

# Experiential Bodily Knowing as a Design (Sens)-ability in Interaction Design

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**Abstract.** This paper develops the notion of experiential bodily knowing as a designer's (sens-)ability to reason about movement and responses to movement as part of the process of designing movement enabled interaction with artifacts, products and spaces. We arrived at this notion by reframing the practice of interaction design as a discipline of movement practice. We then conducted a study of the coming to know of bodily skill as a way of better understanding the nature of experiential bodily knowing and understanding generated through experiences of the moving body. From this study we suggest how this could translate as a designer's ability to understand how people might experience movement-enabled interaction.

**Keywords.** Experiential bodily knowing, design materials, design sensibility, interaction design, movement.

## 1 Introduction

*“If one truly likes to design for movement-based interaction, one has to be an expert in movement, not just theoretically, by imagination or on paper, but by doing and experiencing while designing”* (Hummels et al. (2007)). The research presented in this paper is motivated by this statement by Hummels et al. and other researchers who share similar sentiments. We are also motivated by the fact that interactions with technology now are taking place with a range of different bodily movements as the ability of technology to detect and respond to interaction through movements is evolving. We can enable interaction through mere presence in a location, but also

through different movements and to some extent by the way in which we perform movements (e.g. fast/slow, smooth/erratic movement in Nintendo® Wii™). This has seen the development of several design approaches that advocate explicit and focused bodily involvement by designers as part of the design process, for example Djajadiningrat et al. (2007), Hummels et al. (2007), Jensen (2007), Klooster and Overbeeke (2005), Moen (2007) and Schiphorst and Andersen (2004). In our own work we discovered the usefulness of moving and re-enacting as an essential and necessary part of the process of analysing movements enabling interaction with a computer game in a previous study (see e.g. Loke et al. 2007 for details on the procedures and outcomes of this study).

While we, similar to the authors mentioned above, find an active body appropriate in investigations for the design of movement-enabled interactions, we were interested in exploring further the nature of knowing and understanding potentially generated while doing so. This paper is about how we framed our inquiry to address this. We start by describing how different approaches in interaction design have introduced bodily engagement into both design practice and research. We then present how we conducted the empirical work for this study, the relevant findings, and finally we reflect on some of the methodological challenges we faced. From the empirical findings we develop the notion of experiential bodily knowing as a designer's (sens-)ability to reason about movement and responses to movement as part of the process of designing movement enabled interactions. That is a designer's ability to reason about how someone else could experience the use of a design, and being able to design based on this understanding.

The work presented here is part of larger project with the overall aim of extending our understanding of bodily aspects of technology interactions. See e.g. Larssen et al. (2007) for an account of the *feel dimension* of technology interaction – an articulation of the role our kinaesthetic sense play in experiencing technology interactions, another outcome of this specific study.

### **1.1 Related Work: Moving while Designing/ Designing while Moving**

Djajadiningrat et al. (2007), Hummels et al. (2007), Jensen (2007), Klooster and Overbeeke (2005), Moen (2007) and Schiphorst and Andersen (2004) are all designers, design researchers and design educators who advocate and practise bodily involvement in the design process of movement enabled interactions. *Choreography of interaction*, developed by Klooster, illustrates this with the design of a vase from the movements involved in flower arranging. The final design of the vase is based around four principles that developed when experimenting with arranging flowers (Klooster and Overbeeke, 2005).

Djajadiningrat et al. (2007) are working from ideas of building specific bodily skills, akin to skill development in crafts traditions, playing an instrument or sports. They see skill building not only as a potential outcome of a movement enabled interaction, but skilled action as a way of thinking about designing interaction with products. This necessitates thinking in terms of enjoyment of the experience of use (learning), rather than just ease of use. Jensen (2007) is working from the same ideas,

using the *metaphor lab* and *Video Action Wall* as ways and activities through which qualities of movements are identified and kept present throughout the design process.

Moen's (2007) Kinesthetic Movement Interaction (KMI) uses theories and methods from modern dance. Her BodyBug® concept was developed from the experiences of a group of people participating in a movement/dance class. Similarly, Schiphorst and Andersen developed *whisper*, a wearable public installation, using performance-based methods such as improvisation, props and phantom partners. "*The goal of the workshops was to model experience that could be replicated, re-enacted, and re-played in the context of a public art installation using wearable computing technology*," they said (p. 2). Hummels et al. (2007) have developed the *Attending Theremin*, among other tools for designers to explore what they call the 'expressive power of gesture'.

