12 Mapping modes, methods and moments

A manifesto for map studies

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Introduction

By way of conclusion to *Rethinking Maps* we want to set out a manifesto for map studies for the coming decade. Its goal is to generate ideas and enthusiasm for scholarship that advances our understanding of the philosophical underpinnings of maps, and also enhances the practices of mapping. This is not a call for ever more introspective intellectual navel gazing about maps. Instead it traces routes and methods that might help people to *do* mapping differently and more *productively*, in ways that might be more efficient, democratic, sustainable, ethical or even more fun. This manifesto is, of course, preliminary and partial, coming as it does from a social scientific tradition and the authors' experiences as Anglophone human geographers. It also focuses on understanding *everyday* mapping practices and the various *socio-technological infrastructures* that are a necessary, but often unquestioned, support for contemporary mapping. The aim is to suggest and provoke. Our manifesto for map studies is structured into three "levels": first, looking at *modes* ("what to study"); second, *methods* ("how to study"); and finally, *moments* ("when and where to study").

Modes of mapping

For us, map studies needs to continue to develop alternative ways to think through cartographic history and contemporary practice that are not wedded to simplifying, modernist, narratives of "advancement". In this pursuit, we might build on the relational thinking of Matthew Edney. He forwards the notion of "cartography without progress" (1993: 54), in which mapping is read as 'a complex amalgam of cartographic *modes* rather than a monolithic enterprise'. For Edney, a cartographic mode is not simply a linear chronological sequence, instead it is a unique set of cultural, social, economic and

technical relations within which cartographers and the map production processes are situated. The mode is thus the milieu in which mapping practices occur. Each cartographic mode gives rise to its own kind of map artefacts, and critically this conceptualization does not assume that one is inherently better than another, or that one mode will inevitably evolve into a "superior" mode. As Edney (1993: 58) elaborates: '[t]he mode is thus the combination of cartographic form and cartographic function, of the internal construction of the data, their representation on the one hand and the external *raison d'être* of the map on the other.'

Modes are unique to their time and place, and are transitory. Modes of mapping practice are coupled to the continual emergence of new knowledges, spatial problems, methods and institutions, and drive developments in the design of map representations and in the roles that maps play in society. There are usually multiple but distinct mapping modes operating at the same time in the same place. Modes can interact and may well overlap, merge and diverge. The boundaries between them are likely to be fuzzy and permeable. Cartographic history, according to Edney's theorization, is therefore best read as a plural and relational network of activities, rather than a single linear process. In contemporary cartographic epistemologies, a diverse range of mappings is seen to emerge from a shifting creative milieu, the end result of which is not a unidirectional evolutionary tree of maps, but rather a complex, many-branching, rhizomatic structure.

Part of the undoubted excitement at the moment about maps stems from the fact that contemporary mapping practices consist of multiple, overlapping modes. Mapping is emergent and variegated, drawing on many disparate ideas and data sources, produced by a diverse collection of practitioners and activists, utilizing many forms of visualization. Mapping is thoroughly situated in wider socio-technical changes (particularly the diffusion of the Internet throughout map production and the use of the Web as the main medium of dissemination). To begin to excavate the nature of contemporary mapping modes requires empirical analysis to unpack cultural, social and technological relations that determine these cartographic practices. It seems to us that it would be productive for researchers to focus attention on: (i) interfaces, (ii) algorithms, (iii) cultures, (iv) authorships and (v) infrastructures.

(i) Interfaces: mapping out screen spaces

More and more, everyday mapping is encountered as part of a digital interface, or the map is itself an interface that can be queried. These "screen spaces" are becoming an important site for analysis in map studies. What are the cultural, social and economic relations that bring the interface into being? Interrogating the interfaces of mapping is an ontological project with political ramifications. There is an emerging body of work on the critical reading of computer interfaces that can be drawn upon and might inform map study. For example, Selfe and Selfe (1994: 485) argue that one can hermeneutically

read what gets screened as if it is a cultural map that 'order(s) the virtual world according to a certain set of historical and social values that make up our culture'. Interfaces en-frame and exclude, working as mediating windows onto the world. The task of decoding the embedded cultural biases and distortions in processes of interface screening is challenging, even for supposedly "open" web mapping interfaces because, as Parks (2004: 39) notes, they 'tend to keep users naïve about the apparatus that organizes and facilitates online navigation and how its processes occur in time and extend across space'.

Beyond the cultural politics within spaces of display, there are also phenomenological considerations relating to interfaces (cf. Introna and Ilharco 2006). Mapping often dynamically updates to reflect embodied position and kinetics (Willim 2007), inviting interrogation of the differences digital interfaces make to individual identity and social behaviour that stem from "being on the screen". This interface between person, map and the world in motion would once have been reserved for specialized and particularly military applications, but is now the everyday experience for many when walking with a mobile phone, driving with a satnav, flying with the airshow maps on an in-flight entertainment system, and even playing with handheld GPS units in treasure hunting games of geocaching.

(ii) Algorithms of mapping

As outlined above, the technological practices of map representation are increasingly rendered through computer interfaces on digital screens. What lies beneath these interfaces? They are all products of software, continuously brought into being by complex amalgam of data and algorithms. These codes are highly technical but also deeply culturally contingent, yet from an investigative point of view they are very hard to read or critique.

Map studies needs to open the "black-boxes" of mapping software, to start to interrogate algorithms and databases, and in particular to investigate the production of ready-made maps that appear almost magically on the interfaces of gadgets and devices we carry and use everyday, often without much overt thought about how they work and whose map they project onto their interface. This agenda was aptly expressed by Laura Kurgan (1994: 17) in her imaginative work examining the inherent indeterminacy of the inner workings of GPS software from the external mappings its produces:

> [b]ut the space or the architecture of the information system that wants to locate and fix us in space has its own complexity, its own invisible relays and delays. The difficulty of charting the spaces that chart the spaces, of mapping the scaleless networks of the very system that promises to end our disorientation, demands redefining the points and lines and planes that build the map, and lingering in their strange spaces and times.

Opening the "black-box" of cartographic algorithms was a core element of the social science critique of GIS in the 1990s (Pickles 2004). The rapid popularization of digital mapping in the last five years makes this even more pertinent for map studies, as millions of people walk and drive around with what are effectively mini-GIS mapping gadgets in their pockets and on their vehicle dashboards.

It seems there are several productive routes to critique mapping codes. First, we can draw on emerging ideas in the field of "software studies" that treat code as a form of material culture that can be examined from multiple points of reference to reveal how it comes into being, and works often automatically and autonomously in the world. These ideas seek an expanded understanding of software beyond the technical. They also critique how the world itself is captured within code in terms of algorithmic potential and formal data descriptions (cf. Dodge and Kitchin 2009). This research is trans-disciplinary, often driven by scholars and intellectual hackers in media theory and new media art. Fuller (2008: 2) argues that this kind of approach: 'proposes that software can be seen as an object of study and an area of practice for kinds of thinking and areas of work that have not historically "owned" software, or indeed often had much of use to say about it.' There is much, we believe, that needs to be said by people who have traditionally not "owned" mapping codes.

