



Swansea University
Prifysgol Abertawe



Cronfa - Swansea University Open Access Repository

This is an author produced version of a paper published in :
Human Technology Journal

Cronfa URL for this paper:
<http://cronfa.swan.ac.uk/Record/cronfa27794>

Paper:

Eslambolchilar, P., Bodker, M. & Chamberlain, A. (2016). Ways of Walking: Understanding Walking's Implications for the Design of Handheld Technology, a Humanistic Ethnographic Approach. *Human Technology Journal*, 12(1), 5-30.

<http://dx.doi.org/10.17011/ht/urn.201605192618>

This article is brought to you by Swansea University. Any person downloading material is agreeing to abide by the terms of the repository licence. Authors are personally responsible for adhering to publisher restrictions or conditions. When uploading content they are required to comply with their publisher agreement and the SHERPA RoMEO database to judge whether or not it is copyright safe to add this version of the paper to this repository.

<http://www.swansea.ac.uk/iss/researchsupport/cronfa-support/>

WAYS OF WALKING: UNDERSTANDING WALKING'S IMPLICATIONS FOR THE DESIGN OF HANDHELD TECHNOLOGY VIA A HUMANISTIC ETHNOGRAPHIC APPROACH

Parisa Eslambolchilar
Computer Science Department
Swansea University
UK

Mads Bødker
Department of IT Management,
Copenhagen Business School,
Denmark

Alan Chamberlain
School of Computer Science
University of Nottingham
UK

Abstract: *It seems logical to argue that mobile computing technologies are intended for use “on-the-go.” However, on closer inspection, the use of mobile technologies pose a number of challenges for users who are mobile, particularly moving around on foot. In engaging with such mobile technologies and their envisaged development, we argue that interaction designers must increasingly consider a multitude of perspectives that relate to walking in order to frame design problems appropriately. In this paper, we consider a number of perspectives on walking, and we discuss how these may inspire the design of mobile technologies. Drawing on insights from non-representational theory, we develop a partial vocabulary with which to engage with qualities of pedestrian mobility, and we outline how taking more mindful approaches to walking may enrich and inform the design space of handheld technologies.*

Keywords: *walking, mobile, choreographies, non-representational theory, embodiment, design, interaction, HCI, technology, ethnography.*

INTRODUCTION

Mobile computing technologies—by which we mean smartphones, wearable technologies, and a range of other possible devices and infrastructures intended for portability, mobile access, and use “on-the-go”—are available in all kinds of shapes, forms, and appearances, physical and tangible as well as invisible and ubiquitous. These digital artifacts and infrastructures are used in a variety of ways and contexts. In human–computer interaction (HCI), however, most of the approaches taken have been technology driven, with technological abilities defining the contextual applications, interaction, and design (Moen, 2007).

Within the rapidly growing interdisciplinary research community that participates in HCI and interaction design, we find it pertinent to elaborate on approaches for investigating the way the body moves while on foot (i.e., typically walking) that are not technology based or technology focused. This is done in order to explicate issues and understandings that arise from a stronger focus on the body, as opposed to a narrow technology focus. Many advances in HCI are concerned with what novel technologies can do as they shrink in size and gain in processing capability. These approaches are technical in their focus. Rather, we find that seeking inspiration in anthropology and ethnographic research practices enables more grounded accounts of walking. Walking, the rhythmic movement of the body in space and time, is an interaction between the walker and the land. Hence this mundane and taken-for-granted interaction can be considered a form of choreography increasingly entangled with digital information and possible interactions.

In this paper, we position walking as a ubiquitous, mundane, everyday activity that can involve a number of different experiences: from the incidental to the meditative and the arduous; from choreographed and socialized movement to accidental trips, slips, and losing one’s way. Digital technologies have worked their way into day-to-day existence of human beings living in the 21st century more than ever. Technologies have become part of fluent choreographies of mundane embodiment: the everyday ways of walking.

Digital technologies offer beneficial and enjoyable experiences but can also increasingly detract from, or make people disregard, the pleasures, benefits, and human experiences of walking. We suggest that mobile technologies should be mindfully integrated into places, experiences, and situations that emerge from being on foot. We thus intend to raise awareness on the issue of walking as a sociotechnical practice and the challenges inherent in walking as an increasingly virtualized practice and experience.

We accomplish this by developing a partial vocabulary with which to engage with the qualities of pedestrian mobility. In this way, the paper is an attempt to aid and support the translation of walking as a particular form of mobility into HCI, interaction design work, and other practice-oriented engagements with technology. Additionally, walking, as an everyday choreography, offers a reflective space for a range of dynamic qualities. It offers patterns of movement that can provide a nuanced look at the use qualities of wearable devices and how the attendant interactions with these impact mobilities on foot. We suggest a move towards “choreographic thinking” (Loke, Reinhardt, & McNeilly, 2015) as a way to frame interaction design problems. Thinking choreographically, in this sense, means being mindful of patterns, compositions, and qualities of movement, the materials and spaces that structure movement on foot, as well as the software code that governs the way interactive digital and mobile/wearable devices work.

The agenda that we present in this article is framed by recent design-oriented work and research that focuses on embodiment, as well as on literature on walking as a distinctly human practice. We extend this by drawing upon our own experiences of walking in order that we might suggest particular understandings of walking as a practice. The aim is to relay this research to designers and other researchers in the HCI and interaction design communities.

For the design of mobile technologies, it seems increasingly important to ask questions such as, How do digital mobile technologies work with, as part of and in relation to, walking?, How do digital technologies and interactions shape, challenge, obstruct, or otherwise perform, choreograph, and orchestrate experiences of walking?, and, lastly, How can designers attempt to retain the benefits and pleasures of walking in an age of continuous distractions from ubiquitous, mobile, or wearable technology interactions? We argue that such challenges can best be engaged with from within the practices of walking itself.

Technologies have been implicit in the physical performance of walking for millennia. In basic terms, embodied technologies such as shoes, walking sticks, and backpacks, as well as infrastructural technologies such as paths and signs, have always shaped the ways humans walk. The transition from tree-dwelling beings to creatures who walk upright marks a significant phase in human evolution. A discussion on walking as a primordial human activity is not within the scope of the current paper. However, our fundamental assumption is that walking is, and has arguably always been, a hybrid practice that involved technology. Indeed, Rolian, Lieberman, and Hallgrimsson (2010) suggested that the very ability to build and manipulate tools with some precision with the hands may have coevolved with human bipedalism. American philosopher of technology, Don Ihde, in respect to his work on what he termed post-phenomenology (1990), discussed the inherent hybridity of humans and technology; he suggested that being human is fundamentally also being technological.

In this paper we attempt to extend well-known low-tech hybrid bodies (e.g., walker + shoes, walker + stick, walker + shoes + signs/paths) to encompass also mobile digital devices and the attendant digital infrastructures. Moreover, we introduce a number of *qualities of walking*, and we discuss how these might usefully inspire the design of mobile technologies, being mindful of the practices and qualities of everyday walking.

In the following section, we reference a number of examples from studies that have contemplated the movement of the body and experienced walking as a form of digital-hybrid mobility. We also discuss the examples that have identified specific qualities of interactive artifacts in the context of human mobility.

WALKING CONSIDERATIONS FROM THE DESIGN LITERATURE

The need to account for users' motion in HCI is increasingly recognized by interaction designers. There is not yet a shared set of dimensions or analytical frameworks for understanding how a user's bodily movement impacts the user experience, although there are conceptual forays that examine this question (e.g., Fogtman, Fritsch, & Kortbek, 2008).

The role of walking and interaction with technology is often discussed in the context of health and physical activity (Baker et al., 2008; Consolvo, Everitt, Smith, & Landay, 2006; Harries, Rettie, Studley, Burchell, & Chambers, 2013; Lim, Shick, Harrison, & Hudson, 2011; Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006; Toscos, Faber, An, & Gandhi, 2006).

Since the birth of ubiquitous computing and, in particular the emergence of smartphones and consumer wearable devices, the ability to monitor health-related behavior has become more accessible to a wider age group of people. The use of smartphones is currently moving beyond simple step counting to include the social aspects of motivation, goal sharing, and information provision systems. However, no extensive studies have examined or discussed in much detail the qualities of walking experiences in interaction with portable or handheld devices when a person is nudged or chooses to go for a walk.

The authors referenced here have contemplated the movement of the body and experienced walking beyond a sport-based focus (Gros, 2011). We suggest this broader perspective on walking rather than a detailed domain-specific review; in other words, we do not intend to discuss examples with the distinct normative goal of enhancing particularly healthy behaviors, goals, or similar persuasive agendas.

Marshall and Tennent (2013) argued that mobile interaction designs rely largely on what they called a stop-to-interact model. Typically, an interaction with a device that is ostensibly mobile requires the user to stop moving in order to visually focus and manipulate the device. Marshall and Tennent provided a number of useful insights on the design of interactions that do not inhibit movement, including cognitive load, physical constraints, terrain, and other people. Turning towards the felt qualities of various kinds of mobility, Dix et al. (2000) discussed the nature of mobility, such as categorizing the mobility in mobile use contexts as either fixed, mobile (carried by another object), or autonomously moving around.

Isbister and Höök (2009) introduced a use quality that they termed suppleness. They understood suppleness as an interaction quality that relies on subtle social signals, emergent dynamics, and moment-to-moment experiences. As an example, they listed the iPhone as a device that supports supple experiences because of its soft and gentle gestural interaction with the touch display. However the authors did not discuss the suppleness in embodied interaction, and it was only considered in the context of design quality of interactive artifacts.

