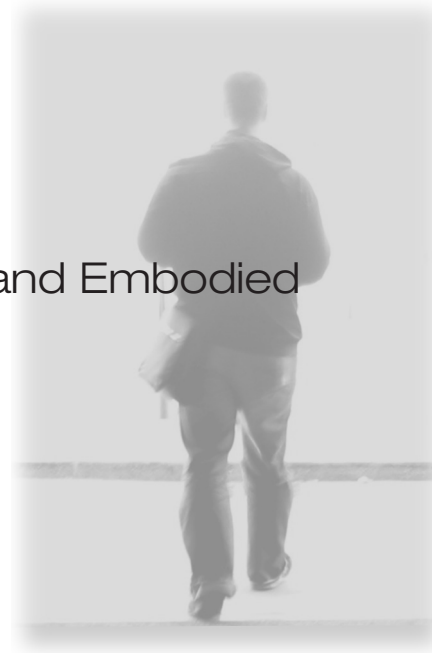
Datascape: A Synthesis of Digital and Embodied Worlds

Eric Kabisch

Space and Culture 2008; 11; 222
DOI: 10.1177/1206331208319147

Datascape

A Synthesis of Digital and Embodied Worlds



Eric Kabisch[1]
University of California, Irvine

Digital and synthetic worlds are often conceived as self-contained entities that exist in abstracted and remote spaces. The author elaborates an approach to hybrid space that instead focuses on local contexts of digital information correlated with the embodied spaces people inhabit—an informational substrate that both describes and regulates human activity. The author presents a mobile interactive art installation as a way to bring geographically referenced information out of databases and into everyday experience of traveling through the world. Datascape enables a hybrid ecology whereby participants author dynamic geographic narratives that compose a digital world coextensive with the planet Earth. A vehicle-mounted digital periscope engenders action between passengers and a visual and sonic landscape that unfolds and emerges based on conversations between people, data, and dynamic representational entities that compose the landscape. By allowing people to view and interact with information descriptive of the location in which it is encountered, Datascape enables awareness of and engagement with the hybrid digital/physical spaces people traverse and inhabit in their everyday lives.

Keywords: *hybrid ecology; geographic visualization; interactive art; generative music; mobile computing; participatory narrative*

As an artist and computer scientist developing interactive systems, I am interested in the hybrid and interdependent nature—the synthesis—of digital and embodied worlds. Virtual and synthetic worlds are often conceived as remote and abstracted spaces, removed from the physicality of our embodied environment. The 1990s gave us *virtual reality* and *cyberspace*–a nebulous domain of information that exists somewhere beyond our computer screens. The emergence of massively multiplayer online games (MMOGs; e.g., World of Warcraft, Everquest) and multiuser virtual environments (MUVEs; e.g., Second Life, Sony Home) have encouraged researchers to move

space and culture vol. 11 no. 3, August 2008 222-238
DOI: 10.1177/1206331208319147

rhetorically away from the virtuality of the 90s, focusing on the relationships that "synthetic worlds" have to "outside" economies and social practices (Castronova, 2005; Malaby, 2006). Still, the "outward flows" suggested by Castronova (2005) imply a spatial domain that is self-contained and distinct from the domain inhabited by the user of the system. Some have investigated the spaces that arise when these remote social contexts move into physical spaces through the use of mobile phones and pervasive computing technologies (Crabtree & Rodden, 2007; de Souza e Silva, 2006). These "hybrid spaces" are considered to be something new, arising from the increased ubiquity of mobile communications technologies. I argue that the "physical world" already exists as a hybrid stew of digital and embodied entities and practices. I am investigating the ways that geographic information technologies and related sociotechnical practices become embedded in our world through an iterative cycle of sensing, representation, and action. As opposed to focusing on synthetic worlds or remote social contexts, I am interested in the cyclical processes between databases and human activity that result in the creation of localized hybrid digital–physical ecologies.

In this article, I discuss my approach to hybrid space as it relates to current trends in participatory mapping, pervasive computing, and virtual worlds—suggesting that pervasive computing technologies not only produce new forms of hybrid space but also can be used to illuminate and shape the existing hybrid qualities of our world—including its substrate of geo-located digital information. I present Datascape, a mobile art installation and vehicle information system, as an experiment in how we might expose this informational substrate to people in a local and embodied context. This project introduces an ontology for *participatory emergent narrative* as a way to expose diverse and independent accounts of space and to explore new modes of emergent representation in geographic visualization. Finally, I discuss the ways in which critical artistic practice, inspired by theories in human geography and social sciences, can inform the design of an information system.

Representation and Regulation of Space and Culture

Scores of databases contain digital information about our physical world and its inhabitants. Every time a credit card is swiped, a cell phone beacon is received, a field survey is recorded, or a crime is reported it adds to our digital landscape. Each of these actions in the world generates a digital trace—whether intentional (as in a field survey) or incidental (a transaction with a buyer rewards card)—which is stored as an entry in a database. As we move through our daily lives we encounter spaces, networks, people, and systems that are both described and regulated by databases. Although many of these databases are perceived as merely descriptive of the areas and people from which they are derived, it is important to see the ways that these data are distributed and acted on.

Pickering (1995) advocated a shift from the *representational idiom*—where science is viewed mainly as a means to represent the world—to the *performative idiom*—where the practice of science is considered an active negotiation with the world it seeks to represent. I would like to consider this shift in relation to geographic databases. Dodge and Kitchin (2004) discussed commercial air travel as a mode of passing through "code/space"—that airline passengers are regulated by a system composed of both physical and digital entities, such as travel Web sites, security checkpoints, air-traffic control, and homeland security databases. They assert that code/spaces are produced through "the mutual constitution of code and space, wherein the material and virtual are produced through each other" (p. 209). Although these databases might at first be

seen as simply describing the relative security threat or frequent flier status of an individual, this example makes it clear how they actively participate in the regulation of mobility and flow of physical bodies.

