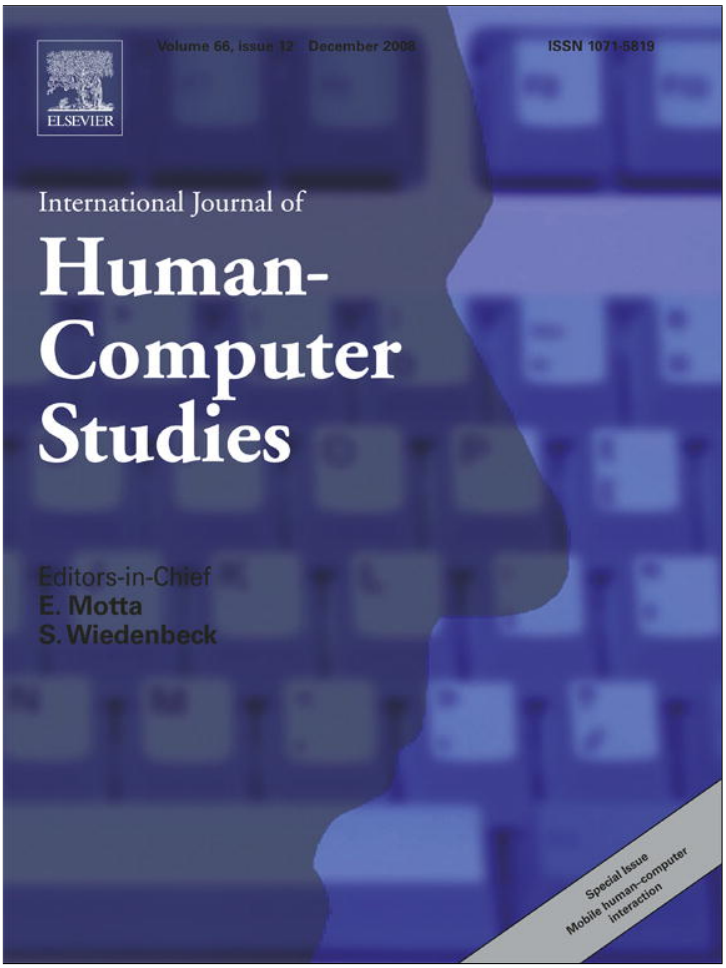

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Storied spaces: Cultural accounts of mobility, technology, and environmental knowing

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Abstract

When we think of mobility in technical terms, we think of topics such as bandwidth, resource management, location, and wireless networks. When we think of mobility in social or cultural terms, a different set of topics come into view: pilgrimage and religious practice, globalization and economic disparities, migration and cultural identity, daily commutes and the suburbanization of cities.

In this paper, we examine the links between these two aspects of mobility. Drawing on non-technological examples of cultural encounters with space, we argue that mobile information technologies do not just operate in space, but they are tools that serve to structure the spaces through which they move. We use recent projects to illustrate how three concerns with mobility and space—legibility, literacy, and legitimacy—open up new avenues for design exploration and analysis.

Keywords: Mobility; Space; Place; Social; Cultural

1. Introduction

Sociologist John Urry (2000) has suggested that mobility, rather than society, may be the primary animating metaphor for sociology in the twenty-first century. He argues that, in contrast to a sociology focused around social stability, sociology must increasingly contend with mobilities of many sorts—movements of people (migrations, diasporas, tourism, "jet-setting", business travel, suburbanization, commutes, and more) but also movements of goods, of capital, of information, and of media—and their dynamics. His argument cuts both ways: not only does it suggest that mobility must be an important concern for social analysis, but it also highlights the importance of social analysis for any account of mobility. Mobility is not simply movement from A to B (Cresswell, 2006). Transnational migrations, economic globalization, and religious pilgrimages are obviously forms of mobility that need to be understood socially, but so too is the daily commute, the venture downtown for an evening's entertainment, or the vacation.

What this implies is that when we approach the topic of mobile technologies, we find ourselves at the nexus of two powerful intellectual and cultural currents. Both mobility and technology are deeply embedded in particular ways of thinking and imagining the world and ourselves. In this paper, our goal is to examine the relationship between these two concepts, and, in particular, to examine the ways in which technology might respond to the many different, simultaneous cultural embeddings of mobility.

This argument extends and develops recent attempts to focus on the social and cultural aspects of mobility in HCI and ubiquitous computing (Brown and Perry, 2002; Ito et al., 2005; Turner and Davenport, 2005; Dourish, 2006b). Questions of spatiality have long been of interest to HCI research, whether they concern the structure of virtual workspaces, the problems of collaboration at a distance, or the choreography of action on collocated environments. In recent years, though, the forms of engagement with the topic of spatiality have changed. Two trends are particularly notable. The first is a response to the spread of wireless and mobile technologies that create new opportunities

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for mobile work and for new spatial configurations of coordinated activity (Weiser, 1991). The second is a burgeoning interest in collaboration beyond traditional working settings, including leisure settings (Brown and Chalmers, 2003; Reeves et al., 2005) and museum and gallery spaces (Heath et al., 2002; Hornecker and Buur, 2006).

These empirical and technical developments have been matched by conceptual accounts that highlight the relationship between spatiality and mobility as topics. In particular, drawing on the work of authors such as Michel de Certeau (1984), some have argued that the social organization of space is a consequence of the ways in which it is inhabited and traversed; that mobility, in other words, is a means through which spatiality is produced (Bidwell and Browning, 2006; Dourish, 2006b).

In this paper, we elaborate this argument by examining the cultural contexts of mobility. We draw on a range of accounts that lie outside of the domain of information technology in order to gain perspective on technological design. We begin by discussing the relationship between mobility, spatiality, and technology as it has developed in HCI research before presenting a series of contexts—mythic, moral, imagined, and historical—for everyday mobility, and reflecting on what these might tell us about the prospects for mobile interactive technologies.

2. The social organization of spatiality and mobility

Spatial metaphors pervade technical discourse. The creation of electronic or virtual spaces for collaboration remains a goal of many projects; they talk in terms of collaboration *environments*, shared work *spaces*, discussion *forums*, data *warehouses*, and similar objects. When we think of collaboration support, it seems, we think of it often in spatial terms. Spatial arrangements dominate the ways in which we understand collaborative problems (Olson and Olson, 2000; Reddy et al., 2006) and so we often draw on spatial models and metaphors of movement and mobility in formulating solutions.

Our embodied experience of the everyday world is not least a spatial experience, and the spatial foundations of both everyday cognition and scientific practice has been explored in some detail (Lakoff and Johnson, 1980; Lakoff and Nuñez, 2000). Nonetheless, the incorporation of social science perspectives within HCI has given rise to critiques of a purely instrumental account of space and collaboration (Erickson, 1993; Fitzpatrick et al., 1996; Harrison and Dourish, 1996; Dourish, 2006b). We will briefly outline this work here in order to highlight its connection to questions of mobility and technology.