Socially rich work investigating the spatiality of software algorithms and data structures has begun in human geography, notably with Thrift and French's (2002) theorization of the "automatic production of space" and Graham's (2005) discussion of the socio-geographical effects of "software sorting". However, analysing algorithmic processing underlying new forms of online mapping has so far received little attention. A noteworthy exception is Zook and Graham's (2007) work on "digiplace" as the mapped interface arising from the opaque complexity of search engine databases and spatial-relevance ranking algorithms. This research offers a significant opening and needs to followed-up and expanded upon.

A second route toward analysing mapping algorithms is to build explicit connections between cartography and the emerging conceptual agenda of "surveillance studies" to reveal the social power frozen in code and the dangers of discriminatory effects emerging from automated sorting of people and code-based representations of place. There is a focus on power at the heart of "surveillance studies" according to Lyon (2007: 1) with explicit attempts to explain surveillance practices in terms of 'rationalization, the application of science and technology, classification and the knowledgeability of subject'. Considering the computerized map as a surveillant technology was initially undertaken by Pickles (1991) who argued that nation states, trans-national corporations and the interests of capital and technology deploy the surveillant potential of mapping to restructure local, regional, national and global geographies. Notable examples of recent work in this vein includes Crampton (2004) who explored parallels between the nineteenth-century

emergence of crime mapping and contemporary post-9/11 surveillance discourses as reflections of Foucauldian rational governance.

(iii) Mapping visual culture

In the 1990s, a research focus on the analytical functions of GIS led to a significant retreat from design issues that had hitherto formed a central concern for cartographic research. It has been argued that this retreat has almost led to the death of cartography as a discipline (Wood 2003). Everyday mapping however, grew apace from the end of the decade, and meanwhile a newly energized emphasis on the visual pervades much critical thought across cultural and media studies (see Sturken and Cartwright 2007 for an overview in this area). We would argue that a new and critical engagement with visual studies could usefully inform research into mapping. Cartography may or may not be heading toward extinction as a technical discipline, but mapping is very much alive and technology alone is insufficient an explanation for the role that new kinds of mapping are playing in society.

Such research might usefully explore new ways of envisioning spatial data in interactive and animated systems, building on the innovative work carried out by researchers such as Dykes *et al*. (2005). Which new ways of symbolizing data work best? Which widgets offer the most appealing ways of performing screen navigation and selection and why? How might geovisualization best represent movement, change and dynamic data? What are the best ways of situating the observer on and in mapping displayed on different kinds of device? Among areas that might usefully receive attention here are the interplay between screen design issues and display design issues: a much greater contextual awareness of the intertextuality of displays could inform critical approaches to the burgeoning literature around usability (see van Elzakker *et al*. 2008). Although a concern with designing better maps has led to a profusion of expert systems encouraging effective use of industry-standard software designs (e.g. Harrower and Brewer's (2003) innovative work on Colorbrewer tool), innovative design solutions for the representation of phenomena only rarely feed through to the mainstream consumption. Yet the immediate appeal of Google Earth stems in large part from the visual novelty of its interface. Mapping researchers could usefully learn from this approach. The difference that media make is also a rich research area: interesting work is already exploring the roles that sound and taste mapping might play in multimedia map design (cf. Taylor 2005).

To realize this kind of research result, mapping needs to be situated in relation to other media. It is noticeable that the mainstream of visual culture and visual studies research almost completely elides mapping at present (see for example Elkins 2003) and that mainstream visualization research largely remains grounded in scientific representation (see Dodge *et al*. 2008). Critical insights from visual studies, with its emphasis upon innovative methodologies could usefully be applied in the more narrowly defined worlds of

geovisualization. Researchers might learn much here from the practical worlds of computer game design and some of the roles that maps play in these (see for example Longan 2008 for a critical examination of mapping/landscape relations in role-playing games where maps are so much more than a neutral backdrop for the action). Surely dialogue between visual studies and cartography would yield richer and more complex insights into the nature of mapping.

(iv) Authorship of mapping

It is also important, we believe, to focus attention in map studies on authorship. Significant changes in notions of authorship are at the heart of many contemporary modes of mapping. In particular there is a fracturing of authorship with the emergence of a more "writerly" kind of mapping (following Roland Barthes), which according to Pickles (2004: 161) can 'engage the reader as an "author" and insist upon the openness and intertextuality of the text'. Moreover, many aspects of map-making practices are undergoing a metamorphosis towards a "remix" cultural model of production that is apparent in many other media (cf. Bolter and Grusin 1999; Diakopoulos *et al*. 2007), in which new media constantly reinterpret existing media in a process facilitated by rapid and unconstrained access. Manovich (2005: no pagination) argues that "[r]emixability becomes practically a built-in feature of digital networked media universe.'

Research needs to consider the implications for mapping. How do new models of map authorship work in practice, for example: How are power structures altered by the rise of the amateur mappers? How do crowds generate wisdom in cartography? To what extent is the democratization of production really taking place? How might map "hackers" fashion genuinely useful hybrid forms of cartography as opposed to merely creative experiments with little lasting value? Who are the new collaborative authors and why are they motivated to map? and What kinds of mapping do they do and is that mapping of quality and utility to others?

The rise of map mashups has been a significant marker of changing authorship and possibly a new mode of mapping that Crampton (2008) has termed "Maps 2.0" (cf. Geller 2007; and Gartner this volume for useful overviews). Mapping mashups are websites or web applications combining content from more than one source to serve a new service, and usually depend upon a third party releasing an application programming interface. We might usefully investigate the pragmatic effects and wider political implications of the emergence of these new ways of mashing maps together. Are they a relatively transitory burst of creativity that will fade as most users return to few maps produced by high-profile providers, or do they herald the beginnings of a lasting "prosumer"[1] revolution? The deeper motivations for being a prosumer, and the degree to which these changes will create trusted and reliable mapping are still largely unknown.

The vanguard of prosumer authorship however, lies beyond mashing together existing data. Instead it offers newly made and often collaborative geospatial data under the guise of FOSS ("free and open source software") doctrines. The authorship of so-called 'open-source' mapping has a strongly counter-cultural ethos, itself a mixing of libertarian freedom of access to information, the socially progressive benefits of non-profit production and opposition to corporate capitalism. Of course it is ironic that much of this work is currently heavily reliant on the GPS system, designed, funded and maintained by the US military. Prosumer mapping has emerged outside of mainstream cartography, driven by enthusiastic and loosely coordinated collectives of activists, artists and programmers. Most have no formal cartographic training or professional GIS credentials, just an interest in the geography in its common-sense meaning, a liking for maps, a deep affinity with technology and, above all, passion for hacking their own elegant solutions; indeed, one of the first books to formalize the field is called *Mapping Hacks* (Erle *et al*. 2005).