In other databases, the spatial correlation is not a physical body but a geographic area or location where the active regulation can be less apparent. In the practice of *geodemographics,* market research companies combine U.S. census information with privately held data—such as survey information, purchasing records, product registration information, credit reports, television viewing patterns, and so on—to profile the consumer behavior of small geographic areas. The resulting demographic narratives ultimately guide decisions about the location of stores, the provision of services, and the distribution and marketing of lifestyle and cultural artifacts (cars, music, movies, etc.). While attempting to understand people's geographic behavior, these marketing systems "are themselves active agents in manipulating that behavior to create 'ideal' geographies" (Phillips & Curry, 2003, p. 145). Sociologists—though their objectives and rhetoric may differ substantially—use similar methods for clustering and classifying human geographies and often arrive at similar results as the "commercial sociologists" (Parker, Uprichard, & Burrows, 2007). These demographic classifications themselves exist in a recursive relationship with their geographies, explored by Parker et al. (2007) as the co-construction of "class places"—geographic clusters of people with similar demographic characteristics—and "place classes"—the categories and narratives employed by marketers or sociologists to describe these clusters. They argue that concepts and categories emerging from the formal classification processes of geodemographics are often reappropriated into the vernacular of the people and social groups they describe. Thus, the "spatialization of class" is enacted, in part through the methodology and axiology of the institutions and organizations that cluster populations for various commercial or policy ends.

In these examples, we see that databases regulate physical bodies in the case of airlines, they shape the makeup of urban landscape in city and commercial planning, and they inform the classes and categories through which people describe and identify themselves within their communities. When data sets meant to describe the world become instrumental in shaping and altering activities within that world, the semiotic boundary between data and its object is tenuous. Therefore, instead of viewing these databases as abstracted representations, it is useful to conceive of their information as a digital substrate—another dimension of the reality we inhabit. Many databases contain a spatial component: a zip code, an address or lat/long, a geometric boundary of a city, township, or community. In many senses, those bits of data could be considered to be situated at the locations they describe and regulate. However, much of this information resides in isolated servers—some networked and some not—and is only brought out into a spatial context via a specifically produced map, visualization, or tabular or textual representation. In effect, the data are hidden from view, whereas interpreted stories are the only record—sometimes because of data sources being privately held, but more important because there has been a lack of tools to view them in context in the lived world.

PARTICIPATORY MAPPING

Until recently, this digital substrate was invisible and inaccessible to the vast majority of the public. Categories, database ontology, data capture methodology, and geographic analysis have largely been employed and created by planning departments, criminologists, biologists, sociologists, commercial interests, and other organizations. This insulary approach to knowledge generation can create what Sunstein (2006) referred to as "information cocoons," "communications universes in which we hear

only what we choose and only what comforts and pleases us" (p. 9). Many have suggested that collaborative approaches to knowledge deliberation, such as wikis and prediction markets, can yield great results and reduce the cocoon effect (Sunstein, 2006; Surowiecki, 2004). Fields that might be collectively termed *collaborative geographic information systems* have been working to make the production and analysis of geographic information and decision making accessible to a broader range of stakeholders (e.g., the general public) for quite some time (see a brief history in Balram & Dragicevic, 2006). And movements such as *GIS and Society* (Harris & Weiner, 1996; Pickles, 1994) have altered the course of geographic informatics by questioning the positivist and rationalist underpinnings of the technologies from perspectives in the social sciences. However, only with the massive growth of Web-enabled mapping applications in the late 1990s and 2000s has the vision of large-scale public access and contribution to the digital landscape come closer to realization.[2] In particular, the rise of social software and Web 2.0 technologies and the availability of free Web mapping application programming interfaces have led to an abundance of geospatial mash-ups, where anyone with a little bit of Web savvy can create and make widely available their own maps that reveal existing or user-generated georeferenced information.

My research, and the related work on Datascape (Kabisch, 2006, 2007), has similar motivations to work in collaborative knowledge sharing—and in collaborative mapping more specifically. Despite the exciting progress made in these areas, this article focuses on two common characteristics of existing public mapping applications that Datascape hopes to address and explore. The first deals with *locality*—much of the geographic information is experienced and created not in the physical space it describes or augments but from a remote context in front of a personal computer.[3] The second deals with *representational ontology*—that limiting ontologies—descriptive, representational, and interactional—contribute to a focus on static representation rather than emergent action.

Locality

Web-based mapping solutions act to pull data out from the abstracted space of databases into public view, but in doing so they create another abstracted space, the representational space that exists between a person and a computer. In most of these mapping applications a static base map is provided as a stand-in for the world and as reference for the landmarks and other features that are represented on the map. In Datascape, the world itself is the base map, overlaid with a three-dimensional graphic and sonic environment that is spatially correlated to the planet Earth (Figure 1). The mirrored topography supports an imagined landscape built from user-controlled entities whose location, appearance, and behavior are driven by geographic data sets. This digital environment is presented to people in a mobile context—such as a vehicle—where they travel through and interact with the physical world and the informational/narrative substrate simultaneously. This enables a localized hybrid environment where the digital and physical are mutually embodied.

Representational Ontology

One of the central problems in presenting the complexity of the world through geographic information technologies is the application of a rational, objectivist, and

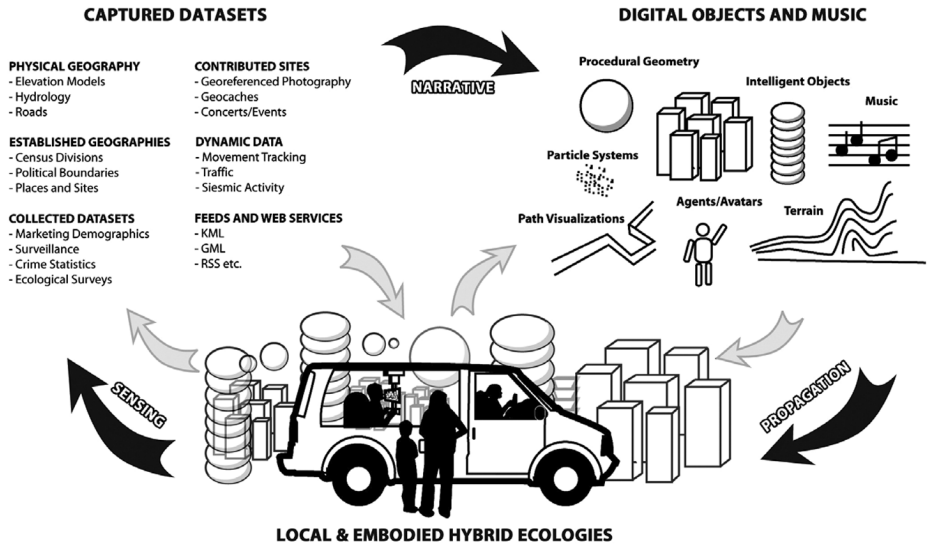


Figure 1. Hybrid ecologies in Datascape

Note: KML = Keyhole Markup Language; GML = Geography Markup Language; RSS = Really Simple Syndication.