A distinct focus on movement and embodiment was pursued in Höök's (2010) work on the experience of body movements while horseback riding. Drawing on her own experiences, Höök identified themes such as the bodily ways of knowing, rhythm and balance, coinciding movement and emotion, learning the language of expressing and understanding bodily action, and describing the sensitive and delicate relationship of wordless signs and signals.

Arguing for the importance of embodied practices, Ferreira and Höök (2011) studied a tribal settlement in Vanuatu only recently introduced to mobile phones. The residents of Vanuatu's encounters with mobile use exposed the need to consider the role of the body and the role of movement when designing mobile digital technologies, as these profoundly affect a human's bodily ways of being in the world. Juhlin and Weilenmann (2013) referred to mobility in terms of the physical movements of hunters, dogs, and prey. Hunters interpret such mobilities in terms of accelerations, distance, trajectories, and temporal alignments.

Moen (2005) took modern dance as an approach to (a) provide a vocabulary for describing existing movement, as well as its quality and associated experiences that are physically based; (b) encourage personal style and individual preferences; and (c) find the essence of a movement and express the movement rather than form. Moen used five notions based on Blom and Chaplin's (1998) work to describe different aspects of human movement expressions: kinesthetic awareness, phrasing, forming, relating, and abstracting (Moen, 2007). Moen's BodyBug design took the user's attention away from the device to another form of bodily awareness, that is,

awareness of the device's physical movement, although it is subtle and small (Moen & Sandsjö, 2005). In the BodyBug design, the characteristics of movement are programmable. Tholander and Johansson (2010), in their paper on skateboarders and golfers, showed that these practices do not distract users from human social interactions, even when skilled practitioners are physically interacting with their boards or golf irons. The authors made the case that an interactive technology often forces users to focus on the screen instead of interacting with others around them or with their surroundings. They identified and presented a number of design qualities for "whole body interaction" based on people's performances in these activities. This line of inquiry was followed by Pijnappel and Mueller (2013), who discussed qualities of mobility inherent in skateboarding. Their overall perspective is that it is the interdependency between the user's body, device, and physical environment that drives a rich, social, sustained, and graceful interaction with the artifacts.

On a more conceptual note, Alaoui, Caramiaux, Serrano, and Bevilacqua (2012) referred to movement quality, which they defined as "the distinctly observable attributes or characteristics produced by dynamics independently of movement trajectory or shape" (p. 2). Lim, Stolterman, Jung, and Donaldson (2007), in their work on what they termed interaction gestalt, the holistic experience and aesthetics of using interactive tools, explored how a number of different attributes of digital interaction technologies (e.g., pace, proximity, movement) give rise to an interaction gestalt, that is, the "felt shape" of an interaction with a technology.

Rather than delineating the specific qualities of interactive artifacts, we attempt to shift the focus towards some basic qualities of walking as a ubiquitous and mundane practice that increasingly provides the context for the use of mobile computing. We outline some of the difficulties of recounting walking in ways that are attentive to the seemingly subjective, felt qualities of walking. The paper retains a theoretical focus while, at the same time, exploring alternative ways of shifting theoretical abstraction towards possibilities for concrete, sensory experiences. The intention is not to merely give an account of a frame or a theoretical lens but to invite the reader into the experience of walking in a way that activates some of those sensory qualities that we treat theoretically as well as empirically in the balance of this paper.

QUALITIES OF WALKING AND NON-REPRESENTATIONAL THEORY

We propose to redirect research toward a particular ergonomics of care for bodily ways of knowing and being in the world, without putting a machine-like perspective on what the body is or could be. In other words, walking, in our rendering, is not merely an activity eligible to become enhanced or measured by machines; it is the upright body's natural movement to exist in and explore the world. What we here call qualities of walking are primarily derived from our own experiences as walkers, developed in a dialogue with concepts that originate in the field of human geography, particularly from the field known as non-representational theory.

Lorimer (2005) described non-representational theory simply as "an umbrella term for diverse work that seeks better to cope with our self-evidently more-than-human, more-than-textual, multisensual worlds" (p. 83). The often-stated aim of non-representational theory (or "more-than representational," as per Lorimer, p. 84) is to shift away from strict scholarly abstractions and the perceived necessity of positioning the researcher as a distanced observer. Instead, non-representational theory emphasizes the mobile ephemerality of sense impressions

and moods, the vitality (or aliveness) and affective practices (i.e., practices affected by precognitive forces such as moods or feelings), and it acknowledges the impossibility of fully representing the living, embodied, often chaotic reality of being alive. A key tenet in non-representational theory is the aim to preserve an intimate proximity to practices and to life as it unfolds. In this sense, proximity does not mean bracketing out other things beyond those experienced closely (or losing sight of them). Instead, the aim is to preserve, in writing and in the performance and representation of research, a sense of the aliveness and sensual nature of being. Neither should it be by mimicry nor by the attempt to capture or distill a lifeworld in objective terms, but rather to experiment with animating and making sensuous the worlds rendered.

Non-representational theory and the ethnographic practices that follow from this tradition (see, e.g., Vannini, 2014) are useful for an engagement with walking practices. First and foremost, non-representational theory is “based on the leitmotif of movement in its many forms” (Thrift, 2010, p. 5). It thus shares with the sociological field of mobilities research (e.g., Büscher & Urry, 2011) an interest in the fleeting and ephemeral “on-flow” of life that traditional (or indeed representational) work cannot sufficiently grasp or indeed (re)present as text, given its insistence on an epistemology and the use of methods that freeze and stabilize the world under scrutiny. In this way, non-representational theory is particularly apt for an engagement with emerging forms of mobile life that have materialized in the wake of the massive transformations brought on by digital technologies. Non-representational theory encourages researchers to try to meet life on its own terms, and, in our case, to attempt a (re)presentation of walking in more open, creative, imaginative, and contingent forms.

The first step towards engaging with walking in a way that is espoused by and encouraged in non-representational theory is very simple. We ask the reader to engage in a slightly playful exercise to further understand some qualities of the world as one may perceive it under foot and to explore and explicate some of the sensory dimensions of walking that are challenging to transmute into a strict textual format. To let the reader participate in experiencing qualities of walking, one needs to awaken the feet as a vital way of knowing about the world. A person’s feet are one of the primary points of contact with the environment; however, they are typically consigned to a lower role in the general schema of the body. The feet often take on a more unconscious and perhaps rather mechanical role compared to the hands (which are capable of fine, conscious manipulation) or the visual sense. Although people can perceive the terrain, the path, and many other qualities of walking with their eyes, their feet, as soon as they come in contact with the ground, seem to keep the brain informed about the position of the body at that exact moment, as well as the texture of the ground and the way in which its elevation changes underfoot.

So, to gently shift the reader’s focus down towards the feet, before reading any further, we ask the reader (kindly) to take off her/his shoes and the socks, maybe take a short walk on whatever surface is in the room. How often do we residents of Western societies get a chance to take off our shoes and walk barefoot in public or merely work barefoot in our research labs, offices, or wherever our work takes us? While the reader is engaged in reading this article, then, we propose that the challenges and opportunities of walking with technologies might present themselves with more clarity and emphasis if the reader follows the example of two of the authors during their drafting the first version of this article (see Figure 1).



Figure 1. We are inviting the reader to experience some qualities of walking. It is as simple as taking off one's shoes and socks for a while and feeling the environment through one of the primary points of contacts, that is, the feet.

Our second step is closer to a more conventional representation. The following exposition and development of qualities take the form of short vignettes from our own walking experiences (Authors 1 and 2). We focus upon our own experiences of walking and suggest that walking can be seen as a “marginal practice” (Ljungblad & Holmqvist, 2007, p. 737) vis-à-vis the design of mobile technologies. Ljungblad and Holmqvist described marginal practices as practices wherein individuals share a specific activity that they find meaningful. Participants in such a practice have interests or needs that are particular, but their underlying motivations could be applicable also for a more general group of people. Thus, its practitioners are not regarded as end users but are involved to provide underlying human interests and qualities of interaction relevant for the design outcome.

By relating our own practices of walking, we do not suggest that we constitute a sufficient sample of relevant end users, enabling us to generalize our practices into requirements for mobile technology design. Rather, we suggest that walking, as a reflected practice, is marginal in relation to concrete design problems. Walking and reflections on the practice and experience of walking can thus work to inform design about the underlying human interests and qualities of being mobile with digital technologies and having such technologies at hand.

The fact that we, the authors of the paper, take personal walking experiences and close scrutiny of our collaborative walking practices as a starting point means that our research has duo- and autoethnographic/biographical and confessional sensibilities (Ellis, Adams, & Bochner, 2010; Sawyer & Norris, 2012; Van Maanen, 2011). The vignettes emerge from the first two authors' (Parisa and Mads) ongoing casual interest in walking, an interest that increasingly became a reflective practice as the project went along. These vignettes also constitute a dialogical reflection, developed in collaboration with the third author, on our personal and collaborative walking practices. Some of this dialogue took place as ongoing email exchanges or in the process of writing about our own personal experiences and subsequently sharing and commenting on these. Other dialogues were set in a more formal and intensive setting at a research retreat in the north of Denmark, where Parisa and Mads walked together, interspersed with periods of reflection and collaborative note writing. More dialogue followed from additional incidental walking episodes,

such as walking together to work. Returning to our respective home institutions, a period of refining these notes into more coherent stories about the experience and formulating possible implications followed. Parisa's and Mads' collaborative walking and reflection at the retreat and beyond was followed up by further email exchanges between the two, the sharing of images on Flickr and other social media platforms and a number of Skype calls, as well as collaborative writing up of the experiences in documents and extended notes.