Open-source authorship changes who can make maps and how they are made and open-source mapping seeks to harness the tremendous productive potential of mass-participation (the so-called "crowd-sourcing" methodology). Such "bottom-up" volunteer knowledge creation (seen elsewhere, for example in Wikipedia) exploits the collaborative capacity of the Web and seeks to remake mapmaking as a social activity. Open-source mapping potentially becomes a way of thinking critically about the *practices* of cartography and not the end *products*. The map is not revered and reified as a special-knowledge product (akin to the "Master Map" as Ordnance Survey markets its main digital topographic product) created by an elite organization and then used by a select few. Instead it becomes something that can be creatively made by many hands and enjoyed by anyone and everyone, without onerous and restrictive licencing. In the particular context of British mapping infrastructure for example, this ethos is mixed with a distinctly anti-establishment streak focused on the longstanding critique of Ordnance Survey's monopolistic pricing/licencing model, which has effectively excluded many individuals, non-profit groups, small businesses and local communities (Dodson 2005). This restrictive local context has certainly been a spur to citizen cartographers aiming 'to build a set of people's maps: charted and owned by those who create them, which are as free to share as the open road' (Dodson 2005, no pagination). Open-source mapping alternatives increasingly represent a direct challenge to the closed-world of cartographic officialdom, with its unaccountable state authorship, its emphasis upon owned and protected products as capital assets, and its claims to provide an exclusive topographic text that spatially prescribes so many aspects of daily life.

Within the domain of authorship map studies might also explore so-called "counter-mappings" (see Harris and Hazen this volume), to pin down the scope of genuinely alternative, subversive and emancipatory mapmaking and the degree to which this mapping has effect. For example, one could argue that much open-source mapping is actually not radical at all – it simply

recreates a mirror copy of existing topographic mapping, albeit distributed under a more egalitarian licencing regime. Is it possible to author counter-mappings that really challenge established power relations and effect political change? Pickles (2004: 185), for example, invokes the work of William Bunge, which he typifies as a nomadic counter-cartography, with its '[s]imple maps of hazardous materials along streets, incidences of rat-bites, or unlit alleyways'. But did Bunge's map really help "take-back" the streets by empowering communities?

(v) Infrastructures of mapping

The fifth and final domain through which map studies can investigate contemporary modes of mapping is to engage with infrastructure. Despite the fact that '[i]nfrastructure can be dullest of all topics', Norman (1998: 55) notes '[i]t can also be the most important. Infrastructure defines the basis of society; it is the underlying foundation of the facilities, services and standards upon which everything else builds.' Critical interrogation of the infrastructures of everyday living has been widely overlooked by the social sciences because of the ways they tend to slip beneath the surface (Graham and Thrift 2007; Star 1999). Infrastructure is often materially unseen and hidden from view; most users are unaware of it and have no experience of its significance in their everyday lives; technical systems are largely ignored as banal and "taken-for-granted"; and infrastructure is hard to analyse because complex corporate ownership structures and fragmented regimes of regulation in the wider neo-liberal political economy tend to mask its existence. From a political perspective, critical studies of infrastructures are made more difficult because of the ways in which institutions deliberately structure them as "black-boxed" systems to keep people from easily observing (and questioning) their design and operational logic. The invisibility of the infrastructure provides an effective cloak under which market manipulation and socially iniquitous practices can be safely carried out by institutions owning and operating them without undue negative public attention.

The lack of critical studies of mapping infrastructures tends to reify biases in the ongoing production of common cartographic data (such as topographic, routing, statistical maps) and to deny alternative ways to build and operate infrastructures. However, these infrastructures have the tendency to widen social difference and inequalities across space. As Pickles (2004: 146) argues:

> [a]s the new digital mappings wash across our world, perhaps we should ask about the worlds that are being produced in the digital transition of the third industrial revolution, the conceptions of history with which they work, and the forms of socio-political life to which they contribute.

Researching mapping as an infrastructure needs to foreground the materiality of production, render transparent usage, and denaturalize the

everyday appearance of maps by highlighting corporate structures that are underlying mapping. Working through infrastructures can be approached in two ways: first, one can consider the infrastructures that make a mapping mode possible. For example the pivotal role of military infrastructures in everyday mapping has long been appreciated in historical studies (e.g. Harley 1988). But it important to realize that the current paths of technical development in mapping are still dependent, in large part, on military infrastructures in various guises and their significance munificence of capital and other resources (cf. Cloud 2002; Kaplan 2006). In particular the underlying geospatial capture infrastructures, such as earth imaging and GPS, are strongly influenced by military funding and imperatives of state security and secrecy. A recent example reported in the press amply illustrates this, with the launch in September 2008 of a new high-resolution commercial imaging satellite, called Geoeye, which is part supported by Google (who gain exclusive commercial access), but over half of the $502 million cost was financed by the US military. Furthermore, the Geoeye system operates under licence from the US government, who ensures their continued primary access to imagery ("shutter control") and denies highest potential resolution to anyone without explicit government authorization (cf. Chen 2008).

Secondl, it is important to analyse the ways in which mapping modes contribute to infrastructures themselves. The mundane disciplining role of mapping infrastructures in systems of computerized governmentality continues to grow, for example in consumer marketing and crime mapping (Crampton 2003); this needs to be actively questioned by map studies. Rather than contributing to a more democratic society, one could argue that the powerful gaze of cartographic visualization at the heart of surveillance infrastructure means mapping is active in deepening social power of corporations and the state over the citizen, particularly after 9/11. This is evident from the prominence of mapping in the fetishization of geospatial capabilities to "target terrorism" (Beck 2003). A critical approach is needed here (see O'Loughlin 2005) – one research possibility is to follow the money directly from military and intelligence sources towards the mapping research that they fund. Such surveillance requirements are also a driver in the development of new mapping techniques for cyberspace, particularly for visualizing online social networks (cf. Dodge 2008).

Mapping methodologies for map studies

How can contemporary mapping practices and socio-technological infrastructures of cartography be studied empirically? What are the new methodological routes in the study of map modes? Do approaches from science and technology studies (STS), Actor-Network Theory, ethno-methodology and non-progressive genealogy that are now *de rigueur* in many areas of social science work for mapping? Can they help scholars to reconstruct the real

conditions under which mapping is brought into being, or offer novel insights into how a map might make a difference in the world?

It seems clear to us that there are many valid and potentially valuable routes into the study of contemporary mapping practice. Some of these have been touched upon, in varying degrees, by the contributions to this volume (e.g. Craine and Aitken's consideration of affect; Crampton's excavation of Foucauldian genealogy; or Krygier and Wood's propositional view of mapping as situated cognitive cartography). It is, we would argue, a stimulating time for mapping scholarship with many challenges and opportunities opening up: no single epistemological position now dominates interpretation. We suggest here a range of methodological routes that might be worth pursuing, focused upon (i) materiality, (ii) political economy, (iii) affect and (iv) ethnography.

(i) Materiality of mapping

In many other areas of the social sciences there has been a marked turn towards the materiality of objects in social processes, with a concern for the tactile experience of things, the ways this facilitates action and a focus on how the physicality of their production affords particular solutions to problems (see for example Clark *et al*. 2008). The materiality of mapping has been largely overlooked in cartographic scholarship,[2] and in particular in contemporary research on digital products and the virtualization of interaction and experience online. In practice, paper maps are still used and many times digital maps are printed out for immediate, convenient use and annotation. Meanwhile, digital map interfaces need to be interacted with in very material ways (e.g. manipulating buttons with fingers, adjusting the position of screens to make things more visible in imperfect lighting conditions and so on). Consequently, there is a need for work that moves beyond the narrow examination of the effectiveness of "special" tactile map products (see for example Rowell and Ungar 2003), to interrogate *everyday* material encounters with mapping in different contexts. This needs to consider how the material forms of mapping might make a difference and perhaps explore the kinds of affordance these enable, *and* disable, and the contributions of the material in everyday problem-solving with maps.

