out in her article. Could it have been more productive to pick up experimental everyday pioneers like the human Barbies and Kens, to

pinpoint the weight of the historical journey Di Stefano lays out?

Di Stefano's approach is fresh, and it shows how we often do not think enough of the historical depth of surface matters. Makeup and hair from Xenophon to contemporary times is also a textual issue. Di Stefano presents an interesting historical work, Trotula de Ruggiero's *Women's Cosmetics* (11th century), the first cosmetic treatise, and I will definitely at some point opt for reading it. She also writes about the way popular culture focuses a great deal on the body as a locus of self-fashioning. Philosophically speaking I am lacking, in Di Stefano's concluding remarks, the philosophical spearhead of what we learned from the classics and how to continue on the chosen path so wittily examined by this Palermo-based philosopher. And thinking about Dewey/Shusterman, and the theme of aesthetic experience, one could have asked, could a paragraph on aesthetic experience and its pragmatist theory been a helpful aid for grasping the issue when we anyway experience both when we beautify ourselves and when we see others beautified?

Éva Antal's "Spectral Absence and Bodily Presence: Performative Writings on Photography" discusses, for example, Jacques Derrida's book *Demeure, Athènes*. In the book Derrida wrestles with the moment of taking a photo, the theme of death and photography, and the way in which the remains of everyday life continue their life in photos. She continues by discussing the role of being and becoming an object/subject in photos, touching of course also on Shusterman's work with Yann Thoma, where the philosopher adventures in a golden suit in a performative manner. As experience was the topic of the book, I was again wondering whether Dewey's thoughts would have helped here. Are moments when photos are taken or looked at moments of fulfilment? Does the endless flood of photos today, where we (philosophers and non-philosophers) are often subjects and objects at the same time (selfies), just add to the fragmentation of experience? What is needed to gather our fragmented field of experience today? And is this something which happens in a more reflective performative act like Shusterman's?

Anne Tarvainen presents an interesting practice of singing and reflecting on it from a body-philosophical point of view in her text "Singing, Listening, Proprioceiving: Some Reflections on Vocal Somaesthetics". The end, which claims that there could be a lot to learn just when one discusses talking as a bodily activity, is just stunning, but otherwise I cannot but think that Tarvainen's way of carefully analysing in pornographic detail a practice like singing is definitely one bright future for the somaesthetics discussion. Still, I would ask: could a stronger reflection on the Deweyan framework of experience have been helpful here? As Dewey was himself a practitioner of Alexander Technique, I am sure it would have been possible to conduct an analysis from that perspective. Singing, for sure, channels organic energies. What could we learn from it in connection to Dewey?

Alexander Kremer's work on Gadamer and his relationship to somaesthetic thoughts and experience (related to pragmatism) is a great exegetic work. Truth and scientific method were at odds with each other for Gadamer, and thinking of him as a "philosophical relative" to Dewey is a good topic for understanding the history of the 20th century philosophy of art and culture. Béla Bacsó's "Experience and Aesthetics" also does good basic work in mapping out ideas on experience in relationship to the Deweyan approach, picking up themes such as the openness of art and how it gets finished in interpretation. These historical texts on ideas balance the book well with basic philosophical matters.

Vinod Balakrishnan and Swathi Elizabeth Kurian write in length about Mira Nair's in tantric circles already classical *Kamasutra* (1996). "Thinking Through the Body of Maya: Somaesthetic Frames from Mira Nair's *Kamasutra*" is quite a pedantic reading of what happens in Nair's film

from massage to sexual education. As the film is situated in a world not yet inhabited by the Central European art system, which through colonialisation and diaspora overshadowed the *kala* system and the broad variety of aesthetic practices of India, I myself started thinking that it could have been interesting to ask how differently all these practices of *ars erotica* (Shusterman's ongoing writing project) would have been framed (as this word was even used) in the system which now no longer exists. It is anyway a fact that many practices were developed in another kind of context, and that theories of aesthetic experience were also developed in a context differing from today's postcolonial one. For example, theories of rasa could have given insight here, not just for the practices discussed, but also for the filmic interpretation of the story. Ars erotica also had a role in the *kala* system. At the end of the article I was also asking for an outcome of the analysis. Maybe one could reframe it: what could one learn from a movie focusing on someone's aesthetic and erotic education?

All in all, *Aesthetics and Somaesthetics* is an engaging, well-written and well-edited book. (I am not discussing all of the texts, but have concentrated on what has *touched me*.) While its variety of approaches show the broad nature of the discussion on somaesthetics, one feels, though, even more now, inclined to think that the connection to the basis of the discussion (Dewey's and Shusterman's theories of aesthetic experience) must somehow be re-established. As the theories seem to still hang around as regulative horizons for thinking – no one is really working out an alternative – this could probably be the next step. Following Dewey's thinking, the book, for me, offered moments when the fragmented energies of my body, my memories, my skills acquired in differing contexts, and my intellect came, from time to time, together, and made me enter "an experience". Like a beaver building a dam, which in the end just picks branches and moves them around a bit, I was left touching the pages and sniffing the book (it smelled like glue as it was fresh), finishing my fulfilment as somatically as I could. I can recommend the book to anyone interested in the philosophy of the body, not just somaesthetics. Here, somaesthetics has anyway showed its potential for being *the* philosophical discourse of the body for a long time to come.

Richard Shusterman (ed), *Aesthetic Experience and Somaesthetics* (Leiden – Boston: Brill, 2018). Incl. texts by Richard Shusterman, Catherine F. Botha, Béla Bacsó, Alexander Kremer, Else Marie Bukdahl, Yanping Gao, Bálint Veres, John Golden, Anne Tarvainen, Éva Antal, Elisabetta Di Stefano, Nóra Horváth, Vinod Balakrishnan and Swathi Elizabeth Kurian.

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