Taking a cue from duo-ethnographic approaches (Sawyer & Norris, 2012), our approach emphasized the role of dialogue in surfacing and subsequently challenging and reflecting on our individual autobiographies and experiences as walkers. Rather than examining practices and recounting them in a seemingly objective fashion, our dialogical and first-person and biographical voicing intends to express some of the richness and complexities of walking experiences from within the felt practice. When writing individually and, for instance, relating a story in spoken form, a companion author would help flesh out words and phrases that adequately described an intersubjective or shared sense of a particular walking episode. Thus our ongoing dialogues, as well as collaborative practices in the form of walking and subsequent reflections, became relevant for understanding and empathically reflecting on our own (private) embodied and mobile ways of being and knowing. While personal experiences are indeed vulnerable to criticism and are possibly highly idiosyncratic accounts that do not typically conform to the authoritative voice of scientific truths, the retelling of experiences in a dialogical space that spanned from rather informal retellings or anecdotes to intense periods of walking alone or together, writing individually as well as cowriting notes at a retreat, to follow-up conversations and further drafts (some of which were dead ends), encouraged Parisa and Mads to take turns writing short narratives that an audience could hopefully relate to, projecting themselves imaginatively into and recognizing in them a sense of the poetics of walking. Our narratives emerge in the current paper as short vignettes or episodes based on the sharing of collected notes, stories, and subsequent write-ups of our individual and collective field work. Some of these are marked as based on collaborative writing (using the plural *we*); some are more private stories retold to the other authors over the course of a few years (using *I* and indicating the author who told the story).

In these vignettes, written and refined by Parisa and Mads through a process of collaborative walking, dialogue, and reflection, we have sought to develop the poetics of walking by adopting a personal, confessional, dialogic, and expressive form. This rendering of our own experience does not aim to set walking against an overarching theoretical framework but rather to evoke some experiences or even memories of walking in the reader.

ASPECTS OF WALKING

Revisiting a selection of our own walking experiences, as well as experiences of walking together as researchers, has led us to describe six concepts that we find particularly pertinent to, and descriptive of, various aspects of walking. These are sensuality; rhythm, synchrony and balance; coincidence and narrative: hybridity; ecology of connection; and creativity. Höök argued that “certain kinds of bodily experiences are best understood through experiencing them yourself—through bodily ways of knowing” (2010, p. 3). Thus we attempt to build these concepts from short narratives or vignettes followed by a paragraph outlining the theoretical or

methodological trajectories and challenges. Our intent is that these qualities can inspire designers to consider ways of walking as means of framing design problems associated with increasingly widespread mobile, embodied digital equipment.

Sensuality

Focusing first on the vitality of walking—that bodily experiences flow and dissipate in and through the body when it is walking—we emphasize that walking is far from mechanical or utilitarian but rather entails a particular way of sensing the world around. Such sensualities of walking are often more pronounced when things do not go according to plans or when mishaps and miscalculations interfere with the otherwise fluent embodiment of walking. For example, two authors of this paper decided to take a walk on the north coast of Denmark. The walk was initially planned to simply get some fresh air and sunlight and to connect with the landscape around the large coastal manor, a dedicated arts and research retreat where we had been cooped up for a couple of days.

We shared a walk on the North Jutland coast of Denmark few days before Christmas, and we wrapped ourselves up in thick coats, hats, gloves, and walking boots. Fearful of catching a cold (or, in one of the author's case, the cold getting even worse), we had already checked the weather conditions and the temperature using a weather app on our smartphones. Soon after embarking on our walk, we realized that we had underestimated the strong northeasterly winds! We aimed to walk a round-trip of 6.5 miles on a cold winter afternoon with only four hours of daylight. After making it halfway through the walk, we wondered whether it might a good idea to hitchhike our way back to a village nearby where we were staying for the week. We were a bit concerned about not being able to see the path, as we did not carry any torches and the daylight was fading rapidly. We did not have any water or food either. Although we were only 3 miles away from the village, we wondered whether we were going to be OK to return home safe and sound. One of the authors pointed to a public facility at an empty car park and suggested that we rest, drink some water, and decide about the best option. It was reassuring to walk with someone in the same boat as you. A few minutes later, we were both determined that we could find our way back to the village with no problems. (Authors 1 and 2's walk, December 2014. Based on collaborative writing at a research retreat)

Vergunst (2008) argued that to understand walking as an everyday activity is not necessarily to attribute repetitiveness to the sphere of the mundane; rather, a particular sensuousness and a tactile way of knowing are central to the everydayness of walking. In the vignette above, our walk increasingly became a ramble across a mildly hostile landscape, and our senses tuned into assessing our abilities to overcome an ordeal. Although we carried both pedometers and smartphones, none of these seemed helpful or even at home in this particular setting. We felt a mounting bodily fatigue, cold winds, achy feet, and an uncertainty of what lay ahead. Also, our lack of water turned what initially began as a pleasant walk into a rather uncomfortable trek.

After participating in walks and observing hill and city walkers' behaviors, Vergunst (2008) argued that walking sensuousness allows the environment to be known through a complex, textured relationship between the walker and the ground. Yet, as much as the beauty of a landscape and other fleeting, pleasant sensations may be actualized in a walk, mishaps and miscalculations are often incorporated within the overall tale of a journey too.

Mishaps occur in all walking environments. Any number of small accidents—such as trips, slips, and losing the way—reveal aspects of the sensory relationships between the walker and her/his immediate surroundings. These mishaps are not exclusively related to rural areas; they happen in urban environments too. Uneven pavements, cobblestone surfaces, traffic, bikes, crowds of people, or ice or snow create little ruses that a walker has to endure and overcome during the walk along.

We were walking together to work in Copenhagen. On what seemed to be a perfectly clear and flat surface in a built environment, I accidentally fell on the pavement. It felt as if there was no reason to fall on the ground other than being a clumsy walker, yet a closer examination of the pavement proved otherwise; there was a small gap between the blocks of concrete. It had caused a little twist on my ankle and the foot could not compensate for that sudden movement, especially as I was wearing slightly high heel boots. For a few minutes we discussed what went wrong and whether it was a slip or trip. We had a shared joke on getting distracted by buildings or a new place. A few minutes later, the slip was a distant memory. (Authors 1 and 2's walk, December 2014. Based on Author 1's notes)

Vergunst (2008) described these mishaps meticulously in his work. Tripping is an intrusion from the environment into the movement of the person. A slip, on the other hand, forces movement of the foot that is usually still. In another words, in the slip, the environment does not intrude substantially into the movement. “Trips are usually minor inconveniences, as the tripped foot is usually able simply to lift itself above the obstacle” (p.110). Vergunst described slips as more serious mishaps. They can cause loss of balance and therefore a fall. The likelihood of mishaps can engender fear in walkers in any environment: fear of slipping on ice, getting lost, being attacked in certain areas of a town, unpredictable weather, walking at night. Therefore the joy of walking is not just about enjoying the landscape; it is the experience of overcoming hardship and of learning (Vergunst, 2008).

When walking along together in precarious conditions, people often converse about the slipperiness of the path, pavement, or road. Such conversations gain their peak in the wet time of the year, which in some countries is not necessarily a seasonal event. Experienced walkers sometimes choose their footwear according to the perceived slipperiness of the path on which they are going to walk. Some walkers change their style of walking; for example, in snow the foot lift is minimized, steps are small, and legs are typically bow-shaped (Vergunst, 2008). In a group walking, there is always sympathy and support from fellow walkers when someone falls, regardless of the reason for falling, and this can benefit the person who has fallen to overcome the fear of slipping in future walks. Research has shown that older adults who experience falls in their home environment begin to lose their confidence in getting out of bed (Good & Medway, 2012). Walking with others can boost one's confidence and the body's capacity to recover. As noted by one rambler in a group walk in which one of the authors participated, “There is always someone there to give me a helping hand if I fall.”

Environments are re-explored and relearned as the walker walks on regular basis; every time, the weather, sights, mood, and physical health of the walker vary. As Vergunst pointed out, “Mishaps are examples of becoming aware of what an environment is *really* like” (Vergunst, 2008, p.114).

Smartphones are capable of perceiving and communicating contextual cues, such as temperature, weather, how strong the sunlight is, and so forth. However, these digital tools are still

far from inferring the shifting textures of the environment, forces, or energies exerted upon (and by) the landscape, and the tactile/sensuous and often miscalculated pragmatic ways of knowing our surroundings.

Moreover, smartphones are fragile devices and they regularly suffer mishaps in the hands or pockets of their users. They also are prone to be lost easily or left behind at the office or home. While walking, if the dropped phone is not in a protective case, it may not survive the fall. And even if it is in a case, it may not fare too well if the case is not overly durable. Many walkers in both rural and urban walks assume the front pockets of their clothing may seem like a safe place to keep the phone. But these pockets are also used for keeping keys and or loose change; so there may be an unpleasant surprise when the phone is pulled out of the pocket: scratches on the screen, dents, and spots.

The manufacturers of outdoor outfits and gear attempt to address some of these mishaps through specific designs to accommodate smartphones' safety. For example, some outdoor trousers and rucksacks have dedicated waterproof pockets for mobile phones. There are solar and biomass chargers designed for phones carried into remote and or extreme environments. These examples show that the focus of attention and care has shifted from carrying the bodies along to care also about the precious digital artifacts carried along. Ferreira and Höök (2011), from their research among the ni-Vans (i.e., inhabitants on Vanuatu), compared this caring for the device to caring for a precious and fragile living thing, like a baby.