Common to these approaches is a focus on explorations through moving of the interaction and movements used to enable interaction first, before explorations of form and appearance of the technology.

## **2 (Re)Framing Interaction Design as a Movement Discipline**

In a paper describing "Choreography of Interaction" Klooster and Overbeeke say, "*We realize that theoretically describing this approach is a nearly impossible venture. In fact, only through movement, through practicing it, the idea can actually be grasped*" (2005, p.23). We agree with the inherent challenge in verbally articulating issues of moving as a way of knowing; however we felt that further investigation could help us better understand and further inform our ability to reason about movement. Two topics crystallised for our inquiry, the first i) to explore the nature of experiential bodily knowing and understanding generated through experiences of the moving body, that is the coming to know of bodily skill, and secondly ii) to explore what this could mean as a type of understanding and knowing in interaction design.

In our inquiry we decided to address this by reframing interaction design as a movement discipline, and then to study movement practices as a strategy for furthering our understanding of the coming to know of bodily skills. What brings a movement discipline forward is improvisation and skilful interaction that push the edges of the current rules and styles of a discipline (e.g. the Fosbury flop in high jump). Reconceptualised as a movement discipline, it is not a big "leap" then to consider movement as a material for interaction design, and the study of movement "in its own right" as appropriate for interaction design. By approaching the domain this way we were hoping to come to understandings of how, when we learn movements, it allows us to do what we want to do when we move, that is perform movement, improvise movement and play with movement.

In developing our study we looked for tools and techniques for studying movement experience both within the discipline of design as well as the many fields that study human movement (e.g. anthropology, medicine, philosophy, dance and performing arts, sport, ergonomics, physical and somatic therapy, biology and anatomy) to understand how our study best could be carried out. As a result we combined a number of

methods from design, anthropology and HCI in the design of our study; we outline these in the next section.

## 2.1 Background to the Study

*When artists, designers, architects and engineers build an understanding of the properties of a material, they often study it by creating a structured collection of basic examples that explore different aspects and properties of the material. A basic understanding of the properties of, e.g., wood, paint, concrete, as materials for design, can perhaps only be achieved by working with them in practice. More systematic studies of the material are then used to map out the design space of possible expressions.* (Hallnäs et al., 2001, p. 195)

As Hallnäs et al. say (2001, p. 195), in the process of designing, designers make use of many different ways to reason about, reflect and conceive of ideas for a design. Both in design education and design practice, there are spaces for experimentation and exploration in the design process. A design process is often highly material, ideas and activities are made visible and tangible by means of different physical materials, and the materials for design are interrogated as part of the process. The corollary, when it comes to materials for movement enabled technology interactions, is that movement becomes one of the materials for design, (the others being sensors, input and output devices and so on).

For an inquiry into issues of knowledge and understanding in design, Donald Schön's (1983) notion of a "reflective conversation with materials of a design situation" is of course relevant. However, movement as a material for design is still an under theorised area within movement interaction design. We see our empirically-based theorisation as part of this paper's important contribution.

In both human-computer interaction (HCI) and interaction design there is an established and influential tradition of reframing issues of technology design within theoretical frameworks new to the field at the time they were introduced; for example Suchman (cultural anthropology/ethnomethodology, 1987), Ehn (participatory design, 1988), and Andersen (semiotics 1990), all grounded their research in empirical findings. In HCI it is now very common to study practice in order to better understand issues of technology design and use.

Our theoretical understandings of movement are influenced by current trends in anthropology, where studies of human movement, arguably, are moving from observationist views of behaviour to a conception of body movement as dynamically embodied action (Farnell 1999), and to more participatory-based embodied approaches for data gathering and analysis. Participatory approaches tend to emphasise the "how" of movement, rather than the "what" and "where". That is, participatory approaches tend to focus and allow fuller understanding of an experience by focusing not just on how it looks ("the arm moved"), but also on how it might feel to do the movement or interact with technology ("how the movement is experienced"). Hence, the nature of our inquiry was determined by the perceived importance of *experience*, experiences of learning, understanding and knowing as central to the inquiry. As such we decided on a phenomenological perspective informed by Merleau-Ponty (1962), because he is

widely acknowledged, also in interaction design, as a phenomenologist focusing on the lived, perceiving and moving body (Robertson, 2002).

