Feminist STS and Ubiquitous Computing
Investigating the Nature of the "Nature" of Ubicomp

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Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as taking a walk in the woods.

—Mark Weiser on ubiquitous computing (1991, 104)

In the late 1980s, ubiquitous computing made its first appearance in the labs of Xerox's Palo Alto Research Center (PARC) as the "third wave" in computing (Weiser 1996, 2). Mark Weiser along with his collaborators at Xerox PARC envisioned a "new technological paradigm" that would leave behind the traditional one-to-one relationship between human and computer and spread computation "ubiquitously, but invisibly, throughout the environment" (Weiser et al. 1999, 693). Weiser named this new paradigm *ubiquitous computing*, and the term made its first public appearance in 1991 in an article published by the magazine *Scientific American* under the title "The Computer of the 21st Century." The aim of ubiquitous computing was to integrate interconnected computers seamlessly into the world (Weiser 1991, 1993). In Weiser's words, "Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence" (1991, 94). Since then, the field has grown and now counts several peer-reviewed journals, professional conferences, and a number of both academic and industrial research centers that, with the help of millions of pounds in research funding, have set out to study the new "post-PC computing" under names such as pervasive computing, ambient intelligence, tangible computing, context-aware computing, the Internet of things, and others.

From the outset, ubiquitous computing was presented as an approach that differed from other contemporaneous computational projects in its explicit focus on the human and on social interactions, rather than on the technical aspects of technology design. As Weiser wrote, ubiquitous computing sought to "concentrate on *human-to-human* interfaces and less on *human-to-computer* ones" (Weiser et al. 1999, 694, emphasis original) and aimed to shift the focus from the personal computer per se to the ways in which it can enrich users' everyday experience. At the same time, ubicomp's early vision expressed a deep-seated nostalgia for an almost lost, implicitly better world that it ought to revive by taking the focus away from the machines and "back to us" in its promise to return us to a natural, instinctive human state that we were all assumed to share. So, talk of "ubiquitous computers, [that] reside in the human world and pose no barrier to personal interactions" was accompanied by dreams of "bring[ing] communities closer together" and of "mak[ing] using a computer as refreshing as taking a walk in the woods" (Weiser 1991, 104).

Reacting to such proclamations of human centeredness, I met the optimistic visions of ubiquitous and hassle-free interactions with a deep skepticism. For a computer science graduate/aspiring STS scholar like myself—admittedly, with strong Luddite-like tendencies that I always tried to manage productively (with various results), but at the same time someone who was and still is unwilling to surrender to dreams of technological utopias—I was troubled by these visions.

A lot has changed since Weiser first articulated these early ubicomp visions, yet such proclamations of the human-centeredness of ubiquitous computing, where the human is figured in broad, universal strokes, along with its alleged uniquely social approach to design, have proven powerful tropes that have become central to the ways that subsequent projects have articulated and continue to articulate their own ambitious visions. And while some theorists within the ubicomp community have sought to "move on" from Weiser's early visions (Rogers 2006), or to propose alternative conceptualizations (such as Dourish and Bell's "ubicomp of the present" (2011)), they too appear to accept this *one thing*, this one ubicomp that is tied to one person, one place, and one vision, even if only to push against it. Efforts such as these demonstrate that foundational stories might be messy but they are worked and reworked and reworked again through and into (hi)stories, and they become powerful and productive in shaping realities and futures in particular ways.

I wish to intervene in this process and tell a different story. This is a story that not only seeks to resist the inevitability of ubicomp's technological vision and challenge the determinism on which it is based, but also allows an exploration and a reflection on questions such as these: Despite their alleged universality, whose visions are these? What kind of worlds do they imagine and then seek to build in "our" name? And how can we intervene in these futures?

Conscious that by focusing on and foregrounding these foundational stories and figures I too would play part to their reproduction, I am up for the challenge. Haraway (1997), after all, has already warned me that things can get messy.

Stories and Figures

Along with others in the fields of feminist technoscience and STS, Haraway has long argued for forms of engagement and critique that do not pretend to gaze objectively and, hence, irresponsibly, but seek to participate messily and partially in the making and the unmaking of the worlds that technoscientific projects seek to bring forth (Haraway 1988, 1991; Kember 2003; Suchman 2007; Traweek 1988). My story is kin to this body of work and presents one suggestion on how such a critical engagement and intervention can be achieved by resisting the ways that ubicomp frames its stories and upsetting instead the naturalization of its figures as they are produced and reproduced within these stories. In simpler words, I want to narrate the past differently in order to open up possibilities for different futures.

Specifically, mobilized by ubiquitous computing's proclaimed human-centeredness as over against the alleged machine-centeredness of the personal computer, I focus on the interaction between human and machine as one of the core issues that arise within ubiquitous computing. But instead of asking traditional HCI questions—*how can we build a better, human-centered ubiquitous computing?*—I take one step back. I trace through some of its early stories the ways that ubiquitous computing figures the human and the machine, and, through the retelling of these stories, I bring to light the imaginaries that have inspired and continue to inspire ubiquitous computing, and the worlds that it works in turn to enact and materialize. In that way, the critical focus changes from assuming the futures and the relations that these technologies project and then considering the consequences for the subjects involved, to, as Suchman (2007, 224n22) writes, the prior and more immediate question of what kinds of relations, ontologies, and agencies are assumed to be desirable, or deemed to be expendable, in these technological worlds.