The sensuality of caring for one's devices and their links to infrastructures challenges the sensuality of the body. As walkers, we quite often want to feel the wind, sunshine, the rain, wet snow, and cold chill on our skin. Being restricted both mentally (e.g., worrying about our digital tools, how to protect, find coverage, and charge them) and physically (e.g., issues related to our outfit) while walking has the potential to challenge some qualities of the walking experience. To get some fresh air or to clear the head, for many people, means being sensual within their bodies and letting things go. Protecting one's digital devices is an ongoing concern and the chosen outfits may limit or obstruct movement and attentional resources; in other words, a walker's experience of being in the immediate landscape can easily be disrupted by the need to maintain an awareness of her/his digital tools and the attendant infrastructures that make them valuable. A digital device with robust characteristics—similar to a solid pair of walking boots, for example, valued for the distinct patina attained over time—may reduce the overhead of caring for it.

Rhythm, Synchrony, and Balance

The French philosopher and urbanist Henri Lefebvre (2004) has written several essays on urban rhythms. His concept of rhythm concerns the repetition of a measure at a frequency. Lefebvre asserted that the human body is composed of several rhythms; in order to observe rhythms outside of the body, the so-called rhythm analyst must use her/his own rhythms as a reference to unify the rhythms under analysis. In other words, the rhythm is the conjunction of the rhythm-analyst and the object of the analysis. Vergunst extended this concept and argued, "A defining characteristic of rhythm is that it is not fixed but continually answerable to perturbations in the conditions of the task as it unfolds" (2008, p.116). This is about "carrying on," as Lee and Ingold (2006) argued, and entrainment (Gill, 2012)—the falling-into-step of other rhythms and beats. The land provides its own rhythmic structure on walking both materially (e.g., by textures, obstacles, things to avoid, and objects that attract) and semantically (e.g., by providing a

landscape that we seem to read as we go along, interpreting it or stopping to respond to objects, and occurrences along the way). Figure 2 shows the landscape we encountered as a constellation of materials and textures to walk on and across, as well as objects that attracted us and called for pause and observation, thus shaping the rhythm of the walk.

Walking is rhythmic physical movement. While walking, a person never puts weight on both feet at the same time; rather, the weight shifts gently from one leg to the other, which creates a balanced gait, a cyclic rhythm. Every person has a unique rhythm of walking. If a walker is tuned into a rhythm, walking for hours can be tireless; if not, the process can be exhausting even after one hour (Gros, 2011).

We are back in North Jutland, walking together just before Christmas. As we begin our walk along the coast, we don't seem to have a shared rhythm. Perhaps two things intervened. Although we shared an interest in photography, we did not always have one subject of interest to photograph. Thus, looking differently at the landscape made getting into a common stride and synchronizing with one another for more than a few minutes exhausting for both of us. Another, more prosaic, artifact that intervened was footwear. The walking boots of one of us were scraping his heels, making him shift his pace and stride unpredictably. However as soon as we started chatting about something—mostly the history of the area or the landscape, such as a tall lighthouse, rocks on the beach, sea birds, etc.—our rhythm of walking became synchronized. We walked for a while with almost the same stride and the author with less comfortable walking boots almost forgot his aching heels. (Authors 1 and 2's walk, December 2014. Based on collaborative writing at a research retreat)



Figure 2. The North Jutland coast in December: Pebbles and sand structured the route we could take and the rhythm of our walk. A lighthouse, a bright yellow cottage built close to the shore, and ruins of WWII bunkers stretched into the sea attracted our attention and led us to slow down, pause, observe, and then move along again. Each component of a landscape can impact the pace and rhythm of paired walkers.

In the ethnographic study by Vergunst (2008) during a hill walk with a group of ramblers, he related numerous irregular movements regarding going up steep hills and negotiating loose rocks and gorges. Vergunst wrote how “the rhythm of walking took its lead and its tempo from the environment of which it was part,” and that in an “uneven environment, the rhythm of the body was precisely attuned to the continuation of movement up the path” (p.117). Walking as a group creates a shared rhythm/pace of movement and the sounds and embodiment of the foot falling on the ground with people who are in close proximity (e.g., 1–2 meters). Rhythm coordinates other senses, mainly the visual, tactile, olfactory, and aural. Thus, through walking along, walkers come to inhabit (or dwell) in a space together. However the carrying on of walking can sometimes be difficult. The aching heel of one of the authors certainly restricted his movement for a while. Yet it seemed that the rhythmic walk, as well as the features of the ground and the curious objects (e.g., a lighthouse, an old cottage), required becoming attuned to the landscape, both mentally and physically.

Gill (2012) argued that the human capacity to synchronize with one another may be essential for survival as social beings. Moving in synchrony with another person involves mutual awareness or sensing. Mithen (2007) made a similar argument about singing. He imagined early humans, and even Neanderthals, needing a sense of synchrony and being as one in order to take part in collaborative hunting; a lack of synchrony was potentially fatal, either in being killed by wild prey or not being successful in hunting and starving to death. The rhythm of the body and synchrony exist between the self and the other in the mutuality of immediate social interaction (Gill, 2012). Each person has an internal rhythm (e.g., heartbeat, breathing). In becoming aware of and needing to interact with another person, the individual rhythms need to synchronize; and as the people synchronize, they can become entrained. The notion of entrainment denotes how each person mutually adapts to another’s rhythmic beat (Gill, 2012). Human sense making is thereby considered as a process of mutual adaptation that is rhythmic in quality (Gill, 2012). For example, Murray-Smith, Ramsay, Garrod, Jackson, and Musizza (2007) showed that conversation partners on mobile phones can align their walking gait without physical proximity or visual feedback. Using vibro-tactile feedback to make one conversation partner aware of another partner’s footsteps, this feedback was sufficient on its own to create synchrony. However, in the study, complex interference effects, such as breathing in the spontaneous speech condition, also helped people synchronize their pace.

Schabrun, van den Hoorn, Moorcroft, Greenland, and Hodges (2014) found that using a smartphone display, for example, typing or reading a text message while being in motion, affects the user’s gait and balance drastically. Their participants’ gait changed when using their mobile phone, with sending a text having a bigger impact than simply reading one. Schabrun et al. also found that texting caused people to slow down, swerve off course, or move their head from side to side. In summary, participants developed a distinctive posture as they strained to keep their eyes on the screen. The researchers described this posture as robot-like: “To keep their eyes steady on the phone, [the participants] ‘locked’ their arms, trunk and head together, all in aid of keeping their phone in their field of vision, so there was less movement between each of their body segments” (p. 8). This study and previous research (e.g., Menz, Lord, & Fitzpatrick, 2003) showed that an increase in the medial–lateral head motion of as small as 1.5 degrees during texting and reading, which exceeded the threshold for detecting sway with proprioceptive, visual, and vestibular systems in humans, added noise to one’s body balance information. This increased medial–lateral head motion is associated with a greater risk of falling in healthy older adults (Menz et al. 2003).

Arguably, some of the design challenges and framings that arise from an attention to rhythmic aspects of walking have to do with understanding how the rhythms of walking—for example, in walking together—can become part of the wider context that smartphones or wearables can sense and process. Smartphones or wearables with the ability to connect to each other (via, e.g., Bluetooth or other radio protocols), as well as the ability to process accelerometer and other movement data, might enable new forms of entrainment and new ways of socializing.

Coincidence and Narrative

One characteristic of the phenomenology of walking is resolving the dilemma between going forward and pulling back, that is, moving in confidence (where to go) or in fear (losing the way). Lye Tuk Po (as cited in Ingold & Vergunst, 2008, pp. 32–33) suggested that “walking takes us back to where we started from. Every arrival promises a departure but towards a point where we can come ‘here’ again.” Lye described walking as inherently circumambulatory: Walking is about knowing how to find one’s way through overlapping pathways. It includes the fear of losing one’s way and of storms, freezing conditions, hunger, walking too far or too fast, blisters/injuries, and so on.

Similarly the love of a memory attached to a particular landscape can take the walker over and over to the same place as if she/he wants to relive the memory of the walk. Couples often would like to return to the landscape where they first met; every arrival in that particular spot or walking the pathway or similar pathways to the spot promises a future plan and revisits the events that have led up to that point in time.

Walking on a heritage path, a pilgrimage, or simply walking (imaginatively) in the footsteps of one’s ancestors provides walkers with understanding of a world that has both continuity and change (Ingold, in Vergunst, 2008, pp. 40–44), but somehow remains in stasis. In this context, to walk is to pay close attention to the surroundings while pondering the multitude of stories related to the surroundings. Walking allows the person to gain knowledge through action and the ability to use that knowledge, for example, through narrating her/his own stories or by guiding other people. Being knowledgeable is about sharing knowledge: the culmination of listening to stories and following footprints, which also allows each walker to leave footprints for future generations to follow.