uniform ontology to diverse and multiplicitous phenomena. A universal ontology is necessary and practical for many forms of analysis, representation, and sharing; however, it often has the effect of removing the very complexities that might be of interest. Turnbull (2007) noted, "The value of Indigenous knowledge lies precisely in its local, place and practice based character and to decontextualise it, to relocate and render it commensurable with scientific knowledge would be to lose its cultural specificity" (p. 141). In my previous work, I have developed a framework to explore the impacts of geospatial technology as a three-part iterative cycle: sensing elements from the environment—*sensing* (data gathering), analyzing and creating narratives from the captured data—*narrative* (analysis and representation), and the propagation of these methods and representations back into the world—*propagation* (feedback and artifacts) (Kabisch, 2006). At each stage of this process, various ontologies are employed, and each in turn affects the possibilities of the next. The underlying vector ontology of GIS—points, lines, and polygons—has passed its way down to the representational level in most Web-based maps, especially focusing on the point, or landmark. The abundance of user-created content is limited to a point in space, embedded with some sort of meaning in the form of text, image, or sometimes sound. Through the specification of formats such as Keyhole Markup Language (KML), the use of technologies such as GPS and radio frequency identification (RFID), and the corresponding representations enabled by them, we can see a focus on the point or the object—on known locations in space and their recorded attributes. This affords a focus on what is *known*—as representational—as opposed to *enacted.*

HYBRID FUTURES

As we look ahead to the evolution of the geospatial Web and 3D virtual environments, many see these two domains converging. But how this convergence and splintering

occurs is still in question. Three emerging scenarios with which Datascape is concerned have been called "mirror worlds," such as the virtual globes Google Earth, NASA Worldwind, and Microsoft Virtual Earth; "virtual worlds," such as MMOGs and MUVEs; and "pervasive computing," the emergence of mobile and embedded technologies that move computation out into the environment. Although many characterize these as three distinct scenarios (see the Metaverse Roadmap at http://www.metaverseroadmap.org/overview/02.html), here I suggest that these three approaches in hybrid form can reveal new approaches to exploring the relationships between the lived world and representations drawn from it. Particularly, I suggest that pervasive computing technologies can enable a merging of "virtual" and "mirror" worlds into what I call *hybrid ecologies.*

Approaches toward virtual globes emerge from the representational idiom that is apparent in GIS and Web-based mapping—a static base map onto which is overlaid relatively static, located symbols. These virtual globe environments have their history in scientific and information visualization purposes and are by their very nature geared to representing aspects of "reality." Virtual worlds such as those in MMOGs and MUVEs however are much more performative in nature–focused on the emergence of meaning between social actors and the virtual environment. These worlds, detached from constraints of the physical world, are often considered through the frame of imaginary narratives. The Metaverse Roadmap reflects this distinction: Although in virtual worlds object creation is constrained only by the environment, "in mirror worlds, creation is constrained by the need to reflect reality." This begs the question—whose reality is being reflected? I would like to question this distinction by suggesting that "data" and "narrative" can happily coexist in one big happy hybrid ecosystem. In fact, it is often difficult to separate out narrative aspects from data collection in the first place. In mirror worlds, data generated from a complex and dynamic world become trapped in a representational stasis, removed and isolated from the ecosystem it is a part of. In Datascape, the data become part of an evolving ecosystem composed of dynamic representational entities and forces. Users compose narratives from existing or user-created data sets and select how these data will be represented, and the behaviors they control, in the digital environment. Experience and meaning emerge through the interaction of people, embodied space, the data substrate, and dynamic user-generated entities that compose the landscape.

Hybridity in Pervasive Computing

The use of the term *hybrid space* is reflected in some recent pervasive computing literature. Crabtree and Rodden (2007) offered a taxonomy that breaks hybrid spaces into four categories: media spaces that *link* physical spaces through digital mediums, mixed reality environments that *fuse* physical and digital environments, ubiquitous computing environments that *embed* the digital into physical environments, and hybrid ecologies that *merge* multiple environments, physical and digital. Their focus is on the "fragmented articulation" of mediated collaborative practices across hybrid environments—where the central question regards people's experience of use in simultaneously interacting with remote, digital, and physical contexts. de Souza e Silva (2006) referred to "hybrid spaces [that] arise when virtual communities, previously enacted in what was conceptualized as cyberspace, migrate to physical spaces because of the use of mobile technologies as interfaces" (p. 261). She highlighted how the mobile phone specifically has brought about a new configuration of space and focused on the migration of mediated communications from fixed locations into mobile use—the *linking* and *embedding* of remote social contexts.

Although these examples point to pervasive technologies as the cause of hybrid spaces—as something new—I suggest that the spaces into which the technology is being embedded are already a hybrid stew of artifacts, practices, and infrastructures. Datascape focuses not on the embedding of remote contexts but instead on the existence of local digital contexts that often remain invisible or inaccessible within daily experience of our landscapes. I suggest that mobile and embedded technologies not only are the root of hybrid spaces but also can help to reveal, explore, and shape the existing hybrid qualities of spaces and cultural practices. In Datascape, the digital and physical are spatially and materially correlated, continuous and interconnected with one another, simultaneously and mutually embodied.