The distinction between "place" and "space" raised by Harrison and Dourish (1996) is, essentially, a distinction between two accounts of spaces—a geometric account and an experiential account.[1] At times, this has been read as a distinction between physical and social forms of spatiality, but we want to argue differently here. We want instead to suggest that place and space are both social products, but products of different forms of social practice.

The distinction that Harrison and Dourish draw responds to attempts to reproduce aspects of social interaction by reproducing aspects of the physical world in virtual systems. They associate this with an attempt to focus on "spatial" interaction and geometric features of the everyday world (such as mutual orientation and the locality of action.) Harrison and Dourish use the term "place" to point towards the social nature of spatialized activities and a social and cultural encounter with settings of action. They argue that collaborative activities are shaped not simply by the spaces in which they arise, but by the social and cultural interpretations of those spaces. Their fundamental point is that, while the physical dimensions of spaces and objects clearly afford different kinds of action, "appropriate behavioral framing" is not purely a consequence of geometry.

This argument has motivated and supported much subsequent work on the spatial organization of collaborative action (Mansfield et al., 1997; Churchill and Bly, 1999; Benford et al., 2001; Jones et al., 2004; Ciolfi and Bannon, 2005). One response has been to look for the ways in which, through patterns of action and habitation, people transform physical "spaces" into social "places." However, while we are sympathetic to the intent of this response, we would disagree with the commitments that underlie it. In particular, we would like to question the central idea that the spatial nature of the world is absolute and pre-given, and that place is logically and temporally subsequent to space. Seeing the social as effectively separate from and consequent to an underlying physical world of which spatial dimensions are essential properties is an approach reminiscent of what Kling et al. (2000) refer to as the "layer cake model" of socio-technical systems. The problem with this perspective is that it confuses the world itself with the concepts that we use to understand and refer to that world. The very features that the geometric view describes as "essential" properties of the everyday world—orthogonal axes, infinite planes, and dimensionless points—are themselves social products, and elements whose appropriate use is negotiated through linguistic and social interaction.

Following Curry (2002, 2005), we adopt a different view of the relationship between place and space, which sees both as social products, although the outcomes of different kinds of practices. By this view, space is not simply an "inert container" for the places of everyday experience;

[1] This work drew on existing understandings outside of CSCW such as that of Tuan (1977), which formed part of the architectural perspective (*footnote continued*) that was a component of Harrison's professional background and part of the motivation for Media Space research (Stults, 1989; Bly et al., 1993). What is more, similar ideas arose around the same time in the work of others (Fitzpatrick et al., 1996). So these are by no means unique contributions of that particular paper, although it is perhaps the most regularly cited source for the distinction.

rather, space itself is the outcome of particular ways of reasoning about and representing the world.

In this alternative reading, the focus of "place" is the experience of particular locales—our embodied experience of settings as having particular kinds of extent, opportunity, and potency. "Place" is fundamentally here about difference and distinction—about what makes one place different from another, and how the boundaries and transitions are encountered and defined. In everyday life, what we encounter and experience are "places": settings invested with particular relevances through a combination of physical affordance and cultural meaning. When we think of being somewhere—at the office, in the woods, on the edge of a bluff—what we think of are places. "Space," by contrast, is a mathematical construction by which our discontinuous experience of the everyday world is made uniform. "Space" concerns those properties of measurement and uniformity by which settings can be connected and understood. The fundamental achievements of the "spatial" view are uniformity and connectedness. Space, then, is a creation, a product of movement and reflection (de Certeau, 1984). When we talk of moving through space, or the space between two points, we invoke the notion of a uniform continuum by which the distinctiveness of place is erased or submerged.

So it is precisely in connection to these issues of connection and disconnection, or uniformity and difference, that mobility and mobile technologies play such a key role. Patterns of connection arise around forms of movement and mobility; our sense of spatial organization arises in consequence of the patterns of movement of everyday life, as made visible in Kevin Lynch's (1960) studies of people's egological maps of their cities. At the same time, technologies of all sorts—from passenger jets and handheld GPS to maps—give us ways of seeing places as connected or unified. Technological infrastructures, in particular, create "seams"—the boundaries between zones of operation and non-operation, regions of stability and difference (Chalmers and Galani, 2004; Dourish and Bell, 2007). We start to navigate and understand spaces in terms of the ways in which they reveal themselves to us as we move through them, and in terms of the portability of practice as we move—whether we are within the range of a cell phone tower, a Wi-Fi zone, a power outlet. New technologies, new technological practices, and new forms of mobility are associated with new ranges of questions about sameness and difference that give everyday space structure and meaning. If there is cellular coverage, is it 3G, EV-DO, EDGE? If there is Wi-Fi coverage, is it with a provider I can use? If there is no Wi-Fi, what part of town can I get myself to where I might find some?

Mobile technology is not, then, simply operating within a spatial environment; it is implicated in the production of spatiality and spatial experience. Our ideas of how spaces are organized are mediated by technologies and the representations they produce. We are all familiar with the arguments that Mercator's projection, a mapping of the spherical surface of the earth onto a flat plane, is navigationally effective but misrepresents the relative areas of different regions of the world (Wood, 1992). Arguably, given its computational properties, Mercator's map does not represent space but rather represents movement. Again, space is understood through movement, here in terms of a planar representation. It should be clear, then, that technological representations of space also come with "points of view," and that, like cartographic representations, these technological representations are implicated in ways of knowing the world.

3. Environmental knowing

In the previous section, we argued that particular ways of knowing the world around us are mediated by technological and cultural lenses. David Turnbull (2000) has used maps and spatial experience as a site to compare technoscientific and indigenous knowledge and the practices that give rise to each. Similarly, we have argued that the mathematical and informational accounts of space are not natural accounts but cultural accounts; they reflect the deployment of cultural logics by which we organize and make sense of our world. The cultural logics by which we understand spatial practice are in turn embedded in the technological products that we bring into those spaces and use to support those practices. In order to gain a broader view, what we want to do here is to explore some alternative cultural logics of space and movement—other ways in which spaces might be encountered and found meaningful, and other forms of environmental knowing (McCullough, 2003). Accordingly, we step away from mobile technologies for a moment, to gain some perspective that will illuminate a later discussion of mobility and digital systems.

3.1. Mobility in mythic space

Our first example is drawn from studies of aboriginal Australian belief system and how it shapes the encounter with the landscape. To the indigenous Australians, places carry the resonance of things that have happened there, of people who have been there and actions that they took. Consequently, the landscape is encountered in terms of its history, including both recent human history and mythic history. This historical aspect of space, and the links with events and people of contemporary times, recent history, and the far past, conditions all aspects of the experience of the landscape.