After we finally arrived at the North coast village where we were staying, no longer afraid of losing our way, we decided to take a stroll through the village. It was completely dark by then and there were only a few pedestrians walking the streets. Christmas decorations were visible everywhere. Gusts of cold wind blew through the cobblestoned alleys. Some shops had their lights on, showing off the stock and Christmas decorations. Close to the outskirts of the village, we came across a more modern looking two-story building. It had many tall windows, showing long corridors that had rows of doors. The garden was neat and had a few Christmas lights. Almost simultaneously, we both pointed to the building and said it looks like a care home for older people. Despite having different nationalities, despite not having lived or even visited Denmark before (in one author’s case), and not being familiar with Danish design for care homes, the place held a particular feeling, a sense of being a quiet place, a sense of memories and experience, a sense of “logic” of the rural village landscape. It felt as if this sudden “local knowing” had somehow accumulated through our long walk. (Authors 1 and 2’s notes, December 2014, Based on collaborative writing at a research retreat)

The stories we weave as walkers and the ways of knowing we accumulate through movements and sensing the world are increasingly compounds of digital and physical mobilities. Most smartphones are equipped with a global positioning system (GPS) and camera. Walkers frequently use these tools to capture the moment and or the activity they are engaged in at the moment while on-the-go. We walkers can consciously decide to share these captured moments with friends or family members online, publicly or privately, through a Wi-Fi or 3G/4G/5G connection. Smartphones access the Internet via these connections through a series of towers and satellites. In making phone calls, sending texts, or connecting to the Internet, a mobile phone will “ping” or connect with any number of towers that are closest to it. This gives the phone’s general location to anyone who is trying to search for it and, by extension, the location of the person using the phone. Every ping is considered to be a distinct footprint left behind, tracks on the trail. These digital footprints can be used to track not only the phone’s location, but also every phone number, online account, or file shared.

An Internet protocol (IP) address is assigned to each location where the Internet can be accessed. An IP address leaves a digital footprint and that is a direct indicator that tells where a message or file originated. Every item, be it a data file, message, or audio file, will have the originating IP address attached to it in some form.

GPS is another tool widely used on mobile phones to track the device and discover its exact location. The use of GPS is widely associated with way finding. GPS can show where you are, the route you need to follow, and your final destination. The latest generation of GPS technologies is able to track walkers in urban and rural areas who have been involved in a hiking accident or lost their way and are stranded.

Digital footprints are left behind sometimes intentionally and, quite often, unintentionally. In the latter case, no matter how much we as digital users try to erase them, our digital footprints are recorded forever. With the advent of advanced hardware and slick apps, smartphones can make it far easier for digital footprints to reach further and contain more data about our physical and digital existence in the world. The benefits of this are demonstrated by a number of consumers who receive and listen to music on-the-go. For example, the Spotify app on a mobile phone can enable someone to see what her/his friends are listening to and stream or download a friend’s suggestions. Mundane activities, music, and movement are brought together to give shape to mobile experiences. Such experiences, at their core, use metadata as a base to both choreograph and coalesce a range of meanings that are extrapolated from the digital world but originate from a physical interaction that involves a variety of sensory encounters.

As the development of technology has progressed, so seemingly has users’ willingness to tell their stories and to increasingly share personal information with numbers of people. There are nearly 40 million Facebook users and 10 million Twitter users in the UK alone, 80% of whom access these sites via mobile devices, sharing a variety of news, their thoughts, personal feelings, reflections, and photos (Ofcom, 2014). A variety of apps or Web pages allow a user to log in through a Facebook or Twitter account. In such occasions, the user may find a displayed offer that someone else has purchased online or the location of others. This type of automation relies on the person being the linchpin in the system, meaning that, without her/his activity, the system does not work. Unintentional and intentional interaction via technology has consequences.

Sharing personal information, even when it is done intentionally, is associated with a number of risks for users of smartphones. For example, a professional and personal profile compiled from the person’s digital footprint, that is, based on what he/she shares and what

others say about him/her, can have a bearing on many aspects of that person's life, such as in job hunting. Many smartphone users are not interested in sharing their holiday photos with their employer but they may enjoy sharing them with work colleagues. This partial sharing or unwanted sharing may not be straightforward with existing services. One's digital footprints, unlike physical footprints, require conscious and thoughtful planning to limit unwanted exposure and may add unnecessary worry to the users rather than liberating them.

If the devices and the software running on them could not only leverage digital footprints but also enable their users to see how walking physically is collapsed into online digital traces, it might make users more aware of their intentional and unintentional digital movements. The amalgamation of the digital and the physical in this manner could reduce concerns about where and how we leave digital footprints. If digital footprints are left, we digital users could hope that they might disappear over time, like the waves wash away our footprints in the sand.

Hybridity

In the previous section, we discussed physical movement and the way this leaves digital traces or footprints when the walker carries a digital device connected to a network. Walking is a hybrid activity and, as Gros (2011) argued, "it is impossible to be alone when walking, with so many things under our gaze which are given to us through the inalienable grasp of contemplation" (p.38). He claimed everything in the landscape, from houses to fields and from forests to paths, belonged to the walker. Walking is a hybrid practice of a walker who carries things along and the ways in which these things may or may not interfere, enhance, or challenge the experience of a walk:

I am walking with my headphones on, and I hear the "incoming mail" ping from my smartphone. It seems to disturb the rhythmic gait of my walking. My gait becomes stiff. I need to orient myself briefly to make it possible to stop along the street to check my mail. This is perhaps a particularly "mindless" walker and technology hybrid. Through the smartphone, the urban landscape attains a virtual layer that gives rise to distracted and disconnected forms of walking. What if the mobile phone knew from embedded accelerometers that the person is walking along briskly (rather than, say, strolling) and thus notifications could be turned off? How could we create a more mindful hybridity between the walker, the landscape, and the technologies we carry along? (Author 2 notes, November 2014)

Ingold (1993) suggested the concept of "practice-scape," arguing that land, typically represented pictorially as a "-scape" (often related to the term scope, suggesting the visual faculties thus used to master the land), could instead be defined in relation to the tasks and practices possible (and desirable) within it, thus also suggesting the etymology of the -scape suffix as a verb derived from the Old Norse word *skapa*, to create, to give shape. People thus see the land not as a three-dimensional dioramic scope but as a space for engagement and of opportunities dependent on their bodies and the equipment they bring into the land, for example, shoes, skis, an ox cart, a bicycle, a torch, a map, or a digital device. This corresponds closely with the concept of affordance in HCI, which, as defined originally by Gibson (1986), described the relationship between an organism (e.g., a human) and the action potential of the environment as a whole. Building on the notion of the practice-scape, smartphones, GPS watches, and many other wearables designed for walkers increasingly appear as new tools with which to interact

with the landscape as we walk through it. How, then, are these new digital devices brought into practices? In other words, how do they perform particular choreographies of place, and how are they leveraged as artifacts of accountable (walking) practices?

Through the hybrid comprising the walker and a digital device, a sensuality (i.e., the sensed qualities) of the landscape increasingly comes to include a sense of coverage and data infrastructure. For example, when walking in a mountainous area, it will be intuitive for the experienced smartphone user to infer that 3/4/5G reception will increase on the top of a hill and decrease in the trough of a valley. The same goes for urban landscapes where buildings or being indoors has a tendency to deteriorate cell reception. In an ethnographic research project on tourism and mobile technology (Bødker & Browning, 2013), one of the authors walking along with a couple of tourists asked the participants why they wanted to go to the harbor side of a small island rather than a more well-known area of the island? The two women in their early 20s with whom he was walking answered that 3G reception was better on the harbor side of the island and that they already had gone for too long without social media use.

Concerning the artifacts of accountable practice, almost all the walkers that the authors have come across are proud of (or at least quite happy with) the marks and scratches registered on their walking sticks, rucksacks, boots/shoes, or other gear. Worn-out walking gear looks as if the walker has many tales to tell. Props like worn-out boots bolster walking narratives, and the worry of getting scratches on their equipment does not discourage the sojourner from walking. Wearing scratched and visibly worn equipment is about displaying and performing that one has used her/his kit (equipment and clothing) to walk. In other words, a walker's kit provides an account of walking. It becomes an accountable artifact: It demonstrates that the user (and wearer) of the kit is and *does* walking. In many respects, the kit provenances and evidences the activities that the walker has engaged in. It makes the ephemeral, abstract, and experiential nature of walking tangible, obvious, and accountable to others who understand walking. The kit does not interfere or challenge the experience of a walk. In regard to mobile phones, on the contrary, scratches and marks are rarely welcome. Users seem to assign a different value to their phones and, as explained in the Sensuality section, users often try to protect them dearly.

Technologies such as smartphones are not natural inhabitants in environments where the more rugged forms of movement such as rambling or hiking are the norm. Unless referring to very particular models of smartphones, the connotations of such technology rarely indicate that they are at home in the outdoors or in more rugged, adventurous settings.

The emerging practice-scapes of walking with digital technologies challenge the experience in respect to being proud of the walks we have done. The sense of accomplishment is rarely registered or displayed digitally. Although one might view and share fitness-related results and other forms of more structured data from our mobile devices, few (if any) aspects of the embodied reality of walking are registered. Unlike the scratched boot, digital records bear little resemblance to the embodied practices of walking, nor do they say anything about the qualities of a walk, the textures of the landscape, the feeling of embodied fluency, or the mishaps or obstructions encountered. While always there in the sense that movement with mobile devices creates traces and records, these are accounts that feel external to the practice through measuring distance, steps taken, elevation, and so on. To accomplish a genuine sense of hybridity, human–technology relations should create a sense of “being one”—or a centaur-like relation as described by Höök (2010) in a reference to her experiences with horseback riding—rather than being a layer abstracted from the practice.