I view hybridity as an evolving product of the cycle of practices through which technologies and technical practices become embedded into the world and society. The metaphor of the biological hybrid here is useful—the blending of two "purified" breeds into an often more robust hybrid offspring. The notion of homogeneity in pure breeds (both biologically and culturally) is often based on socially constructed categories (Stross, 1999), and in this case those categories are virtual–real, synthetic–natural, digital–physical. As new technologies are introduced to society, their purity is apparent—they have yet to become entangled into the mangle of everyday practice. But through their ongoing use—and the methodologies and practices that accompany them—these technologies become hybridized with existing practices, artifacts, and infrastructures, embedding themselves into the fabric of our lived experience and our physical world. In relation to geographic information technologies, I see this process as occurring through a continuous cycle of sensing, representing, and acting in the world. Through each iteration of this cycle, the purity of the embodied world becomes less distinct from the digital or technical practices we use to describe it.

The resulting products of this iterative cycle of sociotechnical practice can apply to spatiality, as focused on in this article, but can also be more broadly applied to other phenomena of human experience. I suggest the following terminology. *Hybrid space* and *hybrid place* refer to the cyclical relations between databases and the social and embodied world as previously described—physical spaces that are regulated by zoning and micromarketing, or the negotiation of presence, place, and identity between virtual and embodied experience. *Hybrid environment* or *hybrid interaction* refer to interactional and technical properties of blending or merging physical space and tangible objects with pervasive computing technologies. *Hybrid worlds* or *hybrid ecologies* consist of the evolving and emergent interplay between digital and embodied entities and practices.[4]

Datascape: A Mobile Exploration of Hybrid Narratives

Datascape is a mobile art installation and information system for the creation of hybrid worlds and narratives that correlate to the planet Earth. Immersive sound and a computer-generated graphical environment are shared with vehicle passengers as they travel through the city. A digital periscope allows its operator to view and interact with information about the surrounding environment. As the riders travel through geographic space, they explore and create a 3D virtual topography built from invisible data sets. Music and sounds are embedded in the landscape, with locally aggregated data driving musical styles and other musical events attached to places, objects, and actions within the hybrid world. A typical commute or drive around town is turned into a sonic and visual exploration of hidden narratives that surround us and envelop the city.

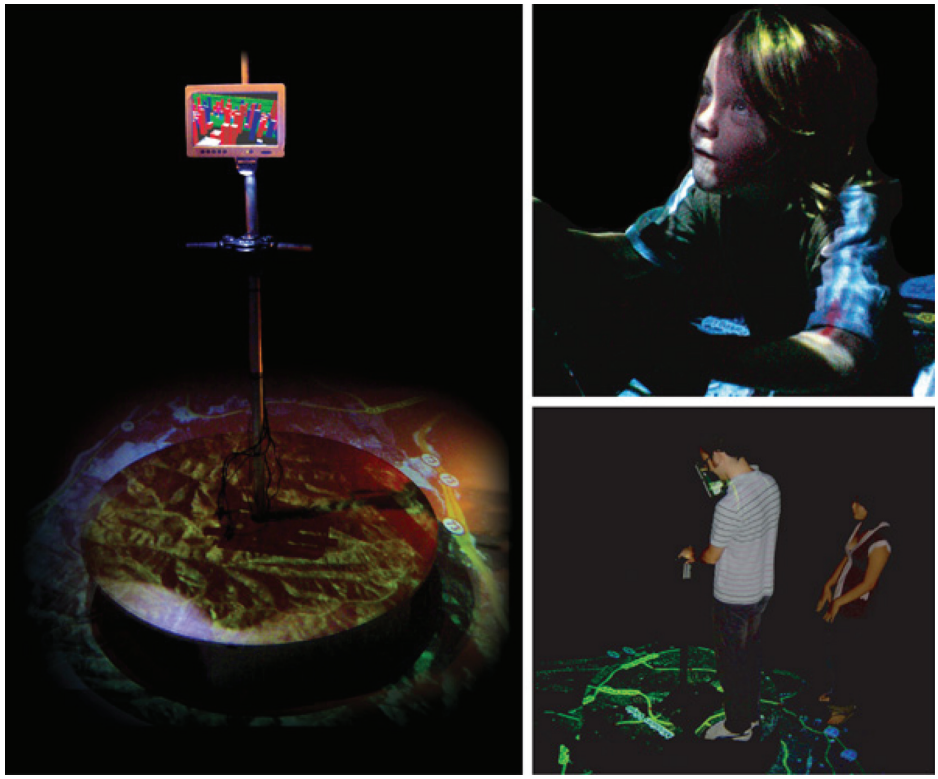


Figure 2. Digital Periscope in the Stationary Installation

Datascape went into development in late 2004, was first exhibited in spring 2006, and is currently undergoing an iterative process of exhibition, design, and development. Datascape version 1.0 is a stationary art installation that has provided a proof of concept and a testing ground for the development of the custom software and hardware. In this installation, people stand at a digital periscope (Figure 2)—a touch-screen LCD mounted on a rotating vertical shaft with a handlebar controller similar to a motorcycle. Map imagery is projected from above onto the floor—this simulates experience of cartographic space and acts as a stand-in for the view out the vehicle window. In the LCD, the user looks into a three-dimensional world that is spatially correlated with the position in the cartographic space of the floor projection. The user simultaneously drives through the virtual and cartographic spaces using the throttle and the handlebars—as the periscope is rotated so is the periscope view such that the LCD acts like a lens into the digital environment.

The data sets used for Datascape v1.0 are demographic marketing data from the company Claritas. Looking into the digital world (Figure 3), census boundaries by which populations are aggregated and described are visualized as walls, segregating areas that are typically moved across seamlessly into discrete islands of cultural uniformity. Data such as median income and population density are presented as color-coded 3D bar charts, a legible skyline with imagined buildings whose heights are dictated by their underlying data. As you pass through the various regions, key lifestyle and consumption traits—cars people drive, restaurants they frequent, magazines they read, and so on—are displayed for the passenger to voyeuristically survey the neighborhoods. In addition, the purported

listening preferences of populations within a radial distance of the vehicle are aggregated into musical styles that control the musical soundtrack. A real-time algorithmic composition program generates music based on stylistic parameters, so that as the vehicle moves through the city, a gradual but apparent change in the music reflects the musical preferences of the locality, as interpreted through the Claritas system of demographic analysis. As the users travel through their own neighborhood or along their normal driving routes, they view the world through the narrative lens of demographic marketing data and experience qualities of the space that were previously hidden from view.