The wellspring of much of indigenous Australian belief is the continuous and active link between current times and the Dreamtime, a period after the creation of the land but before it took on recognizable features (Stanner, 1958). During this time the land was occupied by mythic creatures, generally large forms of contemporary fauna. As these creatures moved across the land, their actions left marks in the form of the contemporary landscape—mountains, hills,

rivers, and so forth. So the landscape is a visible remnant of these activities. The meaning and significance of space is connected, then, to the actions of the beings whose movements are recorded on the face of the landscape. Further, these creatures are totems for different kin groups, and so the landscape takes on a spiritual essence and ritual responsibility in how it is connected to one's own lineage. The link between the Dreamtime and the present day[2] is, then, one that is active and must be maintained—one "has a dreaming" for a particular place, representing one's ritual responsibility not only for its upkeep but for dreaming it into existence, maintaining the connection between the mythic dimension and everyday life.

Just as the landscape carries the signs of ancient actions, so too do the more recent activities of human inhabitants leave their traces. So, in addition to religious sites, former settlements, of particular meetings, of battles and births and deaths, also leave an imprint in the landscape, and become important aspects of the way in which the landscape presents itself to people. Human activities are oriented towards the potencies that places have on the basis of these actions. Settlements, for example, may be laid out to reflect the migration of the people from different directions (Bell, 1983). Places are celebrated or avoided according to the ways in which one is related to the events recorded there. This knowledge, too, is not evenly distributed; the stories that give places their potency may be the stories of different clans, lines, age groups and genders. Place and identity are deeply bound together (Myers, 1986).

Navigation through a landscape is conducted with a consciousness of the pattern of relationships between people and the land. Indeed, aboriginal Australian navigation is often marked by extensive detours reflecting taboos between people and places, perhaps on the basis of ancient history or on the basis of contemporary events such as encampments of others on their way to ritual events (Munn, 1996) or exclusions on the basis of gender or lineage groups (Bell, 1983). Appropriate mobility is cultural participation.

The landscape is understood, then, in terms of its relationship to social groups and cultural meanings; movement in the landscape itself becomes meaningful because of the ways in which it juxtaposes physical and cultural constraints. There is a bidirectional link at work here. To be able to understand the space, you must understand the history through which it should be read; similarly, to understand that history, one needs to be able to access and experience the space. Specific cultural considerations—such as taboos on the names of dead relatives, secrecy about the sacred sites for which one bears ritual and custodial responsibility, restrictions over the ways in which information can be passed on—have resulted in clashes between the indigenous peoples and later settlers over land rights (Hill, 1995; Verran, 1998).

The intertwining of spiritual, social, cultural, historical and spatial aspects of the landscape is at odds with Western conceptions of space and spatiality, and in particular with Western models of land governance and ownership practices (to which we will return), and the separation between the land and the knowledge of the land. It is not merely that people have stories and knowledge about the land; such knowledge is, rather, inseparable from the land itself, and so fundamentally an aspect of one's experience of it, both individually and collectively. The knowledge of the landscape, one's presence within the landscape, and the cultural traditions that govern and shape one's experience, are indistinguishable.

3.2. Mobility in moral space

Our second example draws on Native American experiences of space. Like the Australian case above, Native American practices connect physical spaces to cultural values, but in different ways. In what we present here, we draw particularly on Keith Basso's studies of the Western Apache (Basso, 1988, 1996).

Basso's account of the role of the landscape is strongly connected to stories told about it. Stories play a prominent role in Native American cultural practice, conveying both history and moral and practical lessons. Stories are, in fact, the primary ways in which these lessons are conveyed, and everyone learns a stock of stories and their implications. Wisdom, for the Western Apache, consists partly in being able to draw appropriately on a collection of stories in order to illuminate current situations. Being sensitive to these resonances, and being able to draw appropriately on the stock of stories to understand current events, allows the wise to avoid potential mishaps.

Further, stories are set in places; placeless events are nonsensical. Indeed, the names of those places may be used to refer both to the stories and to the moral lessons that they embody. The places where stories happened are always reported, and allow people to imagine themselves there, since these places are not imaginary or distant ones, but places that are generally known to the people who tell and hear them. Indeed, in line with their view of conversation as a cooperative effort, a good storyteller amongst the Western Apache does not talk a great deal; being a good storyteller rather involves "giving people pictures," helping people to visualize themselves in places, where the story may play out in front of them. These places (and, indeed, particular spatial orientations and vistas) are so central to the telling of stories that their names may become proxies for the stories themselves. It is not just that stories are about places, then, but that stories are about *being in* places.

For example, Basso recounts a number of examples where people comment on a current event by listing a series

[2]The Dreamtime is perhaps more accurately thought of as a parallel time rather than one that has passed and gone; it continues, and the link between the Dreaming and the present is one that is maintained through the lives and actions of contemporary peoples.

of place names (“It happened at Line Of White Rocks Extends Up and Out, at this very place! It happened at Whiteness Spreads Out Descending To Water, at this very place!”), which are not intended to situate the events spatially, but rather to draw others' attention to the analogies between the current situation and the stories of the events that happened at those places. The names of familiar places stand for the stories and for the lessons that the stories contain. The landscape is central to the telling of stories, and central, therefore, to the work that stories do.

Certainly, the stories reflect practical lessons (where to get water, where to find shade, where to plant crops, etc.) that make an unforgiving landscape a little easier to navigate and inhabit. But the work that the stories do is also moral. The stories capture the lessons of experience (either historical or mythic) and, through their repeated retellings, reinforce conventions of appropriate behavior and social norms. Again, the places where the stories take place are, generally, local places, well known to those who use the stories. They are part of daily experience. Consequently, a strong connection is formed between the moral foundations of social order (as expressed in the stories) and everyday experience of space. In one telling example that Basso relates, a girl talks of being “stalked by a place”; she refers to the shame that she feels when she passes a particular place, which was the setting of a story told once by an elder woman to upbraid her for her inappropriate behavior. The elder woman had told the story in order to note the girl's deviation from communal standards of behavior (in this case, how she had worn her hair at a recent ritual), but what is especially interesting for our purposes is the way in which the landscape served to reinforce this lesson because the story and the place are so tightly bound together. In these settings, then, the physical world becomes a moral landscape, reflecting collective standards of behavior, embodying lessons, and forming the basis of wisdom.

Not only are spaces morally grounded, but navigation through, amongst, and with respect to them has a moral character. Here we literally see the notion of a “moral compass”; the ways in which movement through and situated within particular spatial environments links one into a set of collective values.

3.3. Mobility in imagined space

Our third example concerns the ways in which we understand the structure of space for and through navigation. We have already seen, in the example from Munn's work, the ways in which cultural experiences of space may include the ways in which that space can be traversed. We want to argue that this is, in fact, a bidirectional link; not only do we draw upon cultural and historical meanings in order to find space traversable, but the ways in which we navigate space give rise to the structure we find in it.