(ii) The political economy of mapping

A major methodological element of map studies should be to explore the political economy of contemporary mapping. In the late 1980s social constructivist research began to interrogate the power of mapping and its historical implication in capitalist modes of production (see for example the classic studies by Harley 1989; Harvey 1989; St Martin 1995). Similarly, there were a number of studies on the use of cartography in the propaganda of nation states and others (e.g. Monmonier 1996a). However, a political-economic

approach is very rarely taken in studies of contemporary mapping, despite the fact that the vast bulk of mapping, measured in terms of volume, scale and spatial coverage, is still produced and owned by government institutions and large corporations. This concentration of spatial power is likely to remain the case into the future as well, notwithstanding the current fashion and fascination with "open" maps made with volunteer effort. So tracing the monetary and political structures underlying the production of maps used in everyday practice is worthwhile. The fact that we seem to have more "free" access (i.e. underpinned by advertising revenue) to detailed mapping than ever before, via Internet portals masks continuing limits to availability of large-scale data that stem from official and corporate secrecy (cf. Lee and Shumakov 2003). Decisions on where capital is being invested to produce updated and new maps, data and delivery systems affects, in practical and political terms, how the world is going to be envisioned cartographically in the future, but is opaque to scrutiny. Who controls what gets mapped when you enter a mundane geographical search query on the Web, or type a postcode destination into the find menu on your satnav, or text 'locate' on your phone? Tracing out patterns of capital investment, government subsidies, licencing fees and profits that circulate continuously, but unseen, through maps can reveal the wider power structures in which everyday mapping practice is situated, many of which are several steps removed from moments of use.

(iii) Affective understandings of mapping

Research methods also need to consider mapping as practices. Two of us have argued elsewhere that new insights will emerge if mapping is studied processionally rather than representationally (cf. Kitchin and Dodge 2007). From that perspective, there is a need for research that examines contemporary map creation as a performance of space and the affective power flowing from of-the-moment map use in diverse contexts.

There is a burgeoning body of research on the affective nature of spaces in human geography that is clearly relevant to practices of mapping (see Anderson and Harrison 2006 for a useful overview of this emerging field). This kind of research might consider: the emotional capacity of maps to do work in the world; the kinds of action and affect enabled in everyday mapping activities; and the role affect might play in enacting solutions to spatial problems. Thinking affectively could also grant insights in how people map, by focusing attention on the relations between design and its deployment, which would help professional mapmakers to create a wider range of products and interfaces capable of evoking a greater variety of actions and responses beyond the often taken-for-granted neutrality of the map as problem-solving artefact.

Thinking about what affective maps are and might be like has already begun (see Aitken and Craine 2006). Experimental examples that tap into feelings have been produced, particularly by artists (e.g. recent work around

beauty mapping by Christian Nold and angry maps by Elin O'Hara Slavick 2007). In epistemological terms several scholars have begun to see the exciting and innovative potential for making mapping that encompasses affective qualities of space. For example, the recent work of Mei-Po Kwan and collaborators (e.g. Kwan 2007) enacts a feminist re-imaging of GIS as an affective and emotional alternative to neutral science, and Pearce (2008) has translated the sense of place from the narrative of trapper's diaries into affective maps of their journeys in eighteenth-century Canada.

(iv) Ethnography and novel evaluation of mapping

The need to capture *how* maps emerge into the world to do their work necessitates more nuanced means of evaluation than has typically been employed in academic cartographic research to date. Studying mapping needs to progress outside controlled laboratory environments and to seek deeper ethnographic understanding of mapping in the "wild", so to speak. Here the focus moves from measured responses to tests towards situated observations and participation in the mapping process (see Perkins 2008). Ethnographically a map is not a map because it looks like a map, rather mapping is defined by how maps are used in practice and how they perform space. Capturing everyday mapping performance and attempting to interpolate multiple and opaque meanings is challenging conceptually and time-consuming empirically. Gaining access to natural, vernacular and everyday settings to observe situated mapping activities requires creative solutions and negotiation for scholars whose experience has mainly focused on bringing people into their labs for testing. But computer anthropologists and human–computer interaction (HCI) researchers have successfully moved in this direction in their research on how people (mis)use computers (Dix *et al*. 2004). An insightful step in this direction for map studies, which draws on experiences from HCI research is demonstrated in Brown and Laurier's (2005) work on the use of mapping in everyday wayfinding, in which they observe real-world navigational behaviour of people travelling in their cars. Beyond academic studies per se, another constructive illustration of the ethnographic method is Stephen Gill's (2004) photography project, which is really a visual essay resembling in many ways the mundane essence of mapping (Figure 12.1).

One area that seems ripe for such an approach is the study of the cultural practices of open-source mapping. Here, ethnographic methods could be profitably used to study key activists through participant observation of mapmaking work (such as OpenStreetMap). Work is also needed to examine the organizational structures of open-source mapping projects, the incentives for participants and the mechanisms for creating trust in the wiki production of cartographic knowledge. These could be studied as actor-networks, drawing partly on data contained in online discussion lists and blogs, to reveal the complex and contested ways that new mappings are brought into the world.

Figure 12.1 Street photography captures the immediate and embodied use of mapping for orientation and navigation. Gill's images of maps in action also reveal that often mapping is a collaborative process that involves negotiation over the map and the relation to current position and destination. Source: Ronson 2004.

It should also be possible directly to analyse the authorship of the map, because map data itself can tell stories of its own manufacture (see Figure 12.2). This effort at mapping the mappers begins to lift the lid on the traditionally anonymous authorship and authority (see above). Interestingly, this kind of analysis of authorship has already begun to reveal a lack of broad democratic participation in some open-source mapping projects (cf. Haklay 2008).

In addition, there needs to be more ethnomethodology in map studies. Such studies would focus on the use and practices of digital mapping systems and tools (e.g. satnav maps), and would research how technologies are used by different people, instead of how the systems have been designed to work. Studies would be small-scale and focused rather than generalist in nature. This kind of research could usefully study incomplete and failed mapping practices (e.g. getting beyond "scare stories" of satnav "blunders"; see below, Figure 12.3), and conflicted activities to reveal social contexts and the embodied experience of cartographic problem solving. A pragmatic end-goal of such local field studies is to reconstruct the conditions under which mapping is deployed, so as to help in the design of future map systems.