Ongoing development of Datascape is focusing on the integration of the periscope and information system into a vehicle. The mobile periscope is not tethered but instead is a handheld LCD screen that uses sensors to detect the orientation and location of the viewer. Experience reports from users of the stationary prototype suggest that people are excited to be exposed to existing data but also that they would like to contribute their own accounts of space to the landscape. A primary focus of current development is to enable users to create their own data sets and representational narratives, allowing for the juxtaposition of various perspectives, institutional and individual.

PARTICIPATORY EMERGENT NARRATIVE

The translation of data to its representation in the synthetic environment can be considered an act of narrative. Just as the creation of maps has often been characterized as storytelling (Wood, 1992), so is the representation of data within Datascape. In Datascape v1.0, the artist provides the narrative. In this scenario, the users of the system—as framed within the roles of *audiences* and *publics* (Livingstone, 2005)—are primarily cast as audience. This audience is not entirely passive—their movements and interactions actively engage the environment and cause the narrative to unfold. However, they experience only one narrative in the world of possibilities offered by the Datascape system. In current and ongoing development, I seek to enable users to not only explore existing or artist narratives but also create and juxtapose their own—to enable the recasting of users from the more passive role of *audiences* into an active role of *publics*. I refer to this practice as *participatory narrative*.[5] Demographic marketing profiles are stories told within the frame of a particular methodology and axiology. Datascape can enable the telling of stories from alternative perspectives, such as those disadvantaged or marginalized.

To enable *emergent narrative*, I have introduced a representational ontology containing entities that are dynamic, programmable, interactive, and data driven. This ontology enables the world to come to life through the participation of the user, narrator, data, and hybrid environment through which the narratives emerge. The act of narrative creation consists of choosing existing data sets—or adding or creating new ones—and then selecting from a range of embodiments and actions to represent the data in the digital world. As a starting point, I have created an ontology of representations, or entities, consisting of *symbols*, *behaviors*, *forces*, *zones*, *paths*, *links*, *portals*, and *sounds*. These entities make up a dynamic ecology that unfolds in guided but emergent and unplanned ways. By enabling emergent narratives, Datascape takes data structures that have been reduced by a universalizing ontology and reanimates them into an evolving hybrid ecology through the representational ontology suggested herein.

SYMBOLS

Symbol is the term for entities that have a "physical" presence in the digital world. A symbol, for instance, can be selected as the representational entity for a series of

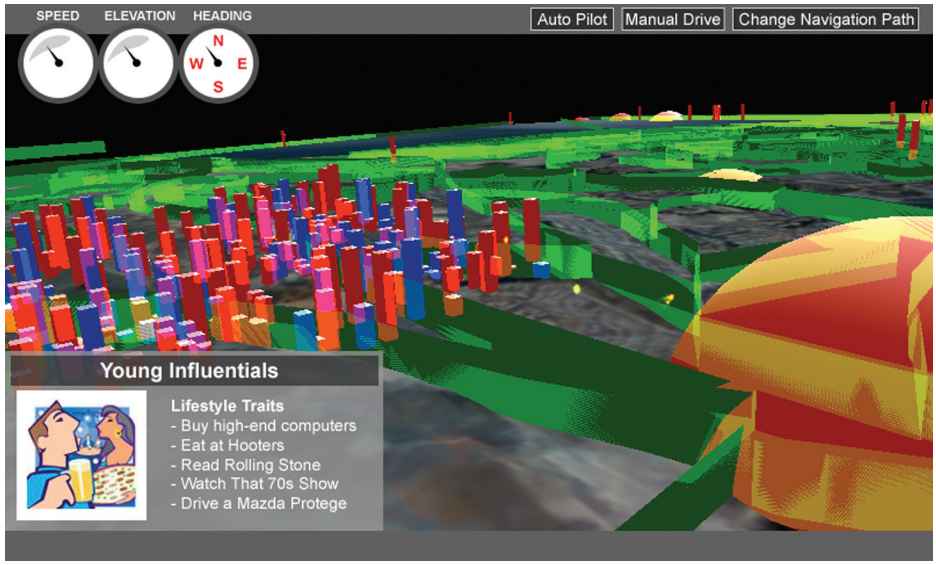


Figure 3. Datascape Version 1.0 Screen Shot

locations in the geodatabase, where the symbol would appear at the corresponding locations in the digital world.

Behaviors

Behaviors enable the data to come to life through action within the digital environment. A behavior can be tied to a symbol, such as animating it to rotate. When a behavior is attached to a symbol, some parameter of the behavior is typically controlled by an attribute value of the underlying data source—such as telling the symbol how fast to rotate. Behaviors can also interact with the actions of a passenger—through dynamics and location of the vehicle or through user interaction. In addition to symbols, behaviors can be associated with zones and forces.

ZONES AND FORCES

Zones are geographic regions defined by a polygon boundary. Examples are city boundaries, census divisions, or user-generated regions such as gang territories or neighborhoods. Zones are not necessarily visually represented in the environment (though they can be through *symbols*), but they are programmed to have impacts on the behaviors or appearance of other entities in the environment. *Forces* are similar in scope to zones, except they are tied to points instead of regions and their effects taper off at a given distance from the center of the force. Forces can also migrate in relation to other forces or behaviors, allowing for dynamic systems and providing a helpful balance to the defined and bounded nature of zones.

PATHS

Paths are temporal and directional in nature. They are defined either by mathematical functions or by a series of points. Paths can be used to guide the movement of symbols or

forces, and can also be derived from such movements. Examples of paths might include the movement of vehicles through the city, flows of migrant workers from season to season, or movement of capital from overseas investors. The coupling of paths and forces allows for behaviors to unfold across a spatiotemporal domain.

LINKS AND PORTALS

Links are used to establish relationships between various entities within the digital landscape. Links are automatically created between symbols that belong to the same data set—such as distributed sensors in an air quality data layer—and can also be established between data sets or between specific symbols. In addition, passengers can create links between symbols as they explore the environment and uncover relationships to share. *Portals*—which are enabled by *links*—allow for the decoupling of the digital topography from geographic space. When a symbol portal is acted on, the digital environment is reconfigured to spatially present the linked symbols according to relationships between the symbols instead of their physical location in the world. Portals thus enable a way to view spatiality in relational and hodological terms, not just cartographic.