One compelling case is presented in Daniel Lord Smail's (1999) study of the emergence of street addressing in late medieval Marseille. Through a careful analysis of contemporary records and the forms of location specification they exhibit, Smail outlines four ways of describing specific locations. One is by reference to landmarks—churches, statues, prominent citizens, civic buildings, topological features, or other remarkable features of the city's geography. Paths or proximity to these landmarks are often sufficient to note locations. A second form of reference is with respect to particular districts, such as church parishes, which provide a patchwork of regions within the city. One interesting class of districts is “islands”—essentially entire city blocks (that is, sets of buildings bounded by streets on all sides) conceived of as coherent units, and labeled, often with reference to their inhabitants and activities found there (e.g., the island of the shoemakers). A third is what Smail terms “vicinities.” Like districts, these name areas or regions of the city, but unlike districts, they have no formal or physical boundaries; they are informal designations that will be familiar to residents. Often, these will refer, again, to the artisan practices to be found in that area. One interesting issue, though, is that the craft associations with a particular region of the city are sometimes historical rather than contemporary; that is, the “quarter of the goldsmiths” might name an area where goldsmithing had traditionally been carried on, even if it was no longer a dominant craft there. To understand these references, then, requires an understanding of not just the geographical but also the historical specificities of the place.

Streets as we understand them are the fourth of Smail's categories, but are by no means the dominant form of addressing in the documentary record. (It is worth noting that Smail's records are notarized contracts; so he is talking about formal documents, not about vernacular practice.) Over time, however, street references become the primary form for identifying locations. Smail associates this with a number of associated transformations, including changes in the legal system and the political order. One particularly fascinating association, though, is with the notaries recording the contracts whose mental cartography became more street-oriented as they themselves became increasingly mobile. In a context where few people moved through the city very extensively, those who did came to think of the space as one to be navigated, and hence of the primary mechanisms of navigation—the streets—as the ways to fix location. The move from “islands” to streets is, essentially, a figure/ground reversal that we can associate with the conception of the city as something to be occupied or to be moved through, suggesting that streets become prominent features first for navigation, and only secondarily as a means to locate particular buildings or people. It is mobility that undergirds a conception of the organization of space; space is understood differently as patterns of movement change.

What we see in these cases is that patterns of movement and mobility in urban environments become the basis of

finding that space meaningful. Transportation systems may provide orienting axes as the "user interface" to the city, in Vertesi's coinage (2008). More broadly, mobility lends city a social geography. Lynch (1960) famously explored similar questions, using a map-drawing technique to solicit people's images of the cities in which they lived. The maps display the city as imagined and experienced rather than as it is actually laid out; the shapes of urban features are adapted to common paths, routes and landmarks around which the city is organized. In other words, again, we see the shape of the city as it is experienced and in terms of the kinds of actions that people can carry out there.

3.4. Mobility in historical space

Finally, here, we see resonances of the links between history, practice, and urban experience in other approaches to spatiality.

Doreen Massey (1993) coined the term "power geometries" to refer to the ways that spatial arrangements (e.g., the locations of homes and their proximity both to amenities and to sources of noise and pollution) and patterns of access and mobility (e.g., in the competition for resources between different forms of public and private transportation) reflect arrangements of power and control. These power geometries also affect the relationships between places and the means by which those relations are brought about; for instance, reflecting on the area of London where she lives, Massey comments: "It is (or ought to be) impossible even to begin thinking about Kilburn High Road without bringing into play half the world and a considerable amount of British imperialist history" (Massey, 1993, p. 65). More broadly, navigating space, then, involves an orientation towards the social structures encoded within that space.

Historical aspects of navigability can be found written into other addressing systems, especially those in which regions or houses are numbered in order of construction, and where traditional patterns of occupancy (e.g., associated with patterns of immigration, employment, ethnicity, or lifestyle) give rise to different forms of spatial segmentation (Burnell, 1997; Lyons, 2003).

Kelleher's (2003) study of memory and identity in Northern Ireland highlights the experience of spatial arrangements reflecting sectarian and political divides. In his study, the division between Catholic and Protestant is a central feature of everyday life. As local residents took Kelleher on tours around their town and its surrounding area, they articulated the space in terms of sectarian associations that mix religious, political, and historical elements. Particular regions of the town are read as being associated with one group or another, in terms of current occupancy and historical patterns of migration. People orient towards the space they occupy and navigate in terms of the social organization of everyday life, in which these distinctions play a central role. To be in particular places at particular times is to mark yourself as being a particular sort of person or, potentially, to place yourself at grave risk. Current and historical patterns of settlement create navigational "fault lines"—invisible barriers that are rarely crossed. The understanding of "our" space and "their" space is a daily aspect of experience. Certainly, this goes well beyond encounters with space; on a more detailed level, even patterns in housing stock have a sectarian reading, as do body images, clothing choices, and forms of talk.

Here, then, the encounter with space is also an encounter with social structure, its antecedents and causes. Other work has pointed to the ways in which such spatial distinctions have their correlates in social networks, an interesting observation in light of recent technological interest in mapping and articulating social ties (Grannis, 1998).

3.5. Environmental knowing

Our choice of examples here is motivated by what Marcus and Fischer (1986) call "defamiliarization"; an attempt to turn to alterantive cultural practices in order to gain perspective on more familiar, everyday considerations. So, by turning to questions of spatiality in pre-modern cultures, we are by no means attempting to set up a distinction between modern and pre-modern encounters with space. Quite the opposite; our goal is to highlight common patterns across these settings. We might equally turn to more modern examples, such as Goodwin and Goodwin's (1996) study of the practical spatial organization of aircraft movements, the transnational economy of culturally recognizable foods such as sushi (Bestor, 2004), or Büscher et al.'s (2001) account of spatial reasoning in the work of landscape architects.

Across all these cases, what we find is that the encounter with space is framed by cultural logics, a series of collective understandings through which space and spaces take on particular kinds of meaning. These logics are themselves social products; they arise out of our actions and interactions as we move around in the world. The cultural logics shape, and are shaped by, patterns of movement and action in space, Examples might include the conventions of daily domestic life, e.g., distinctions between the public and private parts of a house; the structural properties of cities and commutes, e.g., the emergence of urban/suburban regions and the forms of activities and buildings we associate with them; or global patterns of migration, such as the waves of outward and inward movement associated with colonial and post-colonial periods. The social character of spatiality arises out the confluence of these sorts of patterns.