## 2.2 Experiential Bodily Knowing: A Study of Coming to Know

In this endeavour our challenges became to find ways of engaging our participants in movement experiences and triggering reflection about these experiences that would enable the participants to articulate these experiences, as well as finding ways of capturing data about the experiences. We drew on Gaver et al.'s *probes* (1999), Paulos and Beckmann's *interventionist techniques* (2006) and Oulasvirta et al.'s *bodystorming* (2003), to some extent in the way in which these design researchers use different techniques for triggering reflection in study participants. Our study design further led us to consider different movement practices where we, the researchers, could get involved in becoming skilled movers; this was based in thinking that increased understanding of movement in oneself would enable us to understand the movement experiences of the study participants better. We were also looking for practices with a "reflective component," that is practices that acknowledge that knowing can be constructed through experience of the body. We settled on Pilates, yoga and Capoeira.

The objective of our study was not to come to new understandings of the disciplines of Pilates, yoga and Capoeira per se, but to study the experience of learning in these disciplines. As such, a number of different activities could have been chosen for this study. Pilates, yoga and Capoeira were chosen for a few different reasons mentioned below. Each of these movement disciplines brings about different ranges of movement. There are differences in the extent to which the whole body vs. parts of the body are engaged, and the speed of the movements and the movement quality considered appropriate for each discipline differ. These are also activities with some (though to varying degrees) degree of bodily contemplation, that is the extent to which there is deliberate use or encouragement to direct attention inwards as part of the practice. There are also different aims for the movements and different purposes for the objects used. We briefly introduce core aspects of each the three movement practices here.

Pilates is a system of mental and physical conditioning focusing on trunk stabilisation. In Pilates, the *Reformer* and *Cadillac* shape the execution of many of the core exercises. These two pieces of equipment consist of various adjustable parts that provide resistance and/or assistance to varying degrees in exercises for the core abdominal muscles, spinal flexibility and the shoulders in order to strengthen and stretch the body. This is achieved through restricting or aiding movement in certain directions for a full range of movement in different exercises. Other important aspects of Pilates are the emphasis not only on the performance of movement, but on how the rest of the body behaves while the movements are being performed, and the use of mental focus to improve movement efficiency and muscle control.

The physical aspects of yoga involve the performance of different poses, the asanas. The Iyengar tradition introduced the use of props; blankets, blocks, bolsters, straps, pillows, chairs and ropes are now widely used. The purpose of the objects is to assist in attaining ideal alignment in the poses, even if the body is not yet flexible or

strong enough. However, the overall aims of yoga are of balance and unity of mind, body and spirit, and more about spiritual wellbeing than physical activity.

Capoeira is an Afro-Brazilian acrobatic martial art game. The game is played by two capoeiristas (players) with the remaining capoeiristas forming a circle while singing and playing instruments. The two players try to outsmart or trick each other by demonstrating flair and mastery of movement. Objects used in Capoeira are the uniform, the music, the instruments and the other capoeiristas.

### **Method of Analysis**

In our study we were interested in data that could give prominence to experience and awareness of the body itself. The coming to know was explored in relation to both kinesthetic experiences and external feedback involved in the learning of movements in Pilates, yoga and Capoeira. The resulting study employed an ethnographically inspired field study approach. Sixteen interviews with thirteen participants (practitioners and instructors) were conducted. These interviews were both video and audio recorded; in addition observation and participant observation were used to gather data for understanding the transformation of the lived body as skills were acquired. The participant observation part of the study consisted of the researchers trying out movements demonstrated by interviewees, as well as attending classes in the interviewees' practices over a period of time before and after the interviews. This means that we, in this study, claim to study *experience*, *movement*, *experience of movement*, as well as *experiencing movement*. Hence we are studying *experience*, we are *experiencing*, and we are becoming *experienced* in movement in the hope that it will inform our ability to reason about movement.

It should be noted that this study is by no means a proper ethnographic immersion, although it is heavily ethnographically inspired and borrows in its approach to collection, analysis and interpretation of data. It is a dip into a particular setting that was entered with some specific ideas about what we wanted to explore. By attempting to trigger exploration and reflection in our participants about movement experiences, it is a study about movement practice; it is also a study about reflective practice and interaction design practice as our overall perspective in this project is one of informing technology design.