SOUNDS

As described above, a musical soundtrack accompanies travel and interactions in the hybrid environment. The music is based on a continuously evolving *groove* generated in real time through stylistic parameters based on the aggregation of surrounding data.[6] In addition, sampled or generated sounds can be linked to a specific symbol, zone, force, or behavior. These *triggered* sounds are played when the vehicle passes a given threshold or comes within a distance of a symbol. Continuous *located* sounds can also be linked to specific locations or symbols.

Theory and Practice

> In theory, there is no difference between theory and practice; In practice, there is. (Various)
>
> To despise theory is to have the excessively vain pretension to do without knowing what one does, and to speak without knowing what one says. (Bernard de Bovier de Fontenelle)
>
> Praxis means taking our own and other's theories seriously enough to seek to act and live by them, letting what is learned in the living also test and develop the theories. (Richard Johnson, 2004)

Datascape was born within the frame of artistic practice. There were two main motivations in the conception of this project. One was a focus on theoretical critique: to reflect on the effects of geographic information technologies and surveillance in demographic profiling. A second motivation was focused on aesthetics and interaction: to create an immersive aesthetic experience of the city driven by existing spatial information and cultural narratives. As a practicing artist, I am informed and guided by theoretical concerns within human geography. As a doctoral student in informatics, I am looking at implications this project has for technological practices at the confluence of information sciences and geography. Like Johnson's characterization of praxis, the building of this project seeks to explore some theoretical questions and also to put into practice existing theories of spatial and cultural experience.

A focus on practice is often critiqued within the scope of scientific methodology, where it is viewed primarily as a way to test or validate theories. In this regard, we see how practice might seem to involve "pragmatic closures, an overpoliticizing of knowledge and the abandonment of questions of truth" (Johnson, 2004, p. 92). I approach practice not as a way to specifically validate theoretical concerns but as a way to reconsider current technical and representational methodologies—practice as a form of critical theory. This approach could be compared with Agre's (1997) *critical technical practice* or *critical design* as suggested by Dunne (1999). The idea is that system design should not be solely driven by ideals of efficiency, cost-effectiveness, or tried-and-tested consumer interest but also by artistic and performative ideals—aesthetics, playfulness, pleasure, critique, imagination—and by theoretical underpinnings of the social sciences and human geography.

In this final section, I briefly describe some ways in which Datascape addresses several theoretical concerns and suggest how we might consider these theories in the design of interactive information systems. I focus on the ideas that processes of knowledge generation are *local, embodied, temporal, emergent, hodological, personal, collective*, and *imagined*. I elaborate how these qualities pose representational problems for interactive technologies and how Datascape might help elaborate these theoretical issues within the scope of artistic practice.

LOCAL

In most maps and spatial representations, the city is seen from a bird's-eye view. This is the dominant mode of geographic information analysis (biologists, social scientists, city planners) and is also the dominant mode of representation in the creation of maps. This way of seeing and ordering the world is born of technological developments such as cartography and satellite imaging. In *Seeing Like a State*, Scott (1999) critiqued the ways that governments and other institutions have imposed spatial order onto cities for purposes of control and rational division. Scott importantly noted that in creating an urban order legible from the outside, "the grand plan has no necessary relationship to the order of life as it is experienced by its residents" (p. 58). de Certeau (1984) similarly drew a distinction between the experience of the city looking down from a skyscraper—which he refers to as an act of *reading* the city—and the act of *walking* in the city, where the viewer is transformed from voyeur into a participant. The experience of Datascape is decidedly *local* and set in the *everyday*. Information and narrative encountered by the participant are not read from a panoptic vantage point but are read from the same local perspective experienced in daily negotiations with the city. Experience of the city shifts from, in De Certeau's terms, an act of *consumption* to an act of *production.*

EMBODIED

The first-person perspective—such as that offered by 3D environments such as those in MMOGs or in geographic visualization environments such as Google Earth or NASA World Wind—brings a local perspective into forms that were previously read from a removed perspective (MUDs and MOOs, cartographic maps).[7] Instead of presenting the world from a panoptic view, these environments place the user within the world and help to create a sense of immersion and involvement. However, the environment in which one is immersed has no spatial correlation to the world that one's body inhabits, and one's body is in large part immaterial to one's physicality in the synthetic environment.

Dourish (2001) argued for an approach to human–computer interaction he called "embodied interaction," in which phenomenology and embodiment are considered primary in relating to computational systems. The philosophy of phenomenology holds that there is no objective, rational understanding of reality without the body—that meaning comes into existence through experience. With a nod to Heidegger, Dourish emphasized, "the phenomena of experience are central to questions of ontology and epistemology." That is, *being* in the world only arises from embodied action and daily experience. In Datascape, there is an embodied relationship to the digital environment, both through vehicle movement and through physical interaction. Movement in the computerized environment directly mirrors movement through the physical world. In addition, rotation and orientation of the periscope are correlated to orientation in the digital environment. Hybrid spaces arise when passengers encounter digital space in a way that is embodied, experiential, and juxtaposed with the physical world.

TEMPORAL AND HODOLOGICAL

Much work in hybrid environments is focused on an object-based or coordinate-specific representation of information.[8] This focus on the object or coordinate is at least in part a result of the affordances of the technologies available for indexing and representing information—an RFID needs to be attached to an object, and a geodatabase entry needs to be associated with a point, line, or polygon in physical space. The ontology of the geodatabase, while reducing the complexity of dynamic systems and interdependent events to database entries, also has had a tendency to reduce complexity in interactional terms. There are two implications for interaction with which I am primarily interested—that current interactive technologies encourage a direct *fusing* of the synthetic and the physical and that such a fusing breaks interaction down into a chain of discrete encounters as opposed to a continual unfolding of meaning and experience.