Besides ethnographic studies out in the field, we suggest that future map studies should move beyond conventional evaluative methods for revealing

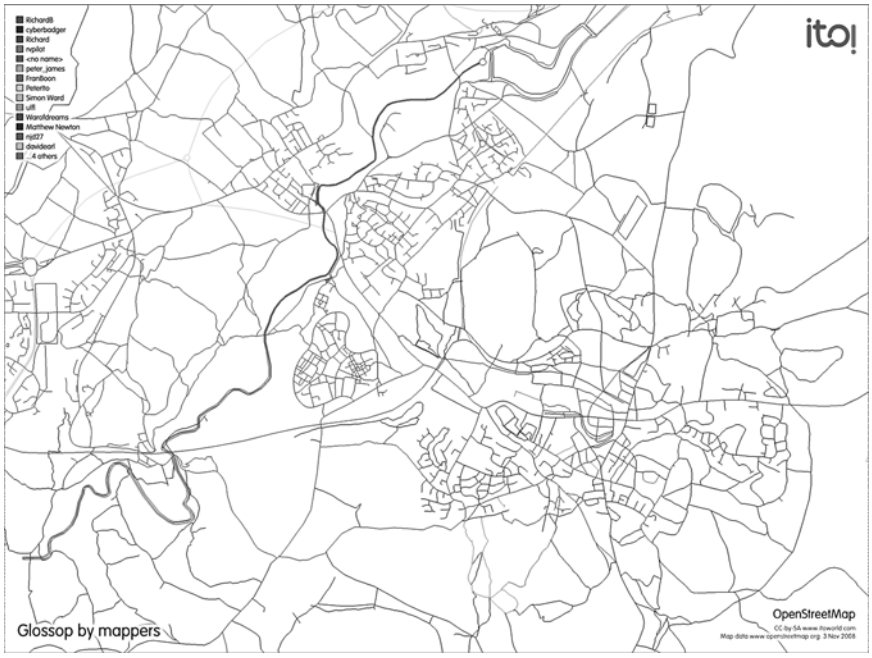

Figure 12.2 The work of multiple map authors contributing to the OpenStreetMap project. Source: author-generated using ITO!'s OSM Mapper service, <http://www.itoworld.com/static/osmmapper>.

the effectiveness of cartographic representations (typically through psychological and cognitive testing in rather artificial lab settings), to look at how people manipulate and play with maps (see Perkins this volume; van Elzakker *et al*. 2008). Online three-dimension virtual worlds and multiplayer games might become useful experimental and experiential spaces for such map evaluation. Processes of testing can be made more engaging and perhaps fun, but with the capacity for comprehensive and rigorous data capture of how users do what they do. Some steps in this direction have been taken by Michael Batty's team at the Centre for Advanced Spatial Analysis in their evaluation of thematic maps, geometric building models and spatial simulations inside virtual worlds (Batty and Hudson-Smith 2007).

The moments of mapping

In this third section of a manifesto for map studies we want to think through when and where mapping really matters. How can scholars identify some of the significant times and places of mapping practice that need to be examined in detail? Instead of the usual and sometimes sterile enumeration of particular sectors, contexts, cultures, places or even types of map or product, we argue that a focus on key processes is more likely to reveal critical aspects of mapping. As such, we offer a tentative list of mapping moments that we think are significant and worthy of study: (i) places and times of failures, (ii) points of change, (iii) time–space rhythms of map performance, (iv) the memories of mapping, (v) academic praxis; and (vi) newly creative engagement with mapping practice.

(i) Moments of mapping failure

The moment when things go wrong often highlights how things really work, a point often overlooked in everyday life. For example, how a software glitch in an air traffic control system leads to the grounding or re-routing of all planes flying in that sector (Dodge and Kitchin 2004). These moments of failure are revealing of the world in process. As Graham and Thrift (2007) discuss, infrastructures – and as noted above mapping is in many respects an informational infrastructure of contemporary capitalism – are often most easily exposed to critical scrutiny when they fail; '[p]erhaps we should have been looking at breakdown and failure as no longer atypical and therefore only worth addressing if they result in catastrophe and, instead, at breakdown and failure as the means by which societies learn and learn to re-produce' (Graham and Thrift 2007: 5).

Many breakdowns in utility and reliability of digital mapping can be related to errors in software code that brings the map to the screen. Often these breakdowns are more a failure in understanding and interpretation between human and computer. The rapid rise in the use of in-car satellite navigation with its novel dynamic map of the driven world coming into being just beyond


www.metro.co.uk

The sat nav definitely said take a right turn

Flooded engine: The water in the ford is just a little deeper than many drivers anticipate

Picture: SWNS

BY SUZY AUSTIN

DOZENS of drivers are unexpectedly getting a soaking after following directions from their satellite navigation systems – straight into a river.

Every day cars, vans and motorbikes plough through the water because their hi-tech sat nav gadgets tell them to.

It began after the B4040, which skirts Luckington, Wiltshire, was closed for roadworks on April 8.

The shortest alternative route to nearby Sherston is to take the road through Luckington and across a ford. Sat nav firms have included the detour on their systems. But, when motorists enter the River Avon, they soon find themselves stuck in 1.2m (4ft) of water. Resident Lesley Bennett, 59, said it was ridiculous.

'Before the road closure there was one a week but now we're getting one or two a day,' she added. 'When the car conks out the driver looks stunned and points to his sat nav.' Some residents are making money by charging motorists £25 a time to pull out cars with a tractor. Driver Julie Jackson had to abandon her Rover 220. 'The car stalled and I heard this gurgling sound. This is my daughter's car – it's a write-off,' she said.

A road safety expert warned drivers about crossing water. 'If you have to cross, keep your revs up,' he added.

OTHER GPS HOWLERS

- **DRIVERS on their way to a village called Crackpot have been sent to the edge of a 30m (98ft) cliff. Cars take the route in the North Yorkshire Dales described by residents as 'just about passable in a 4X4'.**
- **AN RAC Internet route planner sent drivers wanting to travel from Nottingham to Bideford, in Devon, on a 1,732km (1,076-mile) journey through four countries – England, Wales, Ireland and Northern France. The RAC blamed a technical glitch.**
- **A LORRY trying to cross the narrow Morley Bridge in Devon got stuck after the driver was directed there by sat nav, instead of taking the main A383 near Newton Abbott. Police closed the road and knocked down walls to free the vehicle.**

Ford

Unsuitable for motor vehicles

Figure 12.3 Typical newspaper story reporting driving mistakes "caused" by Satnav mapping errors. Source: author scan from *The Metro*, 2006.

the windscreen is a fascinating illustration of this interpretative failure that has led to a considerable amount of press coverage (Figure 12.3). Map studies might seek to get behind the headlines of these satnav "cockup" stories to reveal how people cope with this of-the-moment wayfinding mapping combined with turn-by-turn voice instructions. As such, investigating the processes of getting lost may well be more productive than researching successful navigation!

(ii) Moments of change and decision making

Where mapping is involved in decision making it does so because it makes a difference. Identifying when maps appear in these processes and assessing the contributions they make is, we would argue, a potentially rich field of research, which might allow researchers to track between representational and non-representational approaches to the world in ways that are 'more-than-representational', linking practices to artefacts and material culture (Lorimer 2005). Monmonier (1996b) offers a useful starting point with its consideration of "carto-controversies": moments and processes where mapping has been strongly contested.

The role mapping plays in the construction and maintenance of different global world orders, and its contributions to moments of change such as revolutions, boundary disputes or regime change is seriously under-researched. Productive examples illustrating this potential are Crampton's (2006) work on the role of mapping in the inquiry at the end of the First World War and Campbell's (1999) consideration of mapping in the Dayton Peace Accord after the Bosnian conflict. The role of maps in navigation and travel is also clearly amenable to this kind of treatment. Here map studies could usefully draw on the experience of mobilities researchers with their focus on the contingent and relational ways in which space is produced through movement (Sheller and Urry 2006). The iconic power of mapping has also been an important force in the progress of intellectual decisions, with visualization at times coming to represent change in intellectual fashion, and at times being strongly influential in changing ways of understanding ideas in many different disciplines. In geography for example, two of the authors are identifying the 'Maps that Matter',[3] charting the ways in which ideas come to be embodied in map form and how this has a lasting impact ion the world of ideas.