In our analysis of the data, we transcribed the interviews, viewed the videos multiple times and re-enactment movement both in training session and while writing up the study (in our offices). Researchers, who have written on the use of video data in ethnography and ethnographically inspired research, stress the importance of repeated viewings in order to uncover and understand the issues being investigated (e.g. Schensul 1999 and Jordan and Henderson 1995). We see our repeat viewing of the video data, re-enactment, ongoing involvement in the disciplines and discussions with practitioners as a similar approach, which at the same time allowed us the opportunity to obtain another perspective on the analysis as well as refine and check our analysis. In the analysis we were looking for articulations of the experience of learning and experience of performing movement, articulations of what helped people learn, and what aspects of instructions they focus on and so on.

In the next section we present articulations related to knowing how to do a core movement in each of the three disciplines, namely *neutral spine* in Pilates, *down-*

*wards facing dog* in yoga and *armada* in Capoeira. We will use these three as samples to show different articulations of knowing constituted in practice. The splitting up of the elements and essentials of experience is artificial, but it is convenient for the communication of the experiences in this paper.

### 2.3 Findings: Experiences of Learning, Experiences of Doing

In the coming to know or learning of a movement discipline the fundamental challenge becomes mastering *knowing how to move* in the different situations one finds oneself in as a practitioner in that discipline. When we analysed the three core movements *neutral spine* in Pilates, *downwards facing dog* in yoga and *armada* in Capoeira we found quite different articulations of the *knowing how to move* emerging.

In Pilates, *neutral spine* is one of the fundamental poses, awareness of neutral spine alignment is emphasised throughout all exercises, and one which all Pilates practitioners in the study performed. See **Table 1** below for descriptions of knowing how to do neutral spine.

**Table 1.** Neutral spine in Pilates

Where it is happening	What it looks like	How it feels
Neutral spine is the natural position of the spine when all body parts are in good alignment. When the spine is in neutral, the natural curves of the cervical and lumbar spine are maintained. While on all fours, neutral spine is achieved by moving the pelvis up and down (and sometimes sideways), and finding a point where the practitioner feels balanced and the instructor confirms.		<i>I just love the feeling of straightness that you get, and the feeling that your body is... moving through a.... It's that whole...you know you are sitting in a chair and all of a sudden you notice that you are sitting very straight and you can feel how your body is in alignment and I love that feeling of...sort of... I don't know what to call it.</i>
Researcher's articulation of shape and spatial path	Practitioner's bodily articulation	Practitioner's verbal articulation

In yoga, *downward-facing dog* is one of the basic poses, and one all our yoga practitioner performed. It is a versatile pose in that it incorporates elements of standing poses, arm balancing, forward bends and backbends. One of our participants used the expression “the garlic of all poses” when describing it.

See **Table 2** below for descriptions of knowing how to do downward-facing dog.

**Table 2.** Downward-Facing Dog, in yoga

Where it is happening	What it looks like	How it feels
The palms are positioned shoulder width apart with the fingers spread and the middle finger facing forward. The shoulder blades are worked flat on the back, the collarbones are broadened. While pressing the palms into the mat, the arms, sidechest and waist are extending to lift the sitting bones to the ceiling. The heels are extended towards the floor while lifting evenly through the ankle, knees, thighs to work the legs straight. The head is encouraged to hang.		<i>In this pose the knowing that I'm doing it right means a feeling of energy flow, there is an ease in pose, you are not sweating, the body is not hard, and there is no pain and the effort is evenly distributed.</i>
Researcher's articulation of shape and spatial path	Practitioner's bodily articulation	Practitioner's verbal articulation

*Armada* is one of the basic standing spinning kicks in Capoeira. See **Table 3** below for descriptions of knowing how to do the armada.

**Table 3.** Armada; a basic standing spinning kick in Capoeira

Where it is happening	What it looks like	How it feels
From the base movement, Ginga, a straight back leg is brought forward, up and around in a sweep-like motion. The upper body moves back and the arms swing around to counter the weight of the leg moving forward, up and around with speed. The moving leg is placed back down behind while the arms return to the Ginga position.		<i>The feeling of achievement if you've done it well is that you are completely set up to keep moving.</i>
Researcher's articulation of shape and spatial path	Practitioner's bodily articulation	Practitioner's verbal articulation

The different articulations of the data suggest that the knowing required and involved in doing neutral spine, downward facing dog and the armada is a *knowing how* and that this knowing is felt and achieved through moving. The performance of the bodily practice is the way you display your knowing experientially. This mutual con-

stitution of knowing and doing rather than knowledge as a given, is resonant with Polanyi (1983). Experiential bodily knowing as talked about in this paper is a form of tacit knowing.