To emphasize objects and coordinates is to be concerned with nouns—with entities that are acted on and known about.[9] Although this focus may elucidate the *known,* perhaps a focus on action—on verbs—might bring into view the act of *knowing.* Turnbull (2007) suggested, "All processes of knowledge generation are based in the dynamics of movement through space, and of change over time" (p. 141). He considered the act of knowledge production as hodological—concerned with paths and connections. By focusing on hodology, we move from concentrating on what is known or established to considering the act of knowledge production. If we apply this notion to interaction design, we might see that moving beyond the object or coordinate and focusing on processes of linking and moving between the objects can yield a similar shift in focus.

Datascape does this by enabling a dynamic environment that is continually unfolding. As passengers travel through the environment, there are no rifts or disconnects in the digital environment—users are not focused on moving toward the next virtual object they are gathering in a mixed reality game, the next marker in an augmented reality environment, or the next RFID-tagged object. Instead of presenting objects as *known,* Datascape's narrative ontology allows for its symbols to act in accordance with the observer, its environment, and the data it represents. Meaning is not browsed through static entities; it arises through participatory emergent narratives—through the conversations among people, symbols, behaviors, zones, forces and sounds. Narrative traces not only are instantiated as objects but also can be forces acting on other entities, links and portals, triggers for action, and intelligent agents. Individual database entries are reanimated through behaviors of the environment and other entities in the digital and physical worlds.

PERSONAL, COLLECTIVE, AND IMAGINED

The building of synthetic worlds holds potential for experimentation with alternate systems of valuation and land use. However, a world like that in Second Life has adopted a traditional Western model of capital-driven land ownership and partitioning.[10] In Second Life, users can convert their currency into Linden Dollars, which can then be used to purchase plots of land in the game world. Once purchased, the owner builds structures and objects on his or her land and places other restrictions that govern who can enter onto that property and what kinds of actions are allowed within that space. As such, passing through a Second Life landscape is a series of encounters with synthetic buildings, businesses, trees, and walls—walls that partition space and enclose objects.

Space is not constituted solely of the physical entities that populate it; it is also inhabited by personal, collective, and timeless narratives. Australian indigenous peoples have an alternate concept of land ownership where people do not own land but the land owns the people—their knowledge tradition does not allow for the concept of land ownership (Verran, 1998). This tradition enables—and arises from—their concept of *the dreaming*. The dreaming holds two notions that I find to be important considerations for Datascape: It is composed of both personal and collective stories, and these stories exist in *dreamtime,* where past, present, and future dreams and histories of the indigenous peoples all occupy the same temporal domain.

In Datascape, there are no restrictions on where one can locate a narrative trace—there is no equivalent to land ownership in the digital environment. This allows the imprinting of a personal imaginary on places and areas that are considered private in the physical world. By placing multiple, distinct perspectives in conversation with one another, Datascape enables compartmentalized private space to be simultaneous populated by personal traces and also to be reimagined through a collective lens. Notions of land ownership are often tied to the present and near future. By allowing distinct stakeholders—previous inhabitants, current residents, or passers-by—to embed narratives, we instead imbue the world with historic and speculative imaginaries.

Conclusion

In this article, I elaborated an approach to hybrid space that focuses on the informational substrate of the embodied spaces we inhabit. I distinguished this approach from those that see hybrid space as arising from the embedding of remote contexts via mobile technologies. I suggested that pervasive computing technologies can help to reveal localized digital contexts that are coextensive with the physical world—contexts that exist in an active relationship with the geographies they describe. I presented Datascape, an ongoing art project, as a way to bring information out from databases into everyday lived experience. Datascape is a hybrid environment through which vehicle passengers interact with a digital landscape that is spatially correlated to the physical world. Through the use of a dynamic representational ontology—consisting of *symbols, behaviors, forces, zones, paths, links, portals*, and *sounds*—Datascape enables participants to create, view, and interact with a hybrid digital–physical ecology. By casting users of the system as authors, diverse perspectives and knowledge traditions are placed in conversation with institutional narratives such as demographic marketing profiles. Datascape's representational ontology allows the emergence of these conversations through negotiations among databases, authors, passengers, and autonomous data-driven entities that behave and interact in synergy with their environment.

One of the challenges that exist in developing participatory geographic information systems is that existing methodology and database ontology can act to reduce the complexity of diverse knowledge traditions and cultures (Curry, 1998; Pickles, 1994; Turnbull, 2007). I suggest that they also reduce complexity in representational and interactional terms—specifically in the fields of mixed reality, ubiquitous computing, and geographic visualization—by contributing to a focus on the object and coordinate, on what is known as opposed to the process of knowing. Through critical artistic practice, I elaborated an interactive system for geographic narrative that is inspired by theories in human geography and suggested ways that we can incorporate the rich contributions of this field into the design of interactive computational systems. Specifically, I focused on ideas that spatial knowledge production is *local, embodied, temporal, emergent, hodological, personal, collective*, and *imagined.* Australian Aboriginal cultures believe that, through dreaming, the world can be reimagined and even remade. Datascape allows for the creation of a shared imaginary coextensive with our lived environment—an imaginary that can help broaden conversations about our hybrid ecologies and the technologies through which they are experienced.

Notes

1. This work was funded in part by the National Science Foundation under award 0326105. The author thanks the ARCS (Achievement Rewards for College Scientists) Foundation for their generous support of his research. The author also gives thanks to Paul Dourish, Bettina de Guzman and his colleagues in Paul's research group for discussion and feedback in the development of this research.

2. It should be duly noted that there still exist issues of privilege based on levels of access to computers and Internet connections and other socioeconomic and cultural factors.

3. Some data are collected "in the field" through GPS-enabled devices, and this will likely increase as location-aware mobile devices become more prevalent. But it is currently a safe assertion that field data collection composes a minority of the publicly created data sets.

4. Note that my definition of hybrid ecology differs from Crabtree and Rodden's by concentrating not on ecologies of devices and technologies but on the underlying ecologies of representational and sociotechnical practices that compose our hybrid world.

5. This term has also been applied to research in the field of education that aspires to "enable interplay between various perspectives of diverse people" (Clough & Goodley, 2004; Lämsä & Sintonen, 2006). My usage of *participatory narrative* is also related to the field of *participatory design* (Muller & Kuhn, 1993; Schuler & Aki, 1993).