To this end, this chapter adopts a material-semiotic approach, and focusing on the stories of ubiquitous computing, it explores how specific figurations get constructed and performed within its context and how, in turn, they perform and bring forth specific versions of reality. Stories and figures are two key tools of the material-semiotic approach, an approach that is not foundational in its nature but descriptive. That is, it seeks to tell interesting stories about how things come into being, hold together, or not (Law and Singleton 2000; Law 2000; Law 2009, 141), while it urges us to shift from questions of reference—*what is ubiquitous computing?*—to relational configurations—*how is ubiquitous computing figured in particular practices and knowledges?*

Figuration is a methodological, descriptive tool, developed most explicitly within feminist cultural studies of science, which seeks to both unpack the domains of practice and significance that are built into each figure and articulate the semiotic and material practices involved in the making of worlds (Castañeda 2002). In other words, figuration provides the means to attend to the dual process through which the figure is produced and brought into being (the figure as an effect) at the same time as, in its turn, it brings a particular version of the world into being (the figure having effects). Thinking in terms of effects, attending to the specific and laborious configurations of knowledges, practices, and powers that bring these effects into being, as Castañeda writes, entails "generating accounts of necessarily powerful and *yet still contestable worlds*" (2002, 4, emphasis added) and, hence, leaves space for other possibilities where things are, or could be, configured differently (see Suchman 2007).

In the rest of this chapter, I turn my attention to one of these stories and specifically to ubicomp's vision to return us to a past and more natural world that the personal computer has arguably displaced, and one that ubiquitous computing seeks to revive, investigating the ways that ubiquitous computing figures nature through specific discursive and material practices. This exploration directs me to an entangled knot that tightly ties notions of the natural, the machine, and the human. Resonant with the scholarship that rejects essentialism and endorses relationality, I trace some of the relational entanglements of these three figures as articulated and performed in ubiquitous computing discourses, having as a guide the question, what is the nature of the "nature" that ubiquitous computing invokes, imagines, and performs?

The Nature of "Nature"

Invisibility was at the core of Mark Weiser's vision. As he wrote in 1993, "It was the desire to build technology truer to the possibility of invisibility that caused me to initiate the ubiquitous computing work at PARC five years ago."[1] Since then the idea of the invisible or disappearing computer has made numerous appearances. Donald Norman wrote a book in 1999 titled *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution*, and the same year the director of MIT's lab for Computer Science, Michael Dertouzos, introduced the *Oxygen* project, which aimed to make computing as pervasive as oxygen (Dertouzos 1999). In 2001, Satyanarayanan identified invisibility as one of the four research thrusts incorporated into the agenda of pervasive computing (Satyanarayanan 2001); the EU, within its initiative on the future of ambient intelligence, co-funded the Disappearing Computer project; and in 2005, *Communications of the ACM* dedicated a special issue to the topic "The Disappearing Computer," where the introduction reads, "It seems like a paradox but it will soon become reality: The rate at which computers disappear will be matched by the rate at which information technology will increasingly permeate our environment and our lives" (Streitz and Nixon 2005, 33).

The question of how we can make computers disappear is being addressed in contemporary computer research in various ways. One of the most prominent of these is the approach of tangible computing, which focuses on the physicality and tangibility of the real world, seeking to build physical interfaces through which the physical and virtual worlds can be bridged. The main advocate of this approach is MIT's "Tangible Media Group," led by Professor Hiroshi Ishii. The group has been working on their vision, which they call "Tangible Bits," for almost two decades now, and in 2009 they were awarded the "Lasting Impact Award" at the ACM Symposium on User Interface Software and Technology (UIST 2009) for their metaDesk project (Ullmer and Ishii 1997). Tangible Bits has positioned itself as the "legitimate" ancestor of ubiquitous computing against various "misinterpretations" and "misuses" of Weiser's concept of ubiquitous computing, and Weiser himself in a personal email to Ishii and his colleague Brygg Ullmer recognized the close affinities between the two projects (see the appendix in Ishii 2004, 1310).

Tangible computing is based on the premise that we inhabit two worlds: the physical world and cyberspace, or as Ishii and Ullmer (1997, 234) put it, the world of atoms and the world of bits. Tangible computing asserts that there is gap between these two worlds that leaves us "torn between these parallel but disjoint spaces." This agrees with Weiser's argument that cyberspace, and specifically the computer, has taken center stage, leaving the real world—the real people, the real interactions—in the background and neglected. Tangible computing seeks to address this problem by "bridg[ing] the gaps between both cyberspace and the physical environment," achieving a seamlessness that "will change the world itself into an interface" (234). Specifically, as Ishii and Ullmer write, "The aim of our research is to show concrete ways to move beyond the current dominant model of GUI [Graphic User Interface] bound to computers with a flat rectangular display, windows, a mouse, and a keyboard. To make computing truly ubiquitous and invisible, we seek to establish a new type of HCI that we call 'Tangible User Interfaces' (TUIs). TUIs will augment the real physical world by coupling digital information to everyday physical objects and environments. . . . Our intention is to take advantage of natural physical affordances to achieve a heightened legibility and seamlessness of interaction between people and information" (235).

In one of his earlier works where he explored the foundations of what he termed "embodied interaction" and the relationship that ties ubiquitous computing and tangible interfaces, computer scientist Paul Dourish (2001a, 232) writes that one of the critical features that tangible computing and ubiquitous computing share is that "they both attempt to exploit our natural familiarity with the everyday environment and our highly developed spatial and physical skills to specialize and control how computation can be used in concert with naturalistic activities." Tangible computing then, as Dourish (2001b, 17) writes, seeks to capitalize on these, now naturalized and unquestioned, skills in order to build computational interfaces that fit seamlessly within our everyday, real world.