## 2.4 Findings Abstracted

Our findings suggest that experiential bodily knowing is felt and achieved through moving. The different articulations of the movement experiences; articulation of shape and spatial path, bodily articulation and verbal articulation helped us discover this, as such working with these articulations (or representations) became a tool that helped us reason about movement. Our findings also enabled us to distinguish further characteristics of experiential bodily knowing, these are *continua of knowing*, a *distinction between bodily knowing and understanding*, and the *recognition of knowing in self and others*, all of which we believe could be useful notions for interaction design.

The development of the *continuum of knowing* enabled us to make a distinction between bodily knowing and understanding. In the study our participants described how they over time have come to a certain level of knowing in their practice, this is the ability *to do* movements as well as the ability *to recognise* knowing and ability to perform. Over time they have developed a capacity to perform or act in particular circumstances in their practice, though there are still times when they do not perform at that capacity. This might seem reminiscent of Dreyfus and Dreyfus (1986) stages of skill acquisition, novice – expert. However, in the context of this paper, it allows us to make an experiential distinction between bodily understanding and bodily knowing, which is about how we at different times at the same level of skill, not always perform consistently and what the experience of this is. We illustrate this with a quote from one participant describing a continued struggle with the Armada, the Capoeira spinning kick, as *floating in and out of knowing*.

*...it is like that... like the difference between knowing it and knowing it totally. It becomes a mental thing, I can't access it again...until it becomes completely embedded in my... where I don't have to access it mentally. Soon as I have to start thinking about, right, where should my foot...and then I think not far enough around – it's gone, it is totally totally gone. Unlike some things where if I don't think about it, I do it, it comes back to me. Absolutely this one I sometimes have to go ask someone, I've almost developed bad habits when I'm trying to figure out what the problem is. With some of the double kicks I know, I know why. While with this one I still don't know why ...why am I coming off balance? So I feel like I float in and out of knowing how to do it.*

From this and similar descriptions emerged the *continua of knowing*; the continua describe our participants' articulations of *degrees of knowing*, *ways of knowing* and *access/location of knowing*. The continuum of knowing is detailed below (**Table 4**) with representative quotes. The connections between the different continua are outlined below the table, though they will evolve over time. These continua are not exhaustive or exclusive, they both overlap and interact.

**Table 4.** Continuum of Bodily Knowing

Not knowing how to move...	Knowing how but not be able to move...	Not knowing that I know how, but being able to move...	Knowing how to move...	Knowing how to move completely
	<i>Sometimes can't just do it or think it, I have to actually look at the body parts to remember how to do it.</i>	<i>I remember this one time, I just couldn't think or imagine how to do that pose (an inversion), so figured I just had to do something and see what would happen. It got me into the pose!</i>	<i>Yes that is what it is supposed to feel like. So I feel like have experienced once the feeling what it is to know, what it is to do it properly.</i>	<i>Skill is just there to use</i>

At different points along the continuum (Table 4) a practitioner is able to perform with increasing degrees of awareness, recognition, and understanding of well-executed movement in *oneself* and *others*. This includes the experience of performing consistently, and being able to perform with poise and flare. Another Capoeira practitioner expressed striving for *knowing how completely* this way, “*I have accumulated all this knowledge, now how do I use it to master expression of moves?*”

The experiences presented in the continuum of bodily knowing suggest that for experiential bodily knowing not only might it make sense to experientially differentiate between degrees of knowing, but also between *knowing* and *understanding*. That is how on a continuum of knowing, one can be able to bodily understand, but not yet perform, yet also perform without explicit bodily understanding. This is illustrated in **Table 4** in the middle quote, “*I remember this one time, I just couldn't think or imagine how to do that pose (an inversion), so figured I just had to do something and see what would happen. It got me into the pose!*” (yoga practitioner). This relationship between understanding and knowing is probably best understood in terms of the meaning making that takes place in our ongoing movement dialogue within the particular circumstances in which we act, e.g. neutral spine, downward facing down or armada.

*Awareness* and *reflection* in this movement dialogue is key to being able to benefit from understandings that can be generated this way. Our participants spoke about awareness and making conscious the movement experience as important for increased knowing. Awareness could emerge through affirmative movements, e.g. moving in relation to external (vision, hearing, touch) and internal (kinaesthetic sense) points of reference, as well as injury.