(iii) The rhythms of mapping

Map studies could also focus on the shape of the patterns of mapping in time–space using the notion of rhythm analysis (developed, in part, by Lefebvre 2004). This theoretical perspective is beginning to pick up traction in human geography, because as Edensor and Holloway (2008) argue '[i]t foregrounds the processual, dynamic and complexity of both space and time, and their imbrication with each other . . . . rhythmanalysis can highlight the experience of both mobility and situatedness, and the ways in which they are blended.' The rhythms of how mapping appears and disappears in everyday activities could be a productive area to research, for example the meanings of the repeating nightly viewing of the weather map on television, always subtly different, but reassuringly the same. The extent to which mapping always depicts novelty, bringing possible futures into the present and offering alternatives, itself has a temporality, frequency and spatiallity.

Willim (2007: 8) also argues for a more temporally dynamic approach to the analysis of mapping software, noting:

> [t]he uses of these more dynamic technologies transform social and cultural patterns and processes. The software-based map of GPS-devices represent space not only as distances and spatial relations but also as rhythmic patterns. These technologies may combine spatial and temporal representations in new ways which highlights human experience of the spatial as something also temporal.

(iv) Memories of the moments of mapping

Mapping has always evoked memories, leaving traces behind of its reading that resonate in the everyday experience of individuals in different societies. Anthropological approaches to mapping argue strongly that these traces play important but understated roles in the construction of identities, in senses of place and in practical wayfinding skills (Ingold 2000). Memories of paper mapping have been captured in narrative (see Harley 1987). The digital transition affords new research possibilities for investigating these traces of past practice. What we see as a stable map interface on our screens is really provisional instantiation of algorithms and data, fundamentally ephemeral and unstable, made-of-the-moment and disappearing as quickly as electrons are switched and pixels fade. These fleeting map interfaces, that emerge from software spaces, leave new kinds of traces of their presence in the world, a pattern memory of their creation preserved in automatically generated logs of the executing code. These logs can themselves be rendered visually, as maps of map memories revealing when and where people are mapping their worlds. As an example that illustrates, in a rudimentary fashion, the potential of these map memories is the "heatmap" created by Fisher (2007) showing the differential interest levels of users of Microsoft's Virtual Earth mapping systems (Figure 12.4; see also Aoidh *et al*. 2008). The previously apparently fixed map interface can itself be charted as the memories embedded in its construction are themselves also available: for example, the explosive growth of OpenStreetMap is mapped as an animation, made up of individual mapping stories brought together into a moving set of mobile memories.

The degree to which significant moments of mapping are automatically captured in memories of map use and construction needs to be researched. This empirical work would inevitably have serious ethical implications because of the risks that these memories reveal much more than intended (e.g. searching for the address and directions to an abortion clinic). It also seems likely that the nation state and corporations will be interested in the surveillant potential of individual logs of geographical search and online mapping. The mundane, yet intimate, scope of tracking of social lives from our moments of mapping is part of a wider concern that the world of code does not forget (cf. Dodge and Kitchin 2007).

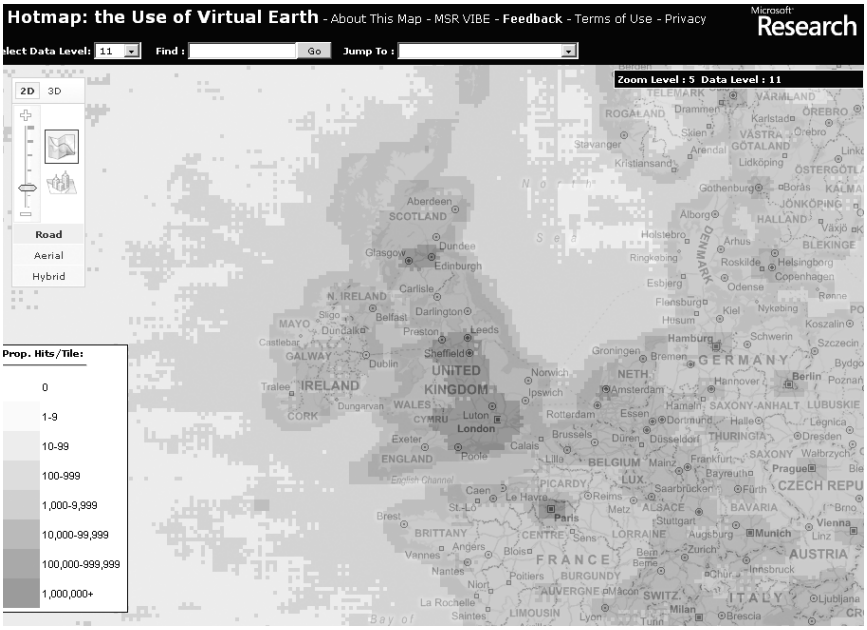

Figure 12.4 Memories of mapping. Source: author screenshot from <http://hotmap.msresearch.us/>.

(v) Mapping ourselves – moments in academic practices

As an introspective moment, map studies could explore how academics, including geographers, deploy maps in their everyday praxis, in university laboratories, their offices and lecture halls. Ongoing questioning of the relation between academic geography and the map could be a productive area to research, leading to a more critical geography of cartography, exploring more than simply publications and curriculae (cf. Dodge and Perkins 2008). It can be argued that there has been disappointingly little development in terms of progressive and creative *use* of maps by human geographers in their researches; Perkins (2004: 385) laments: '[d]espite arguments for a social cartography employing visualizations to destabilize accepted categories most geographers prefer to write theory rather than employ critical visualization.' The humanistic cartography of Danny Dorling is a notable exception to this (the Worldmapper cartogram project he leads has enjoyed considerable success and widespread use). Dorling (2005) has argued for socially-informed mapping to educate the next generation of geographers and also to influence public policy by more effectively and creatively highlighting the extent of social inequalities across space; '[m]aps are powerful images', acknowledges Dorling (1998: 287), but this can be exploited in a progressive way, '[f]or people

who want to change the way we think about the world, changing our maps is often a necessary first step'. Map studies needs to explore these educative moments of mapping in schools and universities.

(vi) Creative moments

A common current in post-structural thought emphasizes that the world may be better theorized as a series of interlinked and constantly changing flows, as a network of possibilities, as a series of bounded possibilities in which change is the only constant and where immanence comes to replace essence (Massey 2005). Map studies needs to create new ways of mapping this context. We live in a time of unprecedented mapping possibilities, in which more people than ever before are engaging in mapping, making their own maps and deploying mapping in novel ways. Artists are deploying the map more than ever before to explore our relationship to the world. Writers use cartographic metaphors to express many different ideas about place. Filmmakers constantly return to mapping as a motif for the human condition. But this mass everyday explosion of mapping is largely taking place outside of the world of map studies. We argue that the creative possibilities of all this new mapping ought to inform our studies too, and that we ought not to separate the analytical from the creative. People studying maps in creative ways need to be more creative in their mapping activities as well.