The above quotes present a number of themes that I would like to explore further such as ideas of everydayness, familiarity, and naturalness that tangible computing appears to invoke, which are also coupled with notions of directness, transparency, and immediacy. Starting my explorations from the latter, I hope to work my way toward the former. So, anticipating an argument, in the following paragraphs I will try to demonstrate that although, at first glance, the idea that "taking advantage of multiple senses and the multimodality of human interactions with the real world, . . . will lead us to a much richer multisensory experience of digital information" (Ishii and Ullmer 1997, 241) seems to make sense, at a closer look it appears to be reduced to a few sets of simplified opposing dualisms, visual versus tactile, symbolic versus physical, technological versus natural, virtual versus real, mediated versus direct/transparent, where the personal computer comes to embody the first components and the "tangible and ubiquitous ones" the second.

Nature

One conventional way of defining the natural, central to Western thinking, is in opposition to the artificial or the cultural, that is, what is "self-occurring" as opposed to the product of skill or artifice (Soper 1995, 37–38). Tangible computing redefines this distinction, shifting the discourse from issues of productive activity (who produces what) to issues of essence (what is made of what) and introducing a distinction between the world of bits and the world of atoms. The former is occupied by entities such as cyberspace, digital information, and computation. The latter is occupied by everyday familiar material objects such as chairs, tables, bottles, and others that, according to tangible computing, invite tangible and direct interactions. As Dourish (2001b, 16) writes, "A . . . topic of investigation in tangible computing is how these sorts of approaches can be harnessed to create environments for computational activity in which we interact directly through physical artefacts rather than traditional graphical interfaces and interface devices such as mice. . . . So tangible computing is exploring how to get the computer 'out of the way' and provide people with a much more direct-tangible-interaction experience."

Interestingly, in contrast to what Weiser and the tangible computing advocates argue, directness and transparency was what the traditional graphic user interface (GUI) was also striving for; hence, it was based on the idea of "direct manipulation" that sought to "replac[e] the complex command language syntax by direct manipulation of the object of interest" (Shneiderman 1983, 57), and it was described in ways that are uncannily similar to the language used by ubiquitous computing and tangible computing.[2] The use of graphics and visuals, which was the main characteristic of GUI in contrast to the text-based earlier interfaces, and the use of mediatory devices (keyboard, mouse) to manipulate these graphics (which represented virtual objects), led the tangible computing advocates to make the distinction that what we see on our screens is symbolic and the result of mediation and technology, while what we touch is direct and therefore real and natural. "More natural that what, though?" Dourish wonders. And he continues, "More natural, presumably, than the abstract, symbolic styles of representation and interaction that characterize conventional interfaces. Symbolic representation is the traditional core of computational media, and it carries over into interface design, which also relies on symbolic representations. . . . With tangible computing, such symbolism can be displaced by more natural, physical interaction" (2001b, 206). But what does direct and natural actually mean in this context? And does the opposition between symbolic and physical hold when one examines some of the tangible technologies that Ishii and his colleagues have developed?

Let's take for example the *bottles*, a system developed in 1999 by the Tangible Media Group and presented again in 2004 in Ishii's paper "*Bottles*: A Transparent Interface as a Tribute to Mark Weiser." According to Ishii, *bottles* "illustrates Mark Weiser's vision of the *transparent* (or *invisible*) interface that weaves itself into the fabric of everyday life" (2004, 1299). The system, which uses glass bottles as an interface in order to "contain" and "control" digital information, is composed of a table 40 inches tall and 25 inches across made of "rich, luxurious materials"—"The legs were solid aluminum with shelves cut from thick mahogany wood"—while its top, or else the "stage," was made of a layer of frosted glass over a layer of Plexiglas. On the stage, one would find three glass bottles each representing a different instrument. By placing and displacing the tops of the bottles, or else by opening or closing the bottles, the user can start or stop the music of its represented instrument. The system also provides a visual stimulation by three different lights illuminating the three corners of the stage from below. The lights correspond to the manipulation of the bottles in order to provide a more "aesthetically pleasing result" (1304). As Ishii (2004) writes, "The metaphor is a perfume bottle: Instead of scent, the bottles have been filled with music—classical, jazz, and techno music. Opening each bottle releases the sound of a specific instrument accompanied by dynamic coloured light. Physical manipulation of the bottles—opening and closing—is the primary mode of interaction for controlling their musical contents" (1299).

From this we see that again the metaphor is at the center of the interface, even if, instead of the desktop metaphor used in the GUI, we have another metaphor, that of the perfume bottle "that evoke[s] the smell of perfume and the taste of exotic beverages" (Ishii 2004, 1299). Besides (or even apart from) the materiality and tangibility of the glass bottle, it is apparent that Ishii draws from an extensive symbolic history of this object. So he demonstrates, regardless of his insistence on separating the symbolic from the physical, that the two are actually intertwined—intertwined along with the human actor, Ishii himself, with his gendered memories and desires of exotic perfumes and beverages—in a performance that results in the object *itself*.

But this is not the story that Ishii wants to tell. In a way, Ishii and his colleagues perform the glass bottle, or to be more precise, a specific glass bottle, both as an object that has traveled through history and as an object that transcends history. The video that used to accompany the project on the group's website (now available on YouTube)[3] starts with an image of dozens of beautiful glass bottles in an unidentifiable space with no labels and no contents, with different shapes and intricate tops that fill the screen. The bottles are arranged and lit in a way that makes the most of their interesting shapes, colors, and reflections. This image is followed by a black screen with the message "glass bottles have been a part of human culture for thousands of years." The beautiful glass bottle (and not the "ugly" plastic bottle with the screwed top that one is more likely to find in the home) is performed as a stand-alone object without a label, without a context that would ground it or situate it. It is enacted as a universal object that transcends cultures, countries, languages, ages, classes, boundaries and becomes a guarantor of what unites us, a guarantor of our humanness, and in one and the same breath it becomes "nature" as we all know it; maybe some of us find it difficult to open a browser, but we all know how to open a bottle, Ishii (2004) tells us in his article. The screen fades out once again and is followed by another image full of beautifully lit glass bottles. Another message fades in that tells us "glass bottles are tangible and visual, and evoke the smell of perfume and the taste of exotic beverages." Ishii's evocations, memories, desires are performed as universal in a way that we are all made to share a history that is now common and familiar.