These characteristics of experiential bodily knowing, *continua of knowing*, the *distinction between bodily knowing and understanding*, and the *recognition of knowing* in self and others, are dimensions we believe could be useful for interaction design.

### 3 Experiential Bodily Knowing in Interaction Design

In the previous section we outlined the findings from our study. In this section we articulate the notion of experiential bodily knowing in interaction design that is what it means to reason about movement in interaction design. We articulate this from a position as design researchers and technology designers, and we see our work to be tools for design in the sense that they help articulate and make available a particular kind of thinking, and might eventually generate particular kinds of design representations.

#### 3.1 Design (Sens)-ability and Movement as a Material for Design

In their paper Hallnäs et al. (2001, p. 195) describe how “...artist, designers and architects and engineers build an understanding of the properties of a material...” and that “...a basic understanding of the properties of, e.g., wood, paint, concrete, as materials for design, can perhaps only be achieved by working with them in practice.” The notion of being able to do without explicit bodily understanding is central to how one could think of using and coming to an understanding of movement as a material for design. The designer/mover can interrogate and reflect on movement by moving, doing and performing with movement. Though as pointed out by our study participants the moving/doing/performing needs to be guided by something that focuses or triggers the designer’s/mover’s attention and awareness. Suchman said that “...*the quality of our thinking, depend to a large extent on the appropriateness of the representational resources that we can use in our thinking...* (1994, p. 1). If one agrees that experiential bodily knowing is felt and is a *knowing how*, this means that meaning is produced in and through movement. For interaction design this is a recognition of that the only way we will have access to or know certain things are through moving, in which case interaction designers should move as part of the process of designing – it is about production of meaning in and through movement.

Gaver et al. said about the Cultural Probes that the probes are to be used as resources for “inspiration, not information” for designers (1999). We see the exploration of movement as material for interaction design as a similar resource, that is to develop a sensitivity to issues of movement as a material for design. Though at the same time we believe, based in the understandings we have developed during this research and the approaches reported on at the beginning of this paper, that methods could be developed that would allow designers and users ways of designing, exploring and evaluating movement enabled interactions. That is given an ability to recognise one’s own movement experiences, an ability to reason about how someone else would experience the use of a design and eventually being able to design based in this understanding. Similar to how data gathered from a one-off heuristic evaluation is different from a usability testing session with a participant where one can watch (and talk to the user about what they think), a movement exploration might allow you to observe, explore and engage at (an experiential) level with how it might feel to carry out the interaction.

Our suggestion that experiential bodily knowing is felt and achieved through moving further implies three things directly relevant the design of movement enabled

interaction. First, that what something looks like and the accomplishment of something (bodily speaking) are or can be different experiences. For interaction design this makes available different ways of thinking about movement for interaction, for example by considering aspects of an experience in terms of as *looking good, feeling good* and *getting it done*.

Second, it suggests the incompleteness of verbal articulation of this type of knowing. Though not the focus of this paper, this highlights a major challenge for the design of movement enabled interaction. That is, the choices we as designers make about how to represent movement, as well as what aspects of movement to use for representation both in the design process and as input for sensing technology.

Third, it is not only about how or what movements the technology make you perform in order to enable interaction, but also about how it sets you up (or not) for what is to happen next. This point was also made by Benford et al. (2005), they say "...a moment of interaction is actually embedded in an entire gesture that determines its timing and feel..." this inspired by Bowers and Hellstrom's (2000) discussion of "expressive latitude" when designing and using electronic instruments.

### **3.2 Designing both *from* and *for* the Experience of Moving**

Schön's (1983) notion "conversation with materials" is part of current design practice. Designers draw and gesticulate (among many other things) as part of the process of reasoning, reflecting and conceiving of ideas. In the design studio, ideas and activities are made visible and tangible by means of physical material. A design process is often highly material, and the materials for design are interrogated as part of the process, as knowing through making. Our proposal is that movement should explicitly be interrogated, reasoned about, reflected on and explored in a similar fashion.