Ecology of Connectedness

What we call the ecology of connectedness in walking is the connectedness or invisible bond between the walker; material objects such as boots, gadgets, and nature (urban, rural); and seemingly immaterial objects such as feelings, fantasies, and memories. The ecology is twofold: The ecology of connectedness is important for walking and walking is important for connectedness. For example, walking outside is to become wrapped or enfolded in an environment or world that in part consists of the weather, which gives rise to the first impression we walkers make of the world with our bare skin (face and hands) when we step out of the door. Is it cold, warm, humid, windy?

Alan Dix, a prominent HCI researcher, set for himself a challenge in the spring and the summer of 2013: to walk the circumference of Wales, UK, covering a distance about 1,000 miles (Dix, 2013, 2015). Although the walk was a personal journey, it was also a technological one, exploring the needs of the walker and other people along the way.

I had the pleasure of walking for a while with Alan Dix as he walked the circumference of Wales in the summer of 2013. In a full-day shared walking experience with Alan, he talked about how much his feet had hurt because he did not have the right kind of shoes to walk on the Welsh coastal path. He then discovered that sandals are the best shoes for him. Sandals, he said, are good in any weather condition for him. If he feels cold, he wears socks. If he feels hot, he takes his socks off. If it rains, the water does not fill up his boots. The technologies that connected him to the landscape were laminated maps and voice recorders (they had real physical buttons) to record his thoughts as he walked along. He found his touch-based smartphone not particularly helpful as there was poor reception and Wi-Fi connections were scarce. Moreover, on rainy and very sunny days, without shelter from the rain or shade from the sun, the display was more or less unusable. He said, "IT [information technology] deepens the division between rural and urban landscapes, but it should not." (Author 1's notes, July 2013)

The relationship between the walker and the land is complex and multilayered, consisting of the material organization and shape of the landscape, its apparent symbolic meanings and sense of history, and the ongoing sensual perception and experience of movement. Walking not only offers distinctive forms of embodied practices, it is also a (re)production and (re)interpretation of space and place (e.g., see Edensor, 2010). Walkers can never simply pass through the land. Things in the landscape, as well as the things we walkers carry, impose themselves upon the body and our ability to walk. Despite the beauty of the walk, we must endure painful, annoying, and awkward tasks as we walk along. Walkers must avoid barbed wire, be wary when passing through fields, make sure not to step in cowpats or mud or in holes, step over logs, leap across streams, negotiate stepping stones and stiles, swat away swarms of flies, and avoid brambles, nettles, and thistles. In an urban setting, the body is constantly exposed to potholes, curbs, irregular slabs of concrete, other walkers, dog mess, wobbly cobblestones, children, lamp posts, bicycles, manhole covers, puddles, icy patches in the winter, and so on. These actions involve detailed choreographies of walking that enroll human as well as a number of nonhuman actors into a complex, finely balanced dance through the land.

The environment and the climate thus impose upon walking various strategies and sensations. The tactile qualities of many paths produce an interaction and reflection about one's balance that is necessarily mindful, as well as a practical and aesthetic awareness of textures underfoot and all around.

The connection might take on another dimension too. Hiking together, for example, walking as part of a ramblers group, is generally a very sociable experience. Vergunst (2008), in his observations of ramblers, reported that people, when walking up a steep hill, usually walk without talking because the personal effort and the amount of concentration needed to complete the task override talking. “Groups often break up at the bottom of the hill and reconvene at the top (or at the staging post), where the celebration of reaching the summit serves to bring everyone together again as they collectively gather their breath” (Vergunst, 2008, p.116).

The division between rural and urban areas, and even between many urban areas in terms of network coverage, has been discussed in the HCI literature (Chalmers, Dieberger, Höök, & Rudstrom, 2004). Regardless of the distance people walk, the lack of or poor signal reception can make people climb hills, towers, trees, and stairs; scan the room, house, building, and the space around them; and speak loudly on their phones or shout. As a result, they become disconnected from one landscape in order to connect to the invisible landscape of cellular coverage. Getting connected and remaining connected makes people explore the different layers of different landscapes: coverage, socially accepted places, private places, gestures, body movements or orientations, and so on (Ferreira & Höök, 2011). In this sense, refinding the ecology of connectedness in an age of digital communication and infrastructures might indeed entail an ongoing commitment to an invisible “Hertzian” landscape (see Dunne, 2005). Of course, being connected is not only about the signal reception: Smartphones often need to be charged at least once a day. If GPS or other navigation apps are running on the phone, the frequency of charging the phone per day increases almost exponentially (Taylor, 2015). Purpose-built navigation systems have a longer battery life than smartphones and their design is more durable. Hence, aspects of sensuality and hybridity are arguably better addressed in such devices. Being worried about running out of battery or not finding a place to charge the phone have a direct effect on a walker’s sensing and awareness; it shifts the sensuality from caring about the body to caring for a device. Looking for an electricity plug or turning certain apps or services off on the phone to save the battery temporarily disconnects the user from the landscape.

As it is, the invisible Hertzian landscapes remains incidental to the mobile phone users’ performances and particular-place choreographies. By understanding the mobile phone or wearable device, users—performing as hybrid figures and as actors in a larger ecology of connectedness, the electronic landscapes or, indeed, the Ingoldian practice-scapes of connections and infrastructures—can become a resource for designs that strive to embed digital devices gracefully into walking experiences.

Creativity

Gros (2011) argued that open-ended walks allow us walkers to lose ourselves in the experience much more than in planned walks. The open-endedness of walking and the fact that there is not really an endpoint is a quality of particular types of walking that attempt to resist a “pedometer-ideology” of walking. “Medicalizing” the landscape in order to generate a certain number of steps, miles, or kilometers from a walking experience is a very narrow vision of how digital technologies should be part of walking practices. It renders the landscape to simple numbers and measures, negating the experiential and social nature of walking. Instead, invoking a creativity of walking emphasizes qualities of playfulness and the emergent character of walking practices. Creativity and walking practices can relate to the playful or artistic appropriation of places.

In a number of old towns and cities in the UK, artists invite members of the public to attend ghost walks. One of the authors received an invitation to attend a 90-minute ghost walk in city of Bath. It was 8 p.m., and it was a dry and pleasant evening in August. I had looked up the starting point prior to the event but, to be on the safe side, I had printed out a small map with the meeting point highlighted. There were about 28 people on that ghost walk, of whom 16 had a paper map, 4 carried a free map from the tourist office, and the rest knew the place by heart. Everyone had had dinner before the walk. The walk was a pleasant stroll through some major landmarks at the heart of Bath. Everyone appeared to be enjoying the walk. At the final landmark, the artist who had organized the walk said, "Thank you for walking 2 miles with me. I enjoyed sharing ghostly moments with you." Many people were amazed that, in the 90 minutes, they had walked, laughed, felt the fear, talked, and made new friends. (Author 1's notes, August 2014)

Many major cities have an underground service and in some countries employees may go on strike. This is not welcome news to commuters and tourists. However, to alleviate the stress of such situations, some city officials have produced a creative walk design, a walking map for users of underground services, such as the "London Walking Tube Map" (West, 2014). Such maps show the walking distance (in minutes) between each stop along the street. Moreover, it lists the city's landmark sites that would be missed if one traveled underground.

One might similarly look to algorithmic walking as a way of doing "disruptive" engagements, particularly in an urban context. By applying the model of an algorithm to a walk, psycho-geographers (e.g., Pinder, 2005) have attempted to challenge the predictable, orderly, and indeed ordering structures of urban landscapes by applying generative methods to shape a walk. For instance, by scripting the walker to go for "one block, then one block left, then two blocks right, then repeat," any habitual and materially structured walking, devoid of adventure and discovery, is contested. This is an active resistance to the pedometer ideology. Pedometers are certainly designed specifically for bipedalism but, as we have discussed, can be seen as devices that inhibit qualities of creativeness and openness in walking by providing binary (e.g., either you did or did not reach your goal) or exclusively quantitative representations of walking activities (e.g., simply stating the number of steps or length of walk).

The creative design space for pedometer devices (or the output of pedometers) is underexplored. People might, on their own accord, be creative in an effort to maximize the number or steps recorded in a day (e.g., Consolvo et al., 2006; Harries et al., 2013; Lim et al., 2011; Lin, Mamykina, Lindtner, Delajoux, & Strub, 2006), leading them to explore the ability of the pedometer to create new experiences and other qualities of walking. We argue that, even in the health and behavior-change literature subscribing to behavioral and economic versions of motivations and change, psycho-geographical sensibilities might be warranted.

As Rossiter and Gibson (2011) argued, "The ambulatory occupation of urban space permits a myriad of unrealized possibilities to surface, triggering emotions and feelings that may lie dormant in many people" (p. 440). This adds another dimension to creativity. A number of studies have proved that, over time, walking and any physical activity improve thinking skills, both immediately and in the longer term. Walking specifically has been linked to creativity (Oppezzo & Schwartz, 2014).

For centuries, writers, poets, philosophers, and artists have developed their best ideas during a walk. To substantiate this intuitive link, Oppezzo and Schwartz (2014) ran four experiments that demonstrated how walking increases creative ideation in real time and shortly after. In one experiment, adults completed the Guilford's Alternate Uses (GAU) test

of creative divergent thinking and the Compound Remote Associate (CRA) test of convergent thinking while seated and then when walking on a treadmill (indoors). Walking increased 81% of participants' creativity on the GAU, but only increased 23% of participants' scores for the CRA. In another experiment, Opezzo and Schwartz generalized the prior effects to walking outdoors. A further experiment by these authors tested the effect of walking on creative analogy generation. Participants sat inside, walked on a treadmill inside, walked outside, or were rolled outside in a wheelchair. Walking outside produced the most novel and highest quality analogies. The effects of outdoor stimulation and walking were separable. Walking opens up the free flow of ideas, and it is a simple and robust solution to the problem of increasing creativity and increasing physical activity.