This familiarity and commonality then becomes the basis for the natural. Unlike opening a browser, we are told, opening a glass bottle is a common, familiar, and therefore natural action. In one move, nature is reduced to the common, the familiar, and in yet another move, nature is reduced to the direct, the uncomplicated, and the unmediated. And, hence, another dualism is put forth. The natural and the mediated are set in opposition where mediation is deemed complicated, unnatural, and therefore undesirable. This is reflected in Ishii's words where he writes that the origin of his idea to design a bottle interface lies in the concept of a "weather forecast bottle," an idea he intended to develop as a present for his mother. "Upon opening the weather bottle, she would be greeted by the sound of singing birds if the next day's weather was forecasted to be clear. On the other hand, hearing the sound of rainfall from the bottle would indicate impending rain." In these two paragraphs of Ishii's article, the readers are introduced to a nice senior lady who has opened thousands of bottles; "she opened and smelled bottles of soy sauce thousands of times" while cooking for her son and family in her familiar physical environment, that is, her kitchen (2004, 1300). This senior lady, who is made to embody the symbolic alignment between woman, the domestic, and nature (Soper 2000; Rose 1993; Plumwood 1993), "has never clicked a mouse, typed a URL, nor booted a computer in her life." Instead, "my mother *simply* wanted to know the following day's weather forecast. *Why should this be so complicated*?" (2004, 1300, emphasis added).

The idea of a primary set of natural tactile skills appears to come hand in hand with a romantic view of an innocent and long-gone natural world that tangible computing seeks to revive, not only a world in which the personal computer did not fit but a world that the personal computer displaced. Thus, Ishii and Ullmer (1997, 234) write about their decision to start their investigations about the "future of HCI" in the museum of the Collection of Historic Scientific Instruments at Harvard University, where they found "beautiful artifacts made of oak and brass", and again artifice is being overshadowed by essence:

> Long before the invention of personal computers, our ancestors developed a variety of specialized physical artefacts to measure the passage of time, to

> predict the movement of planets, to draw geometric shapes, and to compute. . . . We were inspired by the aesthetics and rich affordances of these historical scientific instruments, most of which have disappeared from schools, laboratories, and design studios and have been replaced with the most general of appliances: personal computers. Through grasping and manipulating these instruments, users of the past must have developed rich languages and cultures which valued haptic interaction with real physical objects. Alas, much of this richness has been lost to the rapid flood of digital technologies. We began our investigation of "looking to the future of HCI" at this museum by looking for what we have lost with the advent of personal computers. Our intention was to rejoin the richness of the physical world in HCI. (234)

The idea of our direct experience of the world through our bodily senses along with the romantic view of a past, purer, and better world that the computer threatens and that future technological developments promise point toward what Leo Marx has described as America's "pastoral ideal," a force that according to Marx is ingrained in the American view of life (2000). Balancing between primitivism and civilization, nature and culture, Romanticism and Enlightenment, the pastoral ideal "is an embodiment of what Lovejoy calls 'semi-primitivism'; it is located in a middle ground somewhere 'between,' yet in a transcendent relation to, the opposing forces of civilisation and nature" (Marx 2000, 23). So, unlike Heim's "naïve realists" who rejected the computer fearing the loss of their world to the virtual and perverse reality that cyberspace was introducing and who called for a return to "God's pristine world" (1998, 37), the advocates of tangible and ubiquitous computing seek to find the balance, the "middle state," that the American pastoral ideal sought to achieve. This is a precarious position that managed to reconcile the disfavor and fear of Europe's "satanic mills" and their destructive consequences on England's "pleasant pastures" with an admiration for the technological power of the Industrial Revolution. Or, in other words, a position that managed to reconcile the admiration for technological development with the bucolic ideal of an unspoiled and pure nature.

Machine

But how was such a balance to be achieved? How could the ideal middle state be achieved balancing the opposing forces of technological development and the dream of the return to a serene pastoral existence? According to Leo Marx, for the European colonizers the New World was to provide the answer to this exact question (2000, 101). The American landscape was to become the terrain where old and new, nature and technology harmonically meet to form a libertarian utopia. Technology was seen as "naturally arising" from the landscape as another "natural 'means of happiness' decreed by the Creator in his design of the continent. So, far from conceding that there might be anything alien or 'artificial' about mechanization, [technology was seen] as inherent in 'nature,' both geographic and human" (2000, 160).

Since then, according to Marx (2000), the idea of the "return" to a new Golden Age has been engrained in the American culture and it appears that the power of this idea informs ubiquitous computing's own vision. The idea of a "naturally arising" technology that will facilitate our return to the once lost Garden was to become a dominant and repeating theme within ubiquitous computing discourses. Hence, Weiser envisioned that ubiquitous technologies will make "using a computer as refreshing as taking a walk in the woods" (1991, 104), and twelve years later and writing about the vision of ambient intelligence, Marzano promises that "the living space of the future could look more like that of the past than that of today" (2003, 9).

But while the pastoral defined nature in terms of the geographical landscape, ubiquitous computing defines nature in terms of the objects, tools, and technologies that surround us and our interactions with them. So, while pastoral America defined itself in contradistinction to the European industrial sites and the dirty, smoky, and alienating cityscapes, within ubiquitous computing discourses the role of the alienating force is assigned to the personal computer. And whereas the personal computer with its "grey box" is rejected as the modern embodiment of the European satanic mills, computation is welcomed as a natural technological solution that will infuse the objects that "through the ages, . . . are most relevant to human life—chairs, tables and beds, for instance, . . . the objects we can't do without" (Marzano 2003, 9). Or else, it will infuse the—as we saw earlier, newly constructed—natural landscape, fulfilling the promise that when the "world of bits" and the "world of atoms" are finally bridged, the balance will be restored. But how did these two worlds come into existence? How did bits and atoms come to occupy different and separate ontological spheres?