6. The *groove* typically consists of musical content that might be considered a rhythm section, allowing for other sound and music content to be overlaid on top.

7. MUDs and MOOs are online social spaces that are often seen as the precursors to massively multiplayer online games (MMOGs).

8. Work in augmented reality superimposes virtual objects onto live video by replacing markers in the physical world with computer-rendered graphics. Barcodes and radio frequency identification are used to uniquely identify physical objects to a digital system. Bruce Sterling's (2005) *Spimes* and *The Internet of Things* (http://www.itu.int/osg/spu/publications/internetofthings/) are centered on the idea that everyday physical objects can be uniquely identified and connected to networks that store information and histories about the objects. Mixed-reality games (Benford, 2006; Crabtree & Rodden, 2007) often center on the linking of virtual objects to GPS coordinates in physical space, and a large number of spatial annotation projects enable the embedding of text or media objects to specific locations (http://www.elasticspace.com/2004/06/spatial-annotation/).

9. This separation between object and observer is reminiscent of Latour's (1993) concept of purification.

10. I use the synthetic world Second Life (http://www.secondlife.com/) as an example of an MMOG because, like Datascape, it is driven by user-generated content.

References

Agre, P. E. (1997). *Computation and human experience*. Cambridge, UK: Cambridge University Press.

Balram, S., & Dragicevic, S. (2006). *Collaborative geographic information systems*. Hershey, PA: Idea Group.

Benford, S. (2006, April). *The frame of the game: Blurring the boundary between fiction and reality in mobile experiences*. Paper presented at the 2006 ACM SIGCHI conference on human factors in computing systems, Montreal, Quebec, Canada.

Castronova, E. (2005). *Synthetic worlds: The business and culture of online games*. Chicago: University of Chicago Press.

Clough, P., & Goodley, D. (2004). Community projects and excluded young people: Reflections on a participatory narrative research approach. *International Journal of Inclusive Education*, *8*, 331-351.

Crabtree, A., & Rodden, T. (2007). Hybrid ecologies: understanding cooperative interaction in emerging physical-digital environments. *Personal and Ubiquitous Computing*. E-published ahead of print, March 6, 2007. DOI: 10.1007/s00779-007-0142-7.

Curry, M. R. (1998). *Digital places: Living with geographic information technologies*. London: Routledge.

de Certeau, M. (1984). *The practice of everyday life*. Berkeley: University of California Press.

de Souza e Silva, A. (2006). From cyber to hybrid: Mobile technologies as interfaces of hybrid spaces. *Space and Culture*, *9*, 261-278.

Dodge, M., & Kitchin, R. (2004). Flying through code/space: The real virtuality of air travel. *Environment and Planning A*, *36*(2), 195-211.

Dourish, P. (2001). *Where the action is: The foundations of embodied interaction*. Cambridge, MA: MIT Press.

Dunne, A. (1999). *Hertzian tales: Electronic products, aesthetic experience, and critical design*. Cambridge, MA: MIT Press.

Harris, T. M., & Weiner, D. (1996). *GIS and society: The social implications of how people, space and environment are represented in GIS*. Santa Barbara, CA: National Center for Geographic Information and Analysis.

Johnson, R. (2004). *The practice of cultural studies*. Thousand Oaks, CA: Sage.

Kabisch, E. (2006). *Landscape denatured: Digitizing the wild*. Irvine: University of California, Irvine. Available from Eric Kabisch Web site, http://e.fluxt.com/thesis/

Kabisch, E. (2007, June). *A periscope for mobile discovery and narrative*. Paper presented at the 6th ACM SIGCHI conference on creativity and cognition, Washington, DC.

Lämsä, A., & Sintonen, T. (2006). A narrative approach for organizational learning in a diverse organization. *Journal of Workplace Learning*, *18*(2), 106-120.

Latour, B. (1993). *We have never been modern*. Cambridge, MA: Harvard University Press.

Livingstone, S. (2005). Introduction to the special issue "Audiences and publics." *Journal of Media Practice*, *6*(1), 5-7.

Malaby, T. (2006). Parlaying value: Capital in and beyond virtual worlds. *Games and Culture*, *1*(2), 141-162.

Muller, M. J., & Kuhn, S. (1993). Participatory design. *Communications of the ACM*, *36*(6), 24-28.

Parker, S., Uprichard, E., & Burrows, R. (2007). Class places and place classes: Geodemographics and the spatialization of class. *Information, Communication & Society*, *10*(6), 902-921.

Phillips, D., & Curry, M. (2003). Privacy and the phenetic urge. In D. Lyon (Ed.), *Surveillance as social sorting: Privacy, risk and digital discrimination* (pp. 137-152). New York: Routledge.

Pickering, A. (1995). *The mangle of practice: Time, agency, and science*. Chicago: University of Chicago Press.
Pickles, J. (1994). *Ground truth: The social implications of geographic information systems*. New York: Guilford.
Schuler, D., & Aki, N. (1993). *Participatory design: Principles and practices*. Mahwah, NJ: Lawrence Erlbaum.
Scott, J. (1999). Seeing like a state: How certain schemes to improve the human condition have failed. New Haven, CT: Yale University Press.
Sterling, B. (2005). *Shaping things*. Cambridge, MA: MIT Press.
Stross, B. (1999). The hybrid metaphor: From biology to culture. *Journal of American Folklore*, *112*(445), 254-267.
Sunstein, C. (2006). *Infotopia: How many minds produce knowledge*. Oxford, UK: Oxford University Press.
Surowiecki, J. (2004). *The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies and nations*. New York: Doubleday.
Turnbull, D. (2007). Maps narratives and trails: Performativity, hodology and distributed knowledges in complex adaptive systems—An approach to emergent mapping. *Geographical Research*, *45*(2), 140-149.
Verran, H. (1998). Re-imagining land ownership in Australia. *Postcolonial Studies*, *1*(2), 237-254.
Wood, D. (1992). The power of maps. New York: Guilford.

Eric Kabisch is an artist, interaction designer, and doctoral candidate in the Department of Informatics at the University of California, Irvine. His current research and practice investigate the varied intersections between geospatial information technologies and human geography.