IMPLICATIONS FOR THEORY AND APPLICATION

Understanding the interplay between mobility and technology using ethnographic methods is key to the development of new systems and policies that may evolve from these understandings. The methodology used within this research may be applied across other design domains, where people engaged in research (in this specific case) would actively take part in physical activity in order to fully understand the more physical aspects of human activity that language, as a representational form, has difficulty in describing. This novel research offers its readers the opportunity to engage and take part in a process that more traditional approaches fail to offer and, in so doing, it aims to engender a more reflective and interpretive response to the writing that could lead to better theoretical and applied technical solutions that relate to using technology while on the move.

CONCLUDING REMARKS

There is an abundant literature in HCI on quantifying walking, that is, walking performed as a measurable activity in terms of number of steps, calories burned, or miles or kilometers walked. Similarly, the “quantified self” community (see Parviainen, 2016) is interested in generating numerical data from their physical activities, from food intake to waste and energy consumption. The obsession with numbers and quantitative measures has led to some discussion on an increasing commodification of walking, ultimately leading people to forget what it feels like to walk (e.g., Julian van Remoortere, cited in Amato, 2004). In the following, we suggest first a representational strategy that speaks of the importance of taking walking seriously. Second, we emphasize how our reflections in the paper may provide a groundwork for “walking for design” as a methodological implication for design.

Vitality in Walking Research and in Design Practice

We started this paper by asking the reader to take off her/his shoes and socks, maybe to take a short walk. Hopefully, this experience briefly allowed the reader to sense with her/his feet and perhaps reflect on how the ground felt. It might have felt uncomfortable or peculiar but perhaps also liberating. Our intention was to show what happens if we as researchers strive to

preserve the aliveness of research, literally grounding research on walking in our (and the reader's) own experience. Vannini suggested that,

non-representational research renders the liveliness of everyday interaction through methodological strategies that animate, rather than deaden, the qualities of the relation among people, objects, organic matter, animals, and their natural and built environments. In other words, non-representational ethnographies aim to be as full of vitality as the lifeworlds they endeavor to enact. (2015, p. 4)

Obviously, taking off one's shoes and socks is not a sufficient tactic for researchers or designers who want to engage with the choreographies of walking and digital technology. However, the attempt toward a more sensuous and embodied participation in life as it unfolds on foot should remind us—as researchers and ordinary humans—that there is more to walking than getting from Point A to Point B. Walking is about more than just ordered movement. It is more than facilitating the ergonomics of putting one foot in front of the other.

Preserving the vital qualities of walking is, we believe, key to a genuine engagement with walking and emergent ways of walking as a hybrid digital practice and as a felt experience. Vitality in representation attempts to avoid gross abstractions and might replace textual work with methods that concretely evoke such experiential qualities. This, in turn, can be turned into insights for design.

Designing for Walking, Walking for Design

Using strategies inspired by non-representational (or more-than representational; Lorimer, 2005) theory for relating what walking is and what walking can be opens up for a more alive form of scholarship. We find these strategies useful for framing design problems and design activities where precise and unambiguous representations of embodied practices might not necessarily be warranted.

We technology designers need to better understand how technology like mobile phones and wearable devices may subtly or grossly alter bodily ways of being and moving in the world, raising multiple questions. How are the movements of a walker's body synchronized with other walkers? How are we walkers following internal and external rhythms of our bodily movements and the environment around us? How do we feel the sense of wear, accomplishment, and pride but also the slight shocks and ensuing stiffening of muscles brought on by the distractions from virtual layers of connectivity? How do we share stories of our movements around on foot? How do we sense and act on and in the landscape as we walk? How might digital technologies afford us a sense of embodied fluency but also contribute to mishaps or disaster? Perhaps we misstep as we search for digital infrastructures or walk along with our eyes fixed on the small screen in our hands. How do we appropriate technologies into walking? How do we wear it, protect it from mishaps, stay in rhythm with the device (or vice versa) and other device users, or share our digital footprints mindfully, become creative, and integrate digital technologies gracefully into walking practices?

In this paper we have used our own examples from walking and tried to inspire designers to record, reflect on, and generally take their walking seriously as means of framing their interventions and design practices. There are a number of vocabularies describing the specific qualities of interactive artifacts (e.g., Isbister & Höök, 2009; Moen, 2005) that are useful in

considering the many questions and issues raised in this paper. However, our goal in this paper is aimed at shifting the focus towards some basic qualities of walking as a ubiquitous and mundane form of human mobility that increasingly provides the context for using mobile computing. Therefore, we have developed a partial vocabulary of six characteristics with which to engage with qualities of pedestrian mobility: sensuality; rhythm, synchrony, and balance; coincidence and narrative; hybridity; ecology of connection; and creativity.

We believe that designing for mobility, wearability, or walkability can usefully be improved by walking for design. Designers of mobile technology should walk more. Paying attention to the detailed variety and sensuous nature of walking practices is useful and relevant to design. Dix's work (Dix, 2013; or walking, as recounted above) stands out as a particularly sustained engagement with walking practices and technologies. In this paper we have complemented some aspects of Dix's walk (or work) with an initial and open vocabulary for talking about qualities of walking.

REFERENCES

- Alaoui, S. F., Caramiaux, B., Serrano, M., & Bevilacqua, F. (2012). Movement qualities as interaction modality. In *Proceedings of the Designing Interactive Systems Conference* (pp. 761–769). New York, NY, USA: ACM. doi: 10.1145/2317956.2318071
- Amato, J. (2004). *On foot: A history of walking*. New York, NY, USA: New York University Press.
- Baker, G., Gray, S. R., Wright, A., Fitzsimons, C. F., Nimmo, M., Lowry, R., & Mutrie, N. (2008). The effect of a pedometer-based community walking intervention “Walking for Wellbeing in the West” on physical activity levels and health outcomes: A 12-week randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 44–52.
- Blom, L. A., & Chaplin, L. (1998). *The moment of movement*. Pittsburgh, PA, USA: University of Pittsburgh Press.
- Büscher, M., Urry, J., & Witchger, K. (Eds.). (2011). *Mobile methods*. London, UK: Routledge.
- Bødker, M., & Browning, D. (2013). Tourism sociabilities and place: Challenges and opportunities for design. *International Journal of Design*, 7(2), 19–30.
- Chalmers, M., Dieberger, A., Hook, K., & Rudstrom, A. (2004). Social navigation and seamful design. *Cognitive Studies*, 11(3), 1–11.
- Consolvo, S., Everitt, K., Smith, I., & Landay, J. A. (2006). Design requirements for technologies that encourage physical activity. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 457–466). New York, NY, USA: ACM. doi: 10.1145/1124772.1124840
- Dix, A. (2013). Alan walks Wales: One thousand miles of poetry, technology and community. Retrieved March 16, 2016, from <http://alanwalks.wales/>
- Dix, A. (2015). Wales coastal path. Retrieved March 16, 2016, from <http://www.walescoastpath.gov.uk/about-the-path/hall-of-fame/alan-dix/?lang=en>
- Dix, A., Rodden, T., Davies, N., Trevor, J., Friday, A., & Palfreyman, K. (2000). Exploiting space and location as a design framework for interactive mobile systems. *ACM Transactions on Computer-Human Interaction*, 7(3), 285–321. doi: 10.1145/355324.355325
- Dourish, P., Anderson, K., & Nafus, D. (2007). Cultural mobilities: Diversity and agency in urban computing. In C. Baranauskas, P. Palanque, J. Abascal, & S. D. J. Barbosa (Eds.), *Human-Computer Interaction: INTERACT 2007. Lecture Notes in Computer Science* (Vol. 4663. Part II; pp. 100–113). Berlin, Germany: Springer-Verlag. doi: 10.1007/978-3-540-74800-7_8
- Edensor, T. (2010). Walking in rhythms: Place, regulation, style and the flow of experience. *Visual Studies*, 25, 69–79.