Far from being obvious or commonsensical, the idea of the separation between bits and atoms has a history that grounds it to specific times and places, and consequently makes those early ubiquitous and tangible computing discourses part of a bigger story that, as Hayles (1999) has documented and as Agre (1997) has argued, started some time ago. This view is endorsed and perpetuated by both ubiquitous and tangible computing and is based on the idea of the separation of computation from its material instantiation, presenting the former as a free floating entity able to infuse our world. As we saw earlier, tangible computing takes the idea of the separation of the two worlds of bits and atoms as an unquestioned fact, which then serves as the basis for its visions and research goals.[4] In this way, the idea that digital information does not *have to* have a physical form, but is *given* one in order to achieve a coupling of the two worlds, not only reinforces the view of digital information as an immaterial entity, but also places it in a privileged position against the material world. In this light, ideas of augmentation—"TUIs will *augment* the real physical world by coupling digital information to everyday physical objects and environments" (Ishii and Ullmer 1997, 2, emphasis added)—or of "awakening" the physical world (Ishii and Ullmer 1997, 3) reinforce the idea of a passive material world that can be brought to life and become worthy and meaningful only through computation, and in that way make ubiquitous computing part of an even bigger and more familiar story. Restaging the dominant Cartesian dualism between the "ensouled" subject and the "soulless" material object, the latter is rendered passive, manipulable, and void of agency, and just like Ishii's bottles, it is performed as a mute, docile *empty vessel* ready to carry out any of its creator's wishes; hold perfumes and beverages, play music, or tell the weather.

At the same time, computation is presented as the force that will breathe life into a mundane and passive world. "As technology becomes hidden within these static, unintelligent objects, they will become subjects, active and intelligent actors in our environment" (Marzano 2003, 8–9). Computation becomes a free-floating, somewhat natural, immaterial entity like oxygen, like the air we breathe (hence MIT's project named *Oxygen*),[5] that can travel unobstructed through any medium, our everyday objects and our environment. But how far does computation's power extend? Or in other words, what sort of agency is granted to it?

It is interesting to note that while computation appears to be foregrounded as a powerful, almost magical, entity that is able to give life and soul to our soulless material world, at the same time it is presented as rather controlled and muted: "This model of technology [referring to ubiquitous computing] stands in stark contrast to most interactive computational technologies whose complexity makes them extremely obtrusive elements of our working environments, to the extent that those environments—working practices, organizational processes and physical settings—need to be redesigned to accommodate computation" (Dourish 2001a, 231). The computational power that will fill our lives, according to ubiquitous computing, will not be alienating, complex, obtrusive, or even noticeable for that matter, and again we come full circle to ubiquitous computing's goal of invisibility. It will be invisible, as its advocates envision, it will leave no traces and bring no radical changes. If anything it will enable us to *reestablish* our humanness and return us to our past, natural state. It will not change us or our lives by introducing something new and unfamiliar, but it will enable us to "remain serene and in control" (Weiser and Brown 1996). Benefit us but not change us. Serve us but not get in our way. Stay invisible without "intrud[ing] on our consciousness" (Weiser 1994, 7). Ubiquitous technologies, as this story goes, are supposed to blend into the environment as harmoniously as the smoky train and the industrial buildings blend into the American landscape in Inness's painting *The Lackawanna Valley* (1855), which "seems to say that 'there is nothing inorganic'" (Marx 2000, 221).

Human

At least since Descartes and the mechanical philosophers of the 17th and 18th centuries, the machine has come to challenge man's ontology, blurring the boundaries between humans and the artificial. The technologies of ubiquitous computing carry on this tradition. Marzano, in the book *The New Everyday*, asks, "We live at a time when many of our traditional certainties are being challenged. What does it mean to be human? . . . Where is the borderline between the natural and the artificial?" (2003, 10). Similarly, the scientists and theorists who held a forum in 2007 titled HCI 2020: Human Values in a Digital Age for "anyone interested in the ramifications of our digital future and in ways society must adjust to the technological changes to come"[6] pose these questions: "What will our world be like in 2020? Digital technologies will continue to proliferate, enabling ever more ways of changing how we live. But will such developments improve the quality of life, empower us, and make us feel safer, happier and more connected? Or will living with technology make it more tiresome, frustrating, angst-ridden, and security-driven? What will it mean to be human when everything we do is supported or augmented by technology?" (Harper et al. 2008, 10).

In the following paragraphs, I seek to join these discussions. However, instead of assuming the futures and the relations that these technologies project and then considering the consequences for the subjects involved, I investigate the prior question of what sort of humanness ubiquitous computing imagines, desires, and naturalizes. And at this point my questions join another technological story. After a close reading of the discourses and practices of projects ranging from traditional AI (1987) to the more recent developments of ALife and situated robotics (2007), and while investigating what it means to be human, Suchman (2007) has unearthed a strong sense of sameness that underpins these projects. She argues that despite the abundance of experiments that investigate and invite crossings of the human-machine boundary, the Euro-American figure of autonomous and rational human agency remains central and uncontested, an agency that these projects then seek to extend to other entities through tactics of mimicry resulting in *humanlike* machines—machines that look, act, think *like* humans. This leads Suchman to conclude, "Reading AI discourses would seem to indicate that the project is less to displace an individualist conception of agency with a relational one so much as to displace the biological individual with a computational one. All else in traditional humanist understandings of the nature of agency seems unquestioned" (240).