What is especially of interest here, then, is the ways in which information technologies provide sites and occasions for the development of new forms of environmental knowing. How does the presence of technological infrastructures such as GSM or Wi-Fi shape or respond to patterns of movement and activity in space. Certainly,

those infrastructures are deployed in response to expected patterns of habitation and migration (cell phone towers are denser in urban centers and along established routes), but at the same time they also give rise to new kinds of spatial understandings (e.g., seeking out coffee shops to find a Wi-Fi signal and work for an hour or two).

Technologies of all sorts—maps terrestrial, maratime and cadastral, compasses, sextants and theodolites, steam engines, tide charts, square rigging—have always played a key role in how we understand the spaces through which we move (Law, 1987). While our concern has been primarily with mobility (rather than technology) in these examples, it is important to note that the operation of the cultural logics we have explored is conditioned by the technologies through which the landscape may be encountered and navigated, including technologies of mobility and technologies of representation. Similarly, information technologies are deeply implicated in the operation and emergence of these logics, and the forms of collective encounters with space. It is through these connections that we want, for the rest of this paper, to return to technological topics and focus on the lessons that we can draw from the accounts presented above.

4. Mobile technology and spatial practice

In order to do so, we need to bring in a third element here—not just mobility, and technology, but practice. The lens of practice—how people act in space, and how those actions render spaces meaningful—provides a critical link. One interpretation of this link between cultural accounts of mobility and technology is that our interest must be directed towards the ways in which information technologies create new "virtual spaces" that transcend and overlay the "real" spaces of the everyday world. In fact, we would argue that a number of attempts to create electronic spaces for collaboration and communication, such as technologies for "virtual copresence" or telepresence, have often been founded on just this sort of principle. However, we would argue for a quite different interpretation of the relationship between place and space in technologically mediated practice. The technologically mediated world does not stand apart from the physical world within which it is embedded; rather, it provides a new set of ways for that physical world to be understood and appropriated. Technological mediation supports and conditions the emergence of new cultural practices, not by creating a distinct sphere of practice but by opening up new forms of practice within the everyday world, reflecting and conditioning the emergence of new forms of environmental knowing. Our concern is with the role of technology in practices of spatializing.

Ito and Okabe's (2005a, b) discussion of aspects of Japanese use of mobile telephony and mobile messaging provides a series of vivid examples. Two are particularly relevant to us here. First, they note the critical role of mobile messaging technologies in face to face encounters in the city. Like Ling and Yttri (2002), they point to the ways in which mobile messaging technologies support "micro-coordination," providing a "last 100 yards" solution for rendezvous, as well as allowing very fine-grained coordination of actions in space when people are together. However, they also show that mobile messaging, beyond hypercoordination, also provides for different forms of presence as a part of a rendezvous. In a large and complex city like Tokyo, travel can be challenging especially at busy times, but, amongst the teens whom they studied, one is not "late" to a meeting if one participates virtually. Mobile messaging is a proxy form of participation when one is not yet physically at a meeting spot: "presence in the virtual communication space is considered an acceptable form of initial 'showing up' for an appointed gathering time".

In a second example (Ito and Okabe, 2005a), they discuss the use of phones to allow private and intimate communication amongst those who are otherwise unable to find the privacy or autonomy to maintain such relationships. Examples include young people whose mobility in urban spaces might be limited and whose autonomy may be strictly curtailed by parents, teachers, and others, college-age adults who live at home with their parents before or even after beginning to work due to the high cost of housing, or young couples who find that that same housing market forces them to live apart until they have accumulated money for a larger place together. For people in these situations, mobile messaging provides an opportunity for private communication and intimate extended copresence through the day.

It is tempting, perhaps, to see this as suggesting that new electronic "spaces" are being created which transcend the spatial arrangements and constraints of mundane reality. We would resist such an interpretation, however. The "technosocial situations" that Ito and Okabe detail are certainly forms of social and cultural practice that rely on information technology for the forms that they currently manifest. However, they are firmly situated within, motivated by, and shaped in response to everyday life. Mobile messaging technologies in the examples cited by Ito and Okade do not create new spaces, but rather allow people to encounter and appropriate existing spaces in different ways. These new mobile practices, then, transform existing spaces as sites of everyday action. Far from seeing technology as creating a space apart, we see it as being fundamentally a part of how one encounters urban space and how it is shaped through technologically mediated mobility.

In our previous examples, we attempted to highlight forms of cultural experience of space, and, in doing so, to motivate an approach to "place" and "space" which puts place first and understands the "social" as collective and embodied cultural experience. The examples provided by Ito and Okade point the ways towards a reconfiguration of the conceptual relationships between place, space, technology, and practice as they frequently figure in discussions in ubiquitous computing and computer-supported cooperative

work. Clearly, technology—of all sorts, including information technology, construction technology, transportation technology, and more—plays a critical mediating role in our experience of space. But it does so within a cultural context that gives these technologies meaning as parts of everyday life. Information technology is instrumental in producing social and spatial arrangements.

5. Discussion

Having explored a number of particular cases, we want to take a step back to consider a broader set of concerns within which the topics we have been discussing are embedded, and which have proven useful in our own attempts to understand the relationship between the concepts we have outlined and design considerations. What we have presented is a range of cultural spatial logics; the importance here is that the cultural logics by which we understand spatial practice are in turn embedded in the technological products that we bring into those spaces and use to support those practices. We approach this in terms of three themes: legibility, literacy, and legitimacy. These themes provide orienting contexts for design.

5.1. Legibility

Seeing information as a cultural category rather than a natural one, we have suggested that it may be more fruitful to think instead about how it is that people find spaces and settings informative. This turns our attention from objects to processes, and to the relationship between forms of knowing, ways of being and patterns of acting. In particular, we have found it particularly useful to think in terms of the legibility of spaces and actions—how it is that they can be read and understood as conveying particular sorts of messages.

On an individual level, the legibility of urban space is the central topic of Lynch's "Image of the City," as we outlined earlier. However, of more interest here is a form of collective legibility. The focus here is not on a personal experience of space or settings, but rather how social groups can share not only an experience of a space but a meaning for it. Scott (1998) discusses at length the history of the legibility of social life and attempts to control it, and out of this arises two quite different forms of legibility.

One is what we might refer to as "panoptic legibility," is the legibility of high modernism and central planning. In Scott's work, he associates this particularly with modern state-hood. In order for a state to control or manage (or exploit or appropriate) resources, it must first find a way to understand and compare those resources. Panoptic legibility is a centralized form of legibility, in which a standardized scheme can be applied across multiple settings and locales in order to measure and compare them. Standardized categories—be those categories of work or human action, categories of land or natural resources, or whatever—can be used as the basis for understanding and allocation. Scott provides detailed examples, including agricultural or urban spaces laid out according to straight lines and right angles without reference to local topological features, uniform single-crop (or single-strain) farming planned without reference to variable soil conditions or weather patterns. The primary characteristics of panoptic legibility are uniformity, abstraction, and dislocation; it is, almost by definition, a view from nowhere.