- Ellis, C., Adams, T. E., & Bochner, A. P. (2010, November 24). Autoethnography: An overview. *Forum: Qualitative Social Research*, 12(1), unpaginated. Retrieved November 15, 2015, from <http://www.qualitative-research.net/index.php/fqs/article/view/1589/3095>
- Ferreira, P., & Höök, K. (2011). Bodily orientations around mobiles: Lessons learnt in Vanuatu. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 277–286). New York, NY, USA: ACM. doi: 10.1145/1978942.1978981
- Fogtmann, M. H., Fritsch, J., & Kortbek, K. J. (2008). Kinesthetic interaction: Revealing the bodily potential in interaction design. In *Proceedings of the 20th Australasian Conference on Computer–Human Interaction: Designing for Habitus and Habitat* (pp. 89–96). New York, NY, USA: ACM. doi: 10.1145/1517744.1517770
- Gibson, J. J. (1986). *The ecological approach to visual perception* (New ed.). London, UK: Routledge.
- Gill, S. P. (2012). Rhythmic synchrony and mediated interaction: Towards a framework of rhythm in embodied interaction. *AI and Society*, 27(1), 111–127.
- Good, W., & Medway, N. (2012). *Falls: Measuring the impact on older people*. Retrieved November 15, 2015, from the Royal Voluntary Service website: http://www.royalvoluntaryservice.org.uk/Uploads/Documents/Reports%20and%20Reviews/Falls%20report_web_v2.pdf
- Gros, F. (2014). *A philosophy of walking*. London, UK: Verso Books.
- Harries, T., Rettie, R., Studley, M., Burchell, K., & Chambers, S. (2013). Social norms marketing: Reducing domestic electricity consumption? *European Journal of Marketing*, 47(9), 1458–1475.
- Höök, K. (2010). Transferring qualities from horseback riding to design. In *Proceedings of the 6th Nordic Conference on Human–Computer Interaction: Extending Boundaries* (pp. 226–235). New York, NY, USA: ACM. doi: 10.1145/1868914.1868943
- Ingold, T. (1993). The temporality of the landscape. *World Archaeology*, 25(2), 152–174.
- Ingold, T., & Vergunst, J. (Eds.). (2008). *Ways of walking: Ethnography and practice on foot*. Farnham, Surrey, UK: Ashgate.
- Isbister, K., & Höök, K. (2009). On being supple: In search of rigor without rigidity in meeting new design and evaluation challenges for HCI practitioners. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2233–2242). New York, NY, USA: ACM. doi: 10.1145/1518701.1519042
- Juhlin, O., & Weilenmann, A. (2013). Making sense of screen mobility: Dynamic maps and cartographic literacy in a highly mobile activity. In *Proceedings of the 15th International Conference on Human–Computer Interaction with Mobile Devices and Services* (pp. 372–381). New York, NY, USA: ACM. doi: 10.1145/2493190.2493217
- Lee, J., & Ingold, T. (2006). Fieldwork on foot: Perceiving, routing, socializing. In S. Coleman & P. Collins (Eds.), *Locating the field: Space, place and context in anthropology* (pp. 67–86). Palo Alto, CA, USA: Ebrary.
- Lefebvre, H. (2004). *Rhythmanalysis: Space, time and everyday life*. London, UK: Continuum.
- Lim, B. Y., Shick, A., Harrison, C., & Hudson, S. E. (2011). Pediluma: Motivating physical activity through contextual information and social influence. In *Proceedings of the Fifth International Conference on Tangible, Embedded, and Embodied Interaction* (pp. 173–180). New York, NY, USA: ACM. doi: 10.1145/1935701.1935736
- Lim, Y., Stolterman, E., Jung, H., & Donaldson, J. (2007). Interaction gestalt and the design of aesthetic interactions. In *Proceedings of the 2007 Conference on Designing Pleasurable Products and Interfaces* (pp. 239–254). New York, NY, USA: ACM. doi: 10.1145/1314161.1314183
- Lin, J. J., Mamykina, L., Lindtner, S., Delajoux, G., & Strub, H. B. (2006). Fish’N’Steps: Encouraging physical activity with an interactive computer game. In *Proceedings of the 8th International Conference on Ubiquitous Computing* (pp. 261–278). Berlin, Germany: Springer-Verlag. doi: 10.1007/11853565_16
- Ljungblad, S., & Holmquist, L. E. (2007). Transfer scenarios: Grounding innovation with marginal practices. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 737–746). New York, NY, USA: ACM. doi: 10.1145/1240624.1240738

- Loke, L., Reinhardt, D., & McNeilly, J. (2015). Performer–machine scores for choreographing bodies, interaction and kinetic materials. In *Proceedings of the 2nd International Workshop on Movement and Computing* (pp. 52–59). New York, NY, USA: ACM. doi:10.1145/2790994.2790999
- Lorimer, H. (2005). Cultural geography: The busyness of being “more-than-representational.” *Progress in Human Geography*, 29(1), 83–94.
- Marshall, J., & Tennent, P. (2013). Mobile interaction does not exist. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (pp. 2069–2078). New York, NY, USA: ACM. doi: 10.1145/2468356.2468725
- Menz, H. B., Lord, S. R., & Fitzpatrick, R. (2003). Acceleration patterns of the head and pelvis when walking are associated with risk of falling in community-dwelling older people. *Journal of Gerontology Series A: Biological Sciences and Medical Sciences*, 58, 446–452. doi: 10.1093/gerona/58.5.m446
- Mithen, S. (2007). *The singing Neanderthals: The origins of music, language, mind, and body*. Cambridge, MA, USA: Harvard University Press.
- Moen, J. (2005). Towards people based movement interaction and kinaesthetic interaction experiences. In O. W. Bertelsen, N. O. Bouvin, P. G. Krogh, & M. Kyng (Eds.), *Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility* (pp. 121–124). New York, NY, USA: ACM. doi: 10.1145/1094562.1094579
- Moen, J. (2007). From hand-held to body-worn: Embodied experiences of the design and use of a wearable movement-based interaction concept. In *Proceedings of the 1st International Conference on Tangible and Embedded Interaction* (pp. 251–258). New York, NY, USA: ACM. doi: 10.1145/1226969.1227021
- Moen, J., & Sandsjö, J. (2005). BodyBug: Design of kinaesthetic interaction. In *Proceedings of NORDES 2005: In the Making, No. 1* [online]. Copenhagen, Denmark: NORDES.
- Murray-Smith, R., Ramsay, A., Garrod, S., Jackson, M., & Musizza, B. (2007). Gait alignment in mobile phone conversations. In *Proceedings of the 9th International Conference on Human–Computer Interaction with Mobile Devices and Services* (pp. 214–221). New York, NY, USA: ACM. doi: 10.1145/1377999.1378009
- Ofcom. (2014). *Adults’ media use and attitudes report, 2014*. Retrieved November 10, 2015, from http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/adults-2014/2014_Adults_report.pdf
- Oppezzo, M., & Schwartz, D. L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 40(4), 1142–1152. doi: 10.1037/a0036577
- Parviainen, J. (2016). Quantified bodies in the checking loop: Analyzing the choreographies of biomonitoring and generating big data. *Human Technology*, 12(1), 56–74. doi: 10.17011/ht/urn.201605192620
- Pijnappel, S., & Mueller, F. (2013). 4 design themes for skateboarding. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1271–1274). New York, NY, USA: ACM. doi: 10.1145/2470654.2466165
- Pinder, D. (2005). *Arts of urban exploration. Cultural Geographies*, 12(4), 383–411.
- Rolian, C., Lieberman, D. E., & Halgrimsson, B. (2010). The coevolution of human hands and feet. *Evolution*, 64(6), 1558–1568. doi:10.1111/j.1558-5646.2009.00944.x
- Rossiter, B., & Gibson, K. (2011). Walking and performing “the city”: A Melbourne chronicle. In S. Bridge & G. Watson (Eds.), *A companion to the city* (pp. 437–447). Oxford, UK: Blackwell Publishing Ltd.
- Sawyer, R. D., & Norris, J. (2012). *Duoethnography*. Oxford, UK: Oxford University Press.
- Schabrun, S. M., van den Hoorn, W., Moorcroft, A., Greenland, C., & Hodges, P. (2014). Texting and walking: Strategies for postural control and implications for safety. *PLoS ONE*, 9(1), e84312. doi: 10.1371/journal.pone.0084312
- Taylor, B. (2015, May 13). 15 tricks for getting way better smartphone battery life. *TIME* [online]. Retrieved March 17, 2016, from <http://time.com/3820202/better-smartphone-battery-life/>
- Tholander, J., & Johansson, C. (2010). Design qualities for whole body interaction: Learning from golf, skateboarding and bodybugging. In *Proceedings of the 6th Nordic Conference on Human–Computer Interaction: Extending Boundaries* (pp. 493–502). New York, NY, USA: ACM. doi: 10.1145/1868914.1868970

- Thrift, N. (2010). The 27th letter: An interview with Nigel Thrift. In P. Anderson & B. Harrison (Eds.), *Taking place: Non-representational theories and geography* (pp. 183–201). Farnham, Surrey, UK: Ashgate.
- Toscos, T., Faber, A., An, S., & Gandhi, M. P. (2006). Chick clique: Persuasive technology to motivate teenage girls to exercise. In *CHI Extended Abstracts on Human Factors in Computing Systems* (pp. 1873–1878). New York, NY, USA: ACM.
- Van Maanen, J. (1988). *Tales of the field: On writing ethnography*. Chicago, IL, USA: University of Chicago Press.
- Vannini, P. (2015). Non-representational ethnography: New ways of animating lifeworlds. *Cultural Geography*, 22, 317–327.
- Vergunst, J. L. (2008). Taking a trip and taking care in everyday life. In T. Ingold & J. L. Vergunst (Eds.), *Ways of walking. Ethnography and practice on foot. Anthropological studies of creativity and perception* (pp. 105–121). Farnham, Surrey, UK: Ashgate.
- West, G. (2014, April 29). London creative duo’s “walking tube map” helps keep the capital moving during tube strike. *The Drum* [online; unpaginated]. Retrieved March 17, 2016, from <http://www.thedrum.com/stuff/2014/04/29/london-creative-duos-walking-tube-map-helps-keep-capital-moving-during-tube-strike>

Authors’ Note

Dr. Chamberlain’s input into this research was supported through the following EPSRC projects: Living with Digital Ubiquity (EP/M000877/1) and Fusing Semantic and Audio Technologies for Intelligent Music Production and Consumption (EP/L019981/1)..

All correspondence should be addressed to
Parisa Eslambolchilar
Computer Science Department
Swansea University
Singleton Park
Swansea, SA2 8PP, UK
p.eslambolchilar@swansea.ac.uk

Human Technology: An Interdisciplinary Journal on Humans in ICT Environments
ISSN 1795-6889
www.humantechnology.jyu.fi