Interestingly, ubiquitous computing seems to reverse AI's strategy and, instead of seeking narratives of sameness, it is the differences between human and machine that it strives to bring to the foreground. Influenced by the work of Suchman, an anthropologist employed at the time in Xerox PARC who in 1987 published a groundbreaking critique of AI, Weiser (1994, 8) rejected AI's mimetic tendencies to build machines that can think and act like humans, exclaiming, "Why should a computer be anything like a human being?" Moreover, he explicitly rejected AI's mentalist origins and its eagerness to make things intelligent or smart: "It is commonly believed that thinking makes one smart. But it's frequently the opposite: in many situations, the less you have to think about the smarter you are. . . . Previous revolutions in computing were about bigger, better, faster, smarter. In the next revolution, as we learn to make machines that take care of our unconscious details, we might finally have smarter people" (1996, 8).

So, whereas AI is dreaming of worlds where one will not be able to tell a human from a machine, ubiquitous computing calls for a future that "takes into account the human world and allows the computers themselves to vanish into the background" (Weiser 1991, 94). At first sight it appears that ubiquitous computing seeks to act as a corrective to AI's blindness to human-machine differences by highlighting those differences—"Why should a computer be anything like a human being?" (Weiser 1994, 8). But does that mean that by seeking to foreground human-machine differences, ubiquitous computing seeks to challenge the traditional humanist imaginaries of autonomous, individual agents with essential characteristics? My answer will have to be no. As we will see in the following paragraphs, while AI fixates on issues of sameness by sidestepping the differences between humans and machines, ubiquitous computing brings some differences to the fore, but at the same time reaffirms aspects of the liberal humanist discourse, which identifies a human essence and defines it in terms of its possessive qualities.

According to C. B. Macpherson (1962), the possessive individualism that appeared in the 17th century has been one key characteristic of the subsequent liberal tradition (1). As Macpherson writes, one of the defining propositions that composes possessive individualism states that "what makes a man human is freedom from dependence on the will of others" (263). Or, in other words, "The human essence is freedom from dependence on the will of others and freedom is a function of possession" (3). From this proposition I want to pull the following threads that connect me to ubiquitous computing discourses. One is the specific articulation of the concept of freedom as independence from the will of others, an articulation that defines freedom as the opposite of control and, as we will see, is being challenged by autonomous technology. The other is the articulation of the human essence according to a historically specific concept of freedom. In other words, I would like to attend to the ways that human essence is constructed in specific ways, which then come to be read back into the nature of humanity itself.

Being in Control

Autonomous technology came to highlight the tensions evident in the ways that liberal freedom was being articulated. While on the one hand, according to Hayles who cites Otto Mayr (1989), autonomous technology facilitated the transition from "the centralised authoritarian control that characterised European political philosophy during the 16th and 17th centuries to the Enlightenment philosophies of democracy, decentralised control and liberal self-regulation" (Hayles 1999, 86), on the other, it undermined the latter's very existence. According to Winner (1978), "autonomy" is at heart a political or moral conception that brings together the ideas of freedom and control." And he continues, "To be autonomous is to be self-governing, independent, not ruled by an external law or force. In the metaphysics of Immanuel Kant, autonomy refers to the fundamental condition of free will" (16). Free will, a fundamental characteristic of the liberal humanist subject, is defined as the opposite of control.[7] In this light, autonomous, self-regulating technology threatens the liberal humanist subject as the question is posed, "if technology can be shown to be nonheteronomous [not governed by an external law], what does this say about human will? Ellul is explicit on this point: 'There can be no human autonomy in the face of technical autonomy.' In his eyes there is a one-for-one exchange" (16).[8]

Ubiquitous computing restages this one-for-one exchange between "us" and the personal computer, each struggling for control. Evident particularly in the early ubiquitous computing writings, the post-desktop vision makes its appearance accompanied by clear statements of what humans and machines are, what the former want and why the latter should be kept at bay, placing the two in opposite and antagonistic terrains, as illustrated in Norman's words: "The problem comes about in the form of interaction between people and machines. . . . So when the two have to meet, which side should dominate? In the past, it has been the machine that dominates. In the future, it should be the human" (1999, 140). The tone for this opposition was already set in Weiser's first writings. Weiser (1991) not only envisioned "specialized elements of hardware and software, connected by wires, radio waves and infrared, [which] will be so ubiquitous that no one will notice their presence" (94). He promised a different human-machine interaction with "machines that fit the human environment instead of *forcing* humans to enter theirs" (104, emphasis added).

Within ubiquitous computing discourses, the computer comes to embody a technological menace, the machine that threatens the liberal humanist value of being free and *hence* being in control. As Norman (1999) warns in a book that was characterized as "the bible of 'post-PC' thinking" by *Business Week*, "Today's technology imposes itself on us, making demands on our time and diminishing our control over our lives" (6). And in another point he exclaims, "We have let ourselves to be trapped. . . . I don't want to be controlled by a technology. I just want to get on with my life, enjoy my activities and friends. I don't want a computer, certainly not one like today's PC, whether or not is personal. I want the benefits, yes, but without the PC's dominating presence. So down with PC's; down with computers. All they do is complicate our lives" (72).