The alternative form of legibility explored by Scott is one grounded in indigenous practice, what we might term "local legibility." Rather than a view from without, this is the legibility of the view from within, the view "on the ground." Where panoptic legibility attempts to eliminate difference in order to achieve a coherent ordering of resources across different settings, local legibility focused on the heterogeneous nature of everyday objects and actions, seeing them in terms of individual differences. Most importantly, though, local legibility is the legibility of practice, it reflects the ways in which people work in, engage with, and make use of the world around the world around them, rather than the abstracted view associated with panoptic legibility.

Scott uses the example of the contrast between Western single-crop agricultural management and indigenous African experiences of polycropping. To the Western eye, the practice of planting multiple crops in the same field or patch is disorganized and unscientific, lacking the precision that will allow for yield maximization. To the African farmer, on the other hand, polycrop farming is a practical way to ensure sufficient crops in the face of poor soil and harsh weather, as well as providing for varied growth patterns that can help reduce erosion. Analysis of polycropping practices shows that the multiple crops are not planted at random, but rather in careful relationship to each other, local terrain and topology, soil conditions, historical patterns of crop success and failure, and so on. Like Western agricultural practice, polycropping draws on a complex store of knowledge and practice—but, critically, it is one that is local, is grounded in the long-term, repetitive encounter with the environment, and operates on a different scale.

Informativeness and legibility are two sides of the same coin. The legibility of a space, a setting, or an activity is what allows us to find it informative, and to see it as an instance of a category, as the kind of action that it is, as containing lessons, implications, or constraints. Legibility is a product of a social and cultural encounter with the world; in turn, it structures and shapes those encounters.

The social origin of legibility is a critical issue for collaboration in mobile and ubiquitous environments. The examples that we have presented argue for a very different view of information and information use than pervades conventional engineering discourse. They argue that the elements of the everyday world around which ubiquitous computing applications seek to organize themselves—individuals, roles, groups, places, activities, times, contexts,

and so forth—are not elements of the physical world to be uncovered and recognized, but are instead elements of the social world. Their informativeness derives from the nature of social participation, and their nature and meaning are negotiated in, expressed through, and solely available to social practice.

5.2. Literacy

The approach that we have adopted here places particular attention on the processes by which our experience of the world is shaped and shared. That is, we take a practice-oriented view in which the ways of acting in different settings both reflect and sustain ways of understanding and organizing those settings. Applying this view to our conventional interpretation of "information" has two consequences. One is that we should look towards the ways in which we must actively constitute the informativeness of the everyday world through our actions within it, and we explored this view particularly through a series of examples considering the ways in which space might be found informative. A second consequence, though, is worth raising here, which is the relevance of representational practices themselves. By representational practices, we mean both the practices by which certain kinds of representations are brought into existence, and the practices by which those representations are used, shared, and manipulated.

Walter Ong's (1988) classic account of the relationship between oral and literal cultures puts forth the argument that the different forms of representational practice associated with each result in quite different sorts of experiences of the world. The invention of written language allows for a form of static, reproducible and transmissible experience of the past that is simply impossible to achieve in an oral culture. Looking from our own perspective, in which literacy is the basis of recorded knowledge, oral cultures seem simply to strive but fail to achieve the precision and durability of written knowledge. However, Ong notes that the experience of the world in a pre-literate culture is one in which no such durable, stable, and external record can exist; oral cultures are, instead, performative, ones in which, for example, poetic recitations are not valued for their accuracy but for their vibrancy and their appropriate response to local conditions (indeed, to such a culture, accuracy would be viewed as a poor measure of aesthetic value, and not a part of the poet's art). At the same time, this performative nature of cultural knowledge is also a source of reinvention and adaptation; in his study of Melanesian ritual practices, Barth (1987) ascribes certain aspects of the evolution of these rituals to the "repeated oscillations of cosmological lore between its private keeping and its public manifestations" associated with pre-literate cultures.

Ong's focus on the performative aspect of oral culture clearly resonates with a processual account of information, but it also suggests a concern with similar aspects of written language. Written documents also have their performative aspects, and, by extension, different kinds of representational forms, since they provide different sorts of orderings of objects, imply different kinds of understandings of the world. Goody (1977) discusses different forms of knowing associated with basic literacy and with later developments such as lists and tables. In the absence of the list as a generalized form of knowledge, cataloging and ordering categories are not formalized as practices. Similarly, as the list emerges as a practical form, so too does the practice of knowledge become the accumulation of lists, and then of hierarchies, tables, and more. Studies of early book collections, such as the library of Elizabethan mathematician and magus John Dee (Sherman, 1995), suggest that both forms of writing and even the physical forms of presentation contribute, themselves, to the practice of scholarship; if scholarship consists in amassing and assessing knowledge in the forms of books, then the forms of the books themselves and the capacities that they present—for marginalia, for end-notes, etc.—become aspects of the practice of scholarship and authentic knowledge.

In the spatial realm, maps are one of the most obvious intersections of practice, knowledge, and representation. The invention of maps gave rise to new ways of conceiving, cataloging and moving through space, but maps carry with them commitments to forms of practice. Hutchins (1995) refers to navigational charts as "analog computers" for seafaring, noting that "not until the Mercator projection did a straight line have a computationally useful meaning" (Hutchins, 1995p. 113). In other words, the particular cartographic projection with which we are most familiar is designed in order to support specific kinds of navigational and computational practices. However, while a boon for Western navigation, the Mercator projection is a controversial one. In creating straight lines with navigational utility, the projection distorts the representations of the Earth's surface area, exaggerating the size of countries which lie closer to the poles (largely first world countries and former colonial powers) while under-representing the landmass of those closer to the equator (often third world countries and sites of former colonial occupation.) In this case, our appreciation of the vastness of the African continent is ruled as secondary to the opportunity to use geometric tools for navigation. As a different form of cartography, consider the "occasion maps" that one might draw when giving someone directions to a party or a favorite coffee shop. Here, what is represented is not space but a journey, and we notate significant points along the way: landmarks and turns but not small bends in the road. Consistent representational schemes are forgone or transformed in support of the particular kinds of mutually understood practice within which the map will be put to use.

Representational technologies, then, are coupled to representational practices. Their accuracy or veracity can be defined only with respect to the particular practices by

which they are employed, and through which a relationship is established between the object and its representation. In the approach to information that we have been developing here, then, we similarly see the modern idea of information as a consequence of particular kinds of representational practices. Computer scientists and technologies read environments as informative according to a set of understandings they have of the ways in which the world might be represented; computational representations are tools of the trade, and learning to be a computer scientist involves learning to encounter the world as amenable to those sorts of representations, as a world of iteration and recursion (Lave and Wenger, 1991). We make this point for two reasons. First, by "de-naturalizing" computational representations and informational accounts of the everyday world, we want to further support a transition from "information" to "informativeness," draw attention to the role of mediating practices in informational accounts of ubiquitous computing settings. Traditional informational accounts obscure the work that must be done in creating and maintaining a correspondence between computational and non-computational aspects of a setting (Smith, 1996). Second, by emphasizing the processual aspects of information, we want to turn research attention towards alternative cultural experiences of settings in which technology might be embedded.