Here we look to Gibson's (1979) ecological theory of perception. Gibson said that the world unfolds itself in potential for action; we perceive the world in relation to what we can do with it. Thus, the world is inherently meaningful for our body and by moving we can gain access to that meaning. Artefacts, products and spaces engage with our physicality, and movement is the material in which we engage in a dialogue or conversation with these artefacts. Because interaction creates meaning and meaning generates understanding and knowing in action, it can inspire designers to explore and design useful, usable and enjoyable interactions. Hummels et al. (2007) mention "sensation, dynamic character, story, interaction style, experience, emotion, function, form and semantics" as some of the aspects they have explored. As a designer, an appreciation of movement as a unique material in technology design suggests developing a sensibility for movement that is an ability to recognise one's own movement experiences, reason about how someone else would experience the use of a design, and being able to design based on this understanding.

Our object of inquiry in the work reported here is deep understanding of experiences of moving. As a method for studying relations of technology design and use, it implicitly highlights the aspect of perspective. This should be apparent from Tables 1, 2, 3 where we present descriptions and articulations of visually observable aspects of movement alongside attempts at capturing experience/experiencing.

Others can observe what I am experiencing, but not my experiencing per se. Having an experience while performing a movement does not necessarily determine what the action I am trying to perform is. It is not that the experience determines the action, but that the context determines not only the character of the action, but also the character of experience. Swinging my leg around would not amount to an action in Capoeira or the experience of it without the context of the game. Hence to focus solely on the experiencing as that which explains the character of an action is not adequate either. Experiencing cannot be regarded as distinct from what is experienced. Also, even if it looks the same, it does not mean it means the same.

How do we reconcile these issues methodologically? Human movement can be described from many perspectives, e.g. anatomical, functional, semantic and kinaesthetic, some of which are “easier” for technology to capture and interpret. Our perspective is one of phenomenologically-motivated design research. We propose conceptualisation for technology design based on phenomenological accounts of experience. As such, in addition to employing methods that enable us as designer to think about and around the body, we should also use methods that enable us to think *through* and *from* the body, and equip ourselves to design based on the understandings we generate. Our methods must encourage intertwining and the development of a rich and subtle understanding of experience and awareness of both the potential user and designer/researcher. Also, even though experiences of movement can differ, developing greater sensibilities for recognising one’s own movement experiences strengthen one’s ability to recognise other’s experiences, as well. Our perspective is one of wanting to contribute to the dialogue about the physicality of both users and designers within the field of technology design.

## 4 Conclusion

Merleau-Ponty (1962) said that our skills are acquired by dealing with things and situations, and in turn they determine how things and situations show up for us as requiring our responses. Using Merleau-Ponty’s claim, we have, in this paper, looked at how our participants articulate how their relation to the world is transformed as they acquire skills. From this study of three movement practices, we have sought to contribute suggestions on the nature of experiential bodily knowing and understanding, and movement as a material for design. We did not aim to contribute a particular method, rather this is meant as a conceptual tool to present ways of thinking about knowing and understanding in design practice, specifically aimed at interaction design, but also, potentially relevant for product design and architecture.

At the moment we are exploring further the notion of what it means to *perform movement practice as a professional or trained mover*. Other activities we are considering include developing and testing relevant and specific ways of incorporating bodily engagement into design processes and work practice, and methodological and theoretical ways of grounding this type of movement imagination and reflection.

Experiential bodily knowing is felt. When becoming increasingly familiar with movement as a material for the design of technology interactions, we come to new understandings and nuances of understanding of the material. The focus then becomes

to understand the conditions under which this knowing and understanding is more and less likely to be enacted. As a method, activities that make designers and researchers move and perform movement with prototypes and artefacts while designing can open up for insights into how interaction with new products, environments, or interface may feel to use, in addition to how it may look.

In this paper we have investigated how empirically-based descriptions of the nature of experiential bodily knowing and understanding can be transferable to, and useful for, interaction design. We suggest that the successful design of movement-enabled interactions relies on a designer's ability to reason about movement and responses to movement in an interaction; that is their ability to understand how people might experience an interaction of this kind.

Our aim here has been to provide a theoretical contribution based in and developed from empirical data. Like Klooster and Overbeeke (2005) we hope that this research will engender further discussion on the role of movement in design. We believe the way forward in this important area needs to combine verbal discussions and physical explorations. This is probably also the way to evaluate theories like this one - through moving, exploring, discussing and designing.

**Acknowledgements.** We would like to give sincere thanks and respect to our study participants for their time, effort and insights. We would also like to thank our research colleague Penny Hagen for generously providing sincere and constructive feedback which helped us make significant improvements to the presentation of our work.

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