The computer is found guilty on the grounds that it has surreptitiously taken control over our lives. As the website of MIT's first ubicomp project *Oxygen* writes, "Purporting to serve us, [computers] have actually forced us to serve them. They have been difficult to use. They have required us to interact with them on their terms, speaking their languages and manipulating their keyboards or mice. They have not been aware of our needs or even of whether we were in the room with them. Virtual reality only makes matters worse: with it, we do not simply serve computers, but also live in a reality they create."[9]

To make things worse, not only is the computer purported to have taken control over our, that is, the users', lives, but it appears to have even escaped the technologists' control. Note for example the following quote where Michael Dertouzos, the director of the MIT Laboratory for Computer Science from 1974 to 2001, describes the feelings of frustration and, more importantly, disempowerment the computer evokes to a group of prominent computer experts:

> Last year a few of us from the Laboratory for Computer Science at the Massachusetts Institute of Technology were flying to Taiwan. I had been trying for about three hours to make my new laptop work with one of those cards you plug in to download your calendar. But when the card software was happy, the operating system complained, and vice versa. Frustrated, I turned to Tim Berners-Lee sitting next to me, who graciously offered to assist. After an hour, though, the inventor of the Web admitted that the task was beyond his capabilities. Next I asked Ronald Rivest, the co-inventor of RSA public key cryptography, for his help. Exhibiting his wisdom, he politely declined. At this point, one of our youngest faculty members spoke up: "You guys are too old. Let me do it." But he also gave up after an hour and a half. So I went back to my "expert" approach of typing random entries into the various wizards and lizards that kept popping up on the screen until by sheer accident, I made it work . . . three hours later. (1999, 52)

Almost like a modern Frankenstein's monster, the computer is performed here as a creature that appears uncontained, unruly, and, therefore, dangerous. It escapes the creator's control and, hence, comes to embody the liberal humanist's nightmare.

Reflecting the paradox it is based upon—flooding our lives with computers while they effectively disappear—ubiquitous computing introduces itself as a technological alternative to our apparently technologically oversaturated and alienated lives. Ubiquitous computing then becomes the solution; the human-centered, somewhat natural approach, which will shift the emphasis away from the machine and bring control back to its legitimate owner, the liberal autonomous human subject. Ubiquitous computing comes to reclaim the control we lost over our machines and becomes the facilitator of our humanness. Its ultimate promise? To enable us to "have more time to be more fully human" (Weiser and Brown 1996). Or, as Dertouzos (1999) puts it, to reestablish our superiority, placing us, once again, at the center of everything that matters. "Perhaps the time has come for the world to consider a fourth revolution, aimed no longer at objects but at understanding the most precious resource on earth—ourselves" (55).

Through these visions and promises a human essence is being invoked, an essence that, apparently, got lost during the computer's reign. This is an essence that "we" all share and that connects us with our true nature. Tangible computing bases its projects on a set of natural, tangible, and universal skills, and ubiquitous computing is supposed to unite us under our alleged frustration with the personal computer, while promising to facilitate the return to our shared humanness. Work, play, and home (Weiser 1993, 77) become the defining human arenas, tables, glasses, and chairs the defining objects, while we are all meant to be united in our desires to escape our windowless offices with their glowing computer screens and take refreshing walks in the woods. Humanity and nature are here reciprocally performed, both united in one front against the technological, and hence unnatural, "other," the personal computer. But here I seek to follow Readings's lead and ask, "Who are we to speak?" (2000, 118).

As Readings (following Lyotard) has argued, the claim to universality where human essence is constructed in specific ways only to be read back into the nature of humanity itself as timeless, universal, natural, and "essential" (hence revealing its tautological nature) is a strategy that liberalism has championed. Under the republican "we," liberalism sought to "build a consensus that defines its community as that of humanity in its freedom" (Readings 2000, 118), while freedom itself was defined as a function of possession. As such, the Jeffersonian democracy of the New World promised a society where "everyone" would be economically independent. As C. B. Macpherson (1962) writes, "[Individualism's] possessive quality is found in its conception of the individual as essentially the proprietor of his own person or capacities, owing nothing to society for them. The individual was seen neither as a moral whole, nor as a part of a larger social whole, but as an owner of himself. The relation of ownership, having become for more and more men the critically important relation determining their actual freedom and actual prospect of realising their full potential was read back to the nature of the individual" (3).

The gendered and racial conceptualizations of the individual in this quote are not symptomatic. The figure of the universal individual is indeed male, white, and free; or, in other words, in possession of his own land and destiny. Jefferson called him the "husbandman" and Jackson the "common man," yet both terms were to capture the "mythical cult-figure" (Empson's term, quoted in Marx 2000, 130) who, according to Leo Marx, can claim a somewhat moral superiority solely on the grounds of his connection with the unspoiled American landscape (131). A mixture of simplicity and sophistication, and with a distaste for the abstract, the intellectual, and the artificial, the "common man" claims a modesty and an earthly wisdom "embod[ying] the values of the middle landscape" (2000, 133). As Jefferson wrote, "State a moral case . . . to a ploughman and a professor. The former will decide it as well, and often better than the latter, because he has not been led astray by artificial rules." The "true American," according to Jefferson's views, is the ploughman, "whose values are derived from his relations to the land, not from 'artificial rules'" (Marx 2000, 130).

Yet, just as the American pastoral ideal seeks to strike the "middle state" by balancing between nature and technology, the American Everyman balances between his love for the land and his "decided taste" (Jefferson quoted in Marx 2000, 134) for business enterprise and progress, as embodied by Jefferson himself who, as Marx writes, perplexed the scholars with the seeming inconsistency of his views (2000, 135). The figure of the American Everyman appears to work in such a way as to reconcile, or better, hold together, these very contradictions.

In their writings, Weiser, Ishii, and Dertouzos appear to adopt this figure of the noble Everyman along with its inherent contradictions. The ubiquitous computing advocate is a person no different from the next person, they tell us, who, his achievements, position, and knowledge notwithstanding, is just like you and me. Dertouzos's earlier story of the four MIT experts with a computer on a plane is here to prove it. Ishii along with the American pastoral farmer aspires to build technologies that will *simply* ease their mother or wife's everyday tasks: "Sometimes, [the pastoral farmer says], I delight in inventing and executing machines, which simplify my wife's labour" (in Marx 2000, 115). And Weiser wants to connect once again with nature and envisions being able to see the traces of the creatures that occupy his neighborhood, yet without leaving the comfort and safety of his own home: "Once woodsmen could walk through the forest and see the signs of all the animals that had passed by in the previous few hours. Similarly, my see-through display and picture window will show me the traces of the neighborhood as faintly glowing trails: purple for cats, red for dogs, green for people, other colors as I request" (1996, 6).