5.3. Legitimacy

We have used a number of examples of encounters with spatial settings and landscapes to draw attention to the variety of forms of "environmental knowing," suggesting that the account of information or knowledge incorporated in traditional technologies and technological representations is only one amongst a number of ways of understanding the relationship between people, space, and action. So, for instance, the moral landscape of the Western Apache and the cultural historical landscape of the aboriginal Australians do not contain information in the ways we might normally suggest, but rather are inhabited in ways that render them informative. These alternative environmental epistemologies are products of habitation and purposeful action.

However, as we have presented these, there has been one significant consideration that we have not addressed, which is the fact that these different epistemologies do not always sit comfortably side by side, but are frequently in tension with each other. Implicit in any consideration of how to understand the informative nature of a space, then, is the question of the struggle for legitimacy of different forms of knowledge.

The context in which these struggles take place is the rise of technical rationality as the basis of both industrial practice and state governance. Management "by the numbers"—whether that is the management of production schedules, of marketing campaigns, or of state welfare—has become the dominant approach to understanding and acting within the natural world. Data analysis is the basis for understanding and responsiveness in this approach, and so information technologies of all sorts have played a critical enabling role (Yates, 1993; Agar, 2003). As scientific and computational accounts of the social and natural world are the basis of industrial and governmental practice, they inevitably come into conflict with the alternative epistemologies that they displace.

These issues are vividly demonstrated in disputes over First Peoples' land right claims. In Australia, a growing White population increasingly came into conflict with the indigenous people over land rights and the designation of sacred sites (Hill, 1995). Part of the difficulty here arises from the problems of describing sites and their significance. While the legal frameworks provided by the state operate in Western cartographic terms, Aboriginal descriptions of space depend on historical contingencies or on Dreamings that, themselves, move through the landscape. Further, the kinds of knowledge by which the significance of spaces could be determined are inherently local, partial, and secret. When the interpretive nature of Aboriginal spatial knowledge runs up against the formalist spatial expressions of title law, what results is "debate over the political meaning and legitimate nature of Aboriginal beliefs" (Povinelli, 1993, p. 697).

In the United States, this has arisen as a problem of cataloguing and assessing indigenous cultural resources. Stoffle et al. (1997) discuss this problem as it arises amongst the Southern Paiute. The protection of cultural resources, when incorporated into Western scientific traditions, requires a means for calculating and comparing the cultural significances of different places, so that decisions can be made about priorities. Cultural resources are organized into "Traditional Cultural Properties" which identify specific sites and objects of cultural significance for legal purposes. By contrast, Stoffle and colleagues suggest, the Southern Paiute think not of specific properties, objects, or sites but rather of cultural "landscapes" which focus on the patterns of interdependency and proximity that link cultural resources rather than the properties intrinsic to one or another. Further, again, this holistic approach to the designation of cultural properties is one that is based around a human perspective rather than the "view from nowhere" of traditional cartography (Nagel, 1986). So, in addition to landmarks (which might fit within the Traditional Cultural Property model), Stoffle et al. point to the importance of holy landscapes, storyscapes, ecoscapes, and other ways of understanding the relationship between the land and cultural practice. Similar considerations have been documented in other groups, e.g. amongst the Navajo (Kelley and Francis, 1993).

Both of these cases involve questions of one's claim on the land in the first place, but that is not our focus here. Nor is this simply a tale of incompatible ways of seeing the world. Rather, these examples are struggles for the legitimacy of different epistemologies (Nader, 1996; Eglash et al., 2004). These different epistemologies are embedded

within different systems of practice, and when the practices are in tension, then the legitimacy of forms of environmental knowing is called into question. Information technologies are technologies of representation; as such, they inscribe particular world views and, inevitably, obscure others. Information technology, tied as it is to our mental and cultural images of scientific representation and progress, is a tool not only for automation but also for legitimation.

5.4. Weaving together analysis and design

In this article, we have not had specific technologies in view. Our goal has not been, then, one of evaluation or assessment of their fitness for purpose, with the intent of revising or changing specific features of design. Instead, we have have been attempting to change how we think about mobility and what it means to support it technologically. If mobility is culturally shaped, then we must think about mobile technologies not so much as devices that help solve problems, but as sites at which social and cultural categories are enacted. Our three concerns—legibility, literacy, and legitimacy—capture elements of this. In order to ground these discussions, though, we want to reflect here a little further on the potential impacts upon design practice, by briefly drawing upon some of our own recent work, specifically two projects—Datascape and Undersound.

Datascape (Kabisch, 2007), under development by our colleague Eric Kabisch, is tool for exploring urban space and its representational analogues. Datascape provides a vehicle-mounted display that can be used, much like a periscope, to examine the surroundings while moving through them. The system, then, combines two visual experiences of urban space. One is the sight of the surroundings as viewed from the vehicle. The second, presented on the display, is a virtual world with a topography generated on the basis of geo-referenced data sets such as census records, block-by-block geodemographic marketing data, disease incidence records, etc. What is particularly of interest here is the superimposition of the representational space with the physical space, so that one can explore the landscapes of daily life in the terms in which they are organized for marketers, epidemiologists, and others. By linking different databases for the same space, spatial correlations can be made; while this can also be achieved with conventional geographical information systems, a radically different experience is achieved when these can be grounded in the space through which one is moving. Datascape is at is most powerful when it used not as a tool for exploration but as a tool for reflection, and when the spaces being examined are the familiar uses of daily experience. Initial, static versions of Datascape have already been exhibited; the mobile version is currently in the prototype stage.

It is clear that Datascape responds to the considerations presented in this paper by exposing representational grids. However, Datascape attempts to go beyond this, in at least three ways.

First, by drawing together multiple different forms of information and different databases, Datascape is designed to expose the relationship between multiple grids and multiple practices of homogenization and representation. What becomes particularly interesting as a matter for exploration is the ways in which those grids do and do not line up, the elements that they have in common or separately, the boundaries that are shared and those that are unique. Datascape provides a view of this complex of representations as much as it does any single one.

Second, Datascape doesn't simply allow one to explore geo-referenced data via a digital system (e.g. through a web browser), but instead situates people within the spaces that are represented, as a means to explore them. Critically, it uses these familiar spaces as ways of contextualizing the data. In other words, it is not simply demonstrating the legibility of everyday spaces through the use of large-scale data sets; it is also attempting to make those data sets legible through the use of everyday space. Using familiar space as a lens through which to view and understand things like scientific, environmental, and epidemiological data invites new stakeholders into conversations for whom the source of legibility is the inhabited space itself rather than the abstract representations of graphs, charts, and scientific or mathematical formalism.