Conclusion

The world is changing and the way we understand these changes is itself making new worlds. Mapping is part of this process: maps are products of the world and they produce the world. Such changes demand a new manifesto – new ways of thinking, researching and creating maps. For too long, much mapmaking and research has replicated old certainties, focusing on areas, scales and themes, deploying rather tired existing ways of imagining the world and simply applying these to interactive, animated and multimediated contexts, instead of exploring the full potential of new contexts, styles and technologies. As we have argued in this chapter, and as the chapters in this volume demonstrate, rethinking the modes, methods and moments of maps offers a myriad of new, productive ways to progress cartographic theory and praxis.

As we have collectively argued and illustrated, alternatives need to be made and worked through that push cartography beyond the pursuit of refining itself as a set of ontic knowledges (where the map has essential qualities that are improved solely through technical advancements; see Chapter 1). Our arguments in this concluding chapter have accordingly highlighted *what* aspects of these changing intellectual landscapes may be particularly worthy of attention, identifying some possible ways forward, flagging up some of the many possible options in *how* the new terrains may be studied, and

trying to contextualize this manifesto by stressing that all research needs to be situated, placed and timed. Research and rethinking are both processes, and although in the words of the song, the future's not ours to see, mapping has always been particularly good at bringing it home, offering a route through the infinity of possible outcomes. So to conclude this narrative demands a call for action – a new manifesto: rethink and remake your map studies and practice!

Notes

1 Ritzer (2008) discusses the genealogy of shifts towards a prosumer model of capitalism, in which prosumers produce at least part of what they consume.
2 This denial is, of course, not universal. Researchers in the history of cartography community in particular have long maintained a deep concern with the materiality of cartographic objects. This concern is in terms of both the qualities of the materials used in map production (here primarily as evidence, e.g. for identification of the origins, dating and claims of authenticity; and for the optimal means of preservation and conservation of artefacts themselves) and also the importance of embodied interactions and "connection" with maps as an innate part of deep interpretative scholarship and the connoisseurship of the collector (the affective feel of holding old maps in particular, the emotional need to be in direct touch with original materials).
3 Some initial ideas are presented as a blog, <http://mapsthatmatter.blogspot.com/>.

References

Aitken, S. and Craine, J. (2006) 'Affective geovisualizations', *Directions: A Magazine for GIS Professionals*, 7 February, <http://www.directionsmag.com/printer.php?article_id=2097>.

Anderson, B. and Harrison, P. (2006) 'Commentary: questioning affect and emotion', *Area*, 38(3): 333–5.

Aoidh, E.M., Bertolotto, M. and Wilson, D.C. (2008) 'Understanding geospatial interests by visualizing map interaction behavior', *Information Visualization*, 7: 275–86.

Batty, M. and Hudson-Smith, A. (2007) 'Imagining the recursive city: Explorations in urban simulacra', in H.J. Miller (ed.) *Societies and Cities in the Age of Instant Access*, Dordrecht, Netherlands: Springer, 39–55.

Beck, R.A. (2003) 'Remote sensing and GIS as counterterrorism tools in the Afghanistan war: A case study of the Zhawar Kili region', *The Professional Geographer*, 55: 170–9.

Bolter, J.D. and Grusin, R. (1999) *Remediation: Understanding New Media*, Cambridge, MA: MIT Press.

Brown, B. and Laurier, E. (2005) 'Maps and journeys: An ethno-methodological approach', *Cartographica*, 40(3): 17–33.

Campbell, D. (1999) 'Apartheid cartography: the political anthropology and spatial effects of international diplomacy in Bosnia', *Political Geography*, 18(4): 395–435.

Chen, B.X. (2008) 'Google's super satellite captures first image', *Wired News*, 8 October, <http://blog.wired.com/wiredscience/2008/10/geoeye-1-super.html>.

Clark, N., Massey, D.B. and Sarre, P. (2008) *Material Geographies: A World in the Making*, London: Sage for the Open University.

Cloud, J. (2002) 'American cartographic transformations during the Cold War', *Cartography and Geographic Information Science*, 29(3): 261–82.

Crampton, J.W. (2003) *The Political Mapping of Cyberspace*, Edinburgh: Edinburgh University Press.

Crampton, J.W. (2004) 'GIS and geographic governance: reconstructing the choropleth map', *Cartographica*, 39(1): 41–53.

Crampton, J.W. (2006) 'The cartographic calculation of space: Race mapping and the Balkans at the Paris Peace Conference of 1919', *Social and Cultural Geography*, 7(5): 731–52.

Crampton, J.W. (2009) 'Maps 2.0', *Progress in Human Geography*, 33(1): 91–100.

Diakopoulos, N., Luther, K., Medynskiy, Y. and Essa, I. (2007) *The Evolution of Authorship in a Remix Society*, mimeo, <http://www.deakondesign.com/wp-content/uploads/2007/06/hts5-diakopoulos.pdf>.

Dix, A.G., Finlay, J., Abowd, G.D. and Beale, R. (2004) *Human–Computer Interaction*, 3rd edn, London: Prentice Hall.

Dodge, M. (2008) *Understanding Cyberspace Cartographies*, unpublished PhD Thesis, Centre for Advanced Spatial Analysis, University College London.

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

Dodge, M. and Kitchin, R. (2007) '"Outlines of a world coming in existence": Pervasive computing and the ethics of forgetting', *Environment and Planning B: Planning and Design*, 34(3): 431–45.

Dodge, M. and Perkins, C. (2008) 'Reclaiming the map: British geography and ambivalent cartographic practice', *Environment and Planning A*, 40(6): 1271–6.

Dodge, M. and Kitchin, R. (2009) *Code/Space: Software, Space and Society*, Cambridge, MA: MIT Press.

Dodge, M., McDerby, M. and Turner, M. (2008) *Geographic Visualization: Concepts, Tools and Applications*, London: Wiley.

Dodson, S. (2005) 'Get mapping: As mapmaking becomes big business, citizen cartographers are creating free personal alternatives', *The Guardian*, 7 April, <http://www.guardian.co.uk/technology/2005/apr/07/onlinesupplement3>.

Dorling, D. (1998) 'Human cartography: when it is good to map', *Environment and Planning A*, 30: 277–88.

Dorling, D. (2005) *Human Geography of the UK*, London: Sage.

Dykes, J.A., MacEachren, A.M. and Kraak, M.-J. (2005) *Exploring Geovisualization*, Amsterdam: Elsevier.

Edensor, T. and Holloway J. (2008) 'Rhythmanalysing the coach tour: the Ring of Kerry, Ireland', *Transactions of the Institute of British Geographers*, 33: 483–501.

Edney, M.H. (1993) 'Cartography without "progress": Reinterpreting the nature and historical development of mapmaking', *Cartographica*, 30(2/3): 54–68.

Elkins, J. (2003) *Visual Studies: A Skeptical Introduction, New York: Routledge.*

Erle, S., Gibson, R. and Walsh, J. (2005) *Mapping Hacks: Tips & Tools for Electronic Cartography*, Sebastopol, CA: O'Reilly & Associates, Inc.