Yet these apparent contradictions get folded and usually remain hidden from view through the evocations of a universal figure, just as Jefferson's idea of the Everyman, of the republican "we," actually excluded and silenced huge numbers of individuals. In the Republic's case, it was the possessive nature of freedom that created a community of "human" subjects under the republican "we" excluding other humans, such as women, Africans, and the Native Americans, who were unable to own productive property in their own right.[10] Indeed, liberal inclusion has always been exclusive. Yet who/what gets excluded or silenced, in the case of ubiquitous computing, is a different question that would lead us to another story, which we have to leave for another time.

Epilogue

Ubiquitous computing is multiple and messy, and done differently in different sites and different stories (Kerasidou 2017; see also Dourish and Bell 2011). Indeed even Mark Weiser, before his death in 1999, had identified two homonymous yet different things under the name ubiquitous computing. One was his own vision, and the other was what "they" had turned it into.[11] Yet, this multiplicity and messiness is worked in such ways as to get folded into and hidden away. The stories of the multiple and, sometimes contradictory, ubiquitous computing*s*, in the plural, get sterilized, reduced, and almost solidified around this one thing, the one dominant story and history of the founding father with the ordered past and the visionary future. And indeed even when dissenting voices emerge (see Rogers 2006; Dourish and Bell 2011), they are positioned only as reactions to some*thing* already there; something that needs to be pushed against in order to be able to articulate what a *better*, *different*, *alternative* ubicomp might look like. This is *a* ubicomp, as we are all now meant to agree and repeat, that is tied to a specific time, place, and person, and figures strongly, repeatedly, and, as I have demonstrated elsewhere (Kerasidou 2017), reductively, within the technological stories that the emerging field of ubiquitous computing shares across sites and times. This process then results in a configuration sturdy enough so as to be easily and readily reproducible, and one that can become the basis for other foundational stories, such as stories about nature, hence furthering its dominance.

Haraway (1997, 45) warns us that there is no way out of stories, "We exist in a sea of powerful stories" that weave the technical, social, political, mythic, organic, textual together in their world-making patterns. Yet, she asserts that changing the stories, in both material and semiotic senses, is a modest intervention worth making. Ubiquitous computing's proclaimed human-centeredness along with its alleged uniquely social approach to a "simpler" and more "natural" computational design have indeed proven powerful tropes that have informed, and continue to inform, in various ways the visions of ubicomp's offspring projects, hence making their examination and challenge an important goal worth pursuing.

This is then the modest goal of this chapter: to closely attend to some of the stories and figurations that circulate within ubiquitous computing and then to retell them, tell them *differently* as *my* way of intervening. But make no mistake. Telling stories is no simple matter. Technological stories are not innocent (Law and Singleton 2000). Telling stories, writing histories, performing realities are mingled in the same political and ethical turmoil where my own entanglements and interferences "with other performances of technoscience to prop these up, extend them, undermine them, celebrate them, or some combination of these" (769) cannot but be acknowledged.

So, instead of attempting to *merely* reproduce the stories about nature that circulate within ubiquitous computing (as if even reproduction can ever be complete or innocent), this story is the result of my efforts to consciously and cautiously retell ubicomp's stories in my own way as a way of resisting and critiquing the naturalization of its claims, and as a way of intervening in the future that ubicomp imagines and seeks to build in "our" name.

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Notes

1. http://project.cyberpunk.ru/idb/ubicomp_world_is_not_desktop.html.
2. Rutkowski, for example, used the principle of transparency in 1982 to describe a similar concept as Shneiderman's idea of direct manipulation, writing, "The user is able to apply intellect directly to the task: the tool itself seems to disappear" (quoted in Shneiderman 1983, 63).
3. www.youtube.com/watch?v=U4IYyNL4ld8.
4. http://tangible.media.mit.edu/.
5. http://oxygen.csail.mit.edu/.
6. http://research.microsoft.com/en-us/um/Cambridge/projects/hci2020/default.html.
7. See Chun (2006) for an alternative articulation of the relationship between freedom and control.
8. See also Hayles (1999, 86–87) and Wise (1998, 417–20).
9. www.oxygen.lcs.mit.edu/Overview.html.
10. This exclusion is where C. B. Macpherson (1977) bases his argument that the American democracies as envisioned by Rousseau and Jefferson were only precursors to the theory of liberal democracy

and not liberal democracies themselves. According to his reasoning, the defining characteristic of a liberal democracy is its catering to a class-divided society where class is defined on the basis of a wage relation. The Rousseauean and Jeffersonian democracies, according to the author, were not class-divided societies but one-class societies since their promise was that everyone would be able to own or be in a position to own productive land and capital. The fact that "everyone" was a category that paradoxically excluded women (and others) is explained away, according to Macpherson, on the grounds that the women of the seventeenth century could not be regarded as a class since their labor, unpaid and invisible, did not qualify as wage labor and hence was not regulated by the market (17–22).

11. As is recalled in his obituary, Weiser once told Xerox's chief scientist and PARC's director, John Seely Brown, "they've completely missed the non-technical part of what ubiquitous computing is all about" (quoted in Galloway 2004, 386). These two objects were so different that, apparently, the difference led Weiser to discomfort and frustration and even to an effort to change the name of his vision (see the appendix in Ishii 2004, 1310).

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