Third, when used as an authoring tool rather than purely as a visualization tool, Datascape offers the opportunity for people to create tours and routes simultaneously through physical space and data space, offering a very different form of legibility, one based on communities and peer communication. Here, again, the data sets that are not being used to make space legible, but rather are the objects of representation and critique.

How does Datascape reflect the three themes we have raised? Its concern with legibility is clear; it is a tool for rendering space legible, and allowing people and communities to see how those spaces appear legible to others (those who control and employ the representations being visualized). Its concern with literacy is perhaps also clear; here, our concern is how different groups with concerns about particular spaces or regions can articulate their concerns in terms that each can understand. And finally, its concern with legitimacy is manifest in the very contests over the right to speak about spaces at which Datascape centers itself; as a tool for community groups and activist organizations in dialog with authorities and commercial entities, it is directly concerned with the clash of rights and representations. Each of these three concerns, then, motivates aspects of its design.

Our second systems, Undersound (Brewer et al., 2007), developed by the first author in collaboration with Karen Martin and Ariana Bassoli, is a music-sharing system design designed for the London Underground. It responds to a number of aspects of the urban experience within which the London Underground is enmeshed, including the

social and ethnic diversity of London, the complex relationship between above ground and below ground, and the non-instrumental aspects of public transportation. In studies of public transit in both California and London, a strong concern emerged with those aspects of transit that went beyond "getting from A to B" and focused on the elements by which people would understand trips as good or bad, including the skill of execution, the experiences or people encountered along the way, and more. This turned our attention to the aesthetics of the journey, broadly construed, and to the collective rather than purely the individual elements of riding together on public transit. Undersound is a music-sharing system for mobile phones that allows Tube riders to browse and exchange music. Music files, though, are strongly tied to the geography of the Tube itself; they originate, terminate, and are transferred in particular places. So, from another perspective, Undersound is a system by which music hitchhikes around the Tube on people's mobile phones. Music circulates, much as people do. What we are interested in here is the ways in which the system can provide people with an understanding of two otherwise obscured elements of life in public transit. One is the connection between places and regional or ethic styles, as captured by the forms of locally produced and uploaded music that characterize stations or regions of the city. The second is the flow of bodies within which one is enmeshed as a traveler along particular routes at particular times of day.

Here, then, we are concerned especially with questions of legibility, although they are of quite different sorts. In his writings on the practices of urban life Michel de Certeau distinguished between strategic modes of encounter with urban forms, and tactical modes. The strategic modes are the modes of design; they are concerned with the creation of urban forms in order to control, manage, and regulate activities within them (shaping urban growth, creating points of assembly, routes, etc.). By contrast, the tactical modes are the modes of use and appropriation; the ways in which people's movements through space create new forms of local meaning, on the individual level (e.g., personal choices between different routes taken to work that reflect different moods) or on the collective level (e.g., the emergent and transitory associations between particular ethnic or subcultural groups and regions of the city and the impacts that they have). Our concern is very much here with the tactical, then. Undersound makes visible, as a site of examination and reflection, the urban flows within which people and artifacts are enmeshed, making them meaningful by placing them in the contexts of journeys that themselves are suggestive of particular purposes, needs, and characters. This is legibility from below rather than above.

Literacy and legitimation play a less central role, although both are important here too, primarily in terms of the ways in which collections of music "speak about" regions and areas of the city. To the extent that regional identity is always in flux, always in contest, and always in the course of being produced, we need to be concerned both with the forms of literacy and legitimation at work in any tool that purports to represent spatial character, or to offer resources for people to do so.

These two technology efforts—one designed around special purpose hardware in a highly specific configuration, the other designed for everyday mobile technology—exemplify a different encounter with mobility and technology, informed by the kinds of conceptual reframings we have provided here. They are by no means exhaustive, but, we hope, illustrate the ongoing relevance of our conceptual questions for design practice.

6. Conclusions

Mobility remains a core topic of interest for HCI researchers. Indeed, as the site of computer-mediated collaboration moves into the everyday world, the need to understand the spatial organization of sociality becomes ever more pressing. However, we argue that in these contexts, it is important also to understand the social organization of spatiality. Drawing a distinction between "space" and "place" as accounts of situated activity, CSCW researchers have recognized that individual and collective behavior draws on our understandings of place—of the social experience of settings of action—as much as on the ways on which those places are arranged. However, attempts to operationalize this for the purpose of design—to think about how we can "turn spaces into places"—typically frame place as a social product and space as a natural fact. The focus on mobility can help to address this question.

We have argued that our understandings of spatial environments—geometric, abstract, uniform, and mathematical—are also social products. Space and place are both social phenomena, but of different types. They are the product of different sorts of cultural logics. Our concern here has been to turn attention to mobile practices of spatializing—the means by which collective understandings of space are produced—and the role that technology plays within them. Our goal, then, is not to argue for the primacy of one cultural logic of space over another. Rather, we wish to make a series of more modest points. First, we want to demonstrate the variety of cultural logics that organize collective encounters with space and provide resources for finding those encounters meaningful by embedding them within systems of practice. Second, we want to point to a range of problems that arise when different logics collide. Third, we want to note the ways in which information systems encode specific cultural logics and may, as a result, be incompatible with others.

This analysis is not oriented towards particular technical correctives; it is not intended to provide implications for design, but may provide some orientation for designers (Dourish, 2006a). In particular, the fact that situated practice is, inevitably, the site of both application and development of cultural logics of space suggests that our

design approach should, at the very least, recognize that those logics live outside of particular technological arrangements, and, perhaps, may participate in the development of those logics. We have argued that legibility, literacy, and legitimacy may be useful orienting concepts that help us approach the problem of spatiality and technology with new eyes and with new questions in mind. When mobile technologies provide their users with a way to organize space in terms of consumable resources, for example, then they provide a particular way of rendering space legible. We would argue, then, that if legibility is a design outcome, then it should also be a design consideration from the beginning. Similarly, we may want to evaluate mobile technologies in terms of the forms of spatial literacy that they assume and those that they support. Finally, attending to the contest for legitimacy between simultaneous representations and accounts of space draws our attention to the range of stakeholders in any given design scenario; while these tensions are often elided in the selection of audiences and applications, the relationship between our designs and these kinds of contests of representation should play a role in design deliberations (Suchman, 1994).

These are areas in which considerable experience from disciplines such as geography, architecture, and urban studies can be brought to bear; it is also, we think, a fruitful area where the lessons of several decades of research into HCI might intersect with the needs and concerns of more recent research in ubiquitous computing.

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