Fisher, D. (2007) 'How we watch the city: Popularity and online maps', *Workshop on Imaging the City, ACM CHI 2007 Conference*, <http://research.microsoft.com/~danyelf>.

Fuller, M. (2008) *Software Studies: A Lexicon*, Cambridge, MA: MIT Press.

Geller, T. (2007) 'Imagining the world: The state of online mapping', *IEEE Computer Graphics and Applications*, March/April, 8–13.

Gill, S. (2004) *Field Studies*, London: Chris Boot.

Graham, S. (2005) 'Software-sorted geographies', *Progress in Human Geography*, 29(5): 562–80.

Graham, S. and Thrift, N. (2007) 'Out of order: Understanding repair and maintenance', *Theory, Culture & Society*, 24(3): 1–25.

Haklay, M. (2008) *How Good is OpenStreetMap Information? A Comparative Study of OpenStreetMap and Ordnance Survey Datasets for London and the Rest of England*, mimeo, <http://povesham.wordpress.com/2008/08/19/openstreetmap-quality-evalution-and-other-comparisons>.

Harley, J.B. (1987) 'The map as biography: thoughts on Ordnance Survey map, six-inch sheet Devonshire CIX, SE, Newton Abbott', *The Map Collector*, 41: 18–20.

Harley, J.B. (1988) 'Maps, knowledge and power', in D. Cosgrove and S. Daniels (eds) *The Iconography of Landscape*, Cambridge: Cambridge University Press.

Harley, J.B. (1989) 'Deconstructing the map', *Cartographica*, 26(2): 1–20.

Harrower, M.A. and Brewer, C.A. (2003) 'ColorBrewer.org: An online tool for selecting color schemes for maps', *The Cartographic Journal*, 40(1): 27–37.

Harvey, D. (1989) *The Condition of Postmodernity*, Oxford: Blackwell.

Ingold, T. (2000) *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*, London: Routledge.

Introna, L.D. and Ilharco, F.M. (2006) 'On the meaning of screens: Towards a phenomenological account of screenness', *Human Studies*, 29: 57–76.

Kaplan, C. (2006) 'Precision targets: GPS and the militarization of U.S. consumer identity', *American Quarterly*, 58(3): 693–714.

Kitchin, R. and Dodge, M. (2007) 'Rethinking maps', *Progress in Human Geography*, 31(3): 331–44.

Kurgan, L. (1994) 'You are here: information drift', *Assemblage*, 25: 14–43.

Kwan, M.P. (2007) 'Affecting geospatial technologies: Toward a feminist politics of emotion', *The Professional Geographer*, 59(1): 22–34.

Lee, K.D. and Shumakov, A. (2003) 'Access to geospatial data in 2003: a global survey of public policy and technological factors', *Cartography and Geographic Information Science*, 30(2): 225–30.

Lefebvre, H. (2004) *Rhythmanalysis: Space, Time and Everyday Life*, London: Continuum.

Longan, M.W. (2008) 'Playing with landscape: social process and spatial form in videogames', *Aether*, 2: 23–40.

Lorimer, H. (2005) 'Cultural geography: the busyness of being more-than-representational', *Progress in Human Geography*, 29(1): 83–94.

Lyon, D. (2007) *Surveillance Studies: An Overview*, Cambridge, Polity Press.

Manovich, L. (2005) 'Remix and remixability', *Nettime*, 16 November, <http://www.nettime.org/Lists-Archives/nettime-l-0511/msg00060.html>.

Massey, D.B. (2005) *For Space*, London: Sage.

Monmonier, M. (1996a) *How to Lie with Maps*, 2nd edn, Chicago, IL: University of Chicago Press.

Monmonier, M. (1996b) *Drawing the Line: Tales of Maps and Cartocontroversy*, New York: Henry Holt.

Norman, D. (1998) *The Invisible Computer*, Cambridge, MA: MIT Press.

O'Loughlin, J. (2005) 'The war on terrorism, academic publication norms, and replication', *The Professional Geographer*, 57(4): 588–91.

Parks, L. (2004) 'Kinetic screens: Epistemologies of movement at the interface', in N. Couldry and A. McCarthy (eds) *Mediaspace: Place, Scale and Culture in a Mobile Age*, London: Routledge, 37–57.

Pearce, M.W. (2008) 'Framing the days: Place and narrative in cartography', *Cartography and Geographic Information Science*, 35(1): 17–32.

Perkins, C. (2004) 'Cartography – cultures of mapping: power in practice', *Progress in Human Geography*, 28(3): 381–91.

Perkins, C. (2008) 'Cultures of map use', *The Cartographic Journal*, 45(2): 150–8.

Pickles, J. (1991) 'Geography, GIS, and the surveillant society', *Papers and Proceedings of Applied Geography Conferences*, 14: 80–91.

Pickles, J. (2004) *A History of Spaces: Cartographic Reason, Mapping and the Geo-Coded World*, London: Routledge.

Ritzer, G. (2008) *Production, Consumption . . . Prosumption?*, mimeo, <http://www.georgeritzer.com/docs/>.

Ronson, J. (2004) 'Attention to detail', *The Guardian*, Saturday Magazine, 15 May, <http://www.guardian.co.uk/print/0,,4923064–103425,00.html>.

Rowell, J. and Ungar, S.(2003) 'The world of touch: results of an international survey of tactile maps and symbols', *The Cartographic Journal*, 40(3): 259–63.

Selfe, C.L. and Selfe, R.J. (1994) 'The politics of the interface: Power and its exercise in electronic contact zones', *College Composition and Communication*, 45(4): 480–504.

Sheller, M. and Urry, J. (2006) 'The new mobilities paradigm', *Environment and Planning A*, 38(2): 207–26.

Slavick, E.O. (2007) *Bomb After Bomb: A Violent Cartography*, New York: Charta.

Star, S.L. (1999) 'The ethnography of infrastructure', *American Behavioral Scientist*, 43(3): 377–91.

St Martin, K. (1995) 'Changing borders, changing cartography: Possibilities for intervention in the new world order', in A. Callari, S. Cullenberg and C. Biewener (eds) *Marxism in the Postmodern Age*, New York: Guilford Press, 459–68.

Sturken, M. and Cartwright, L. *(2007) Practices of Looking: An Introduction to Visual Culture,* 2*nd* edn*, Oxford: Oxford University Press.*

Taylor, D.R.F. (2005) *Cybercartography: Theory and Practice*, Amsterdam: Elsevier.

Thrift, N. and French, S. (2002) 'The automatic production of space', *Transactions of the Institute of British Geographers*, 27: 309–35.

van Elzakker, C., Nivala, A-M., Pucher, A. and Forrest, D. (2008) 'Caring for the users', The Cartographic Journal, 45(2): 84–6.

Willim, R. (2007) Walking Through the Screen: Digital Media on the Go, mimeo, <http://www.robertwillim.com/rw_gps.pdf>.

Wood, D. (2003) 'Cartography is dead (thank god!)', *Cartographic Perspectives*, 45: 4–7.

Zook, M.A. and Graham, M. (2007) 'Mapping digiplace: geocoded internet data and the representation of place', *Environment and Planning B: Planning and Design*, 34: 466–82.