

# **Rethinking the geographies of cultural 'objects' through digital technologies: interface, network and friction**

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# **Cultural geography, cultural 'objects' and digital technologies: interface, network and friction**

## **Abstract**

This paper addresses how geographers conceptualise cultural artifacts. Many geographical studies of cultural objects continue to depend heavily on an approach developed as part of the 'new cultural geography' in the 1980s. That approach examined the cultural politics of representations of place, space and landscape by undertaking close readings of specific cultural objects. Over three decades on, the cultural field (certainly in the Global North) has changed fundamentally, as digital technologies for the creation and dissemination of meaning have become extraordinarily pervasive and diverse. Yet geographical studies of cultural objects have thus far neglected to consider the conceptual and methodological implications of this shift. This paper argues that such studies must begin to map the complexities of digitally-mediated cultural production, circulation and interpretation. It will argue that to do this, it is necessary to move away from the attentive gaze on stable cultural objects as formulated by some of the new cultural geography, and instead focus on mapping the dynamics of the production, circulation and modification of meaning at digital interfaces and across frictional networks.

**Keywords:** new cultural geography, digital media, interface, network, friction, methodology

## **1 introduction: the cultural object and the new cultural geography**

Cultural geography as a subdiscipline has long argued for the importance of cultural artifacts of many kinds in mediating human experiences of place, space and landscape. Much of this work continues to be shaped by concepts developed as part of what was called 'the new cultural geography'. As is well-known, the new cultural geography emerged in the second half of the 1980s, when influential arguments were made for a more theoretically-engaged and more critical cultural geography. A number of geographers drew on various forms of British marxist cultural theory, particularly work of Raymond Williams, Stuart Hall and John Berger, to insist that "culture is not a residual category... it is the very medium through which social change is experienced, contested and constituted" (Cosgrove and Jackson, 1987: 95). Other theorists were soon enrolled into the project too, including anthropologists like Geertz, postcolonial writers like Bhabha, Said and Spivak, feminists such as bell hooks, Irigaray and Haraway, psychoanalysts Fanon, Freud and Lacan, and social theorists such as Foucault, Baudrillard and Derrida (Anderson et al., 2003b; Atkinson et al., 2005; Blunt et al., 2003; Cook et al., 2000; Crang, 2004; Duncan et al., 2004; Johnson et al., 2013; Oakes and Price, 2008; Shurmer-Smith, 2002; Thrift and Whatmore, 2004). As its theoretical reference points multiplied, so too did empirical studies of 'maps of meaning' (Jackson, 1989), across a large number of geography's subdisciplines. 'The new cultural geography' thus diversified and dispersed almost as soon as it emerged; it was hardly surprising that complaints were soon heard about both its lack of theoretical clarity and the dilution of its marxist critique (Barnett, 2004; Mitchell, 2000).

This paper focuses specifically on the legacy of those new cultural geographers who were concerned to interpret cultural objects. In books like Cosgrove's *Social Formation and Symbolic Landscape* (1984) and Duncan's *The City as Text* (1990), geographers took cultural objects to be representations of the world which articulated, sustained and/or resisted social power relations: such objects were understood as offering, to quote Jackson, "a preferred reading of the material world, with prevailing social relations mirrored in the depiction of physical space" (1989: 186). So, for example, the traditional geographical concept of landscape was given sustained attention in early new cultural geography, with

Cosgrove (1984) arguing that the very idea of landscape as it emerged in fifteenth century Europe was inextricably bound into the changing ways in which land was being materially appropriated by an emerging propertied class. Cosgrove made his argument looking at a range of sources, from written texts to surveys, maps, plans and landscape paintings. He argued that all of these different forms of cultural objects were devices that enabled "visual control over the countryside" which legitimated the private ownership of land (Cosgrove, 1984: 221). Others elaborated the ways in which the landscape painting genre in particular came to represent specific forms of national identity (Daniels, 2011; Matless, 1998), and feminist and postcolonial critics pointed to the ways in which such paintings also affirmed specific gendered and racialised power relations (Rose, 1993).

This strand of the new cultural geography thus gave careful attention to a particular form of cultural object: one that might be described as 'auratic'. According to Hansen (2008), 'aura' was understood by Benjamin as the experience offered by single, beautiful, crafted objects. It is the effect of an authentic original. An original that might be reproduced, of course, hundreds or millions of times, by printing or by films and photographs, and Benjamin himself reflected at length on the cultural and political consequences of the 'age of mass reproduction' (1973). Nonetheless, the new cultural geography emerged at a historical moment when the vast majority of cultural objects could be traced back to an original: an original manuscript, a building, a reel of film, a map. And the conceptual tools for interpreting such objects offered by the new cultural geography took such auratic objects – the original, as it were, a canvas, a novel, a film, a photograph, a building – and, treating it as an inert, stable object, approached it as a text to be interpreted through various forms of close reading. For Barnes and Duncan (1992), cultural objects were to be interpreted in relation to other texts and discourse; for Cosgrove and Daniels (1989), this sort of reading was best described as a form of iconography. Either way, close attention was paid to the form and structure of the cultural object, in order to unpack the meaning of each of its constituent symbolic parts.

These were relatively rich and sophisticated methodological discussions, and they have produced powerful and subtle readings of many forms of cultural 'texts'. In some ways then, it's perhaps not surprising that much of the cultural

geography that examines cultural objects continues to cleave to this method: close readings of cultural texts, with the aim of construing their implicit meanings and analysing how those meanings affirm or challenge power relations.

In other ways, though, the continuing hegemony of this particular approach to understanding cultural artefacts is very surprising indeed. For in the three decades or so since the emergence of the new cultural geography, both cultural objects and the technologies and practices in which they are embedded have altered significantly. Over the past thirty years there have been profound changes in the processes and practices of cultural production, in the circulation and display of cultural objects, and in the processes of audiencing, participation and critique. These changes have been enabled by a wide range of digital technologies, yet cultural geographers have had almost nothing to say about their implications for the creation of meaningful places, spaces and landscapes.<sup>1</sup> This silence, I will suggest, is in large part a consequence of the methodological orientation bequeathed by certain parts of the new cultural geography – specifically its focus on stable cultural objects – which is increasingly inadequate for engaging with much making of cultural meaning in the contemporary moment.

The next section of this paper argues that since the creation of so many cultural objects – though certainly not all, and not everywhere – is digitally mediated now, the stable cultural object is currently the rare exception rather than the rule. Digital 'objects' are not stable, but rather are mutable, multimedial and mass. Geographers interested in cultural objects therefore require some new tools to be able to continue to offer robust interpretations of digital cultural expressions, and the third section of this paper offers three concepts which might help towards that end: interface, network and friction. *Interface* is the key term here, which embeds the content of a text, sound or image file via particular software and devices into specific social practices of meaning-making. To understand the interface requires a certain spatiality, however, and the notions of *network* and *friction* describe that spatiality. This is the space of digital cultural objects, a spatiality that is not only visible *in* many digital images, but is also the geometry *through which* they must be understood – as, in part, no longer 'objects' at all. The fourth section offers some brief thoughts on the methodological implications of this shift.

## **2 the challenge of digital cultural activity: mutable, multimedial, mass**

Since the 1980s, a very wide range of digital technologies have saturated everyday life, certainly in the global North, and geographers have been at the forefront in describing and conceptualising these changes. Graham and Marvin (2001), Thrift (Thrift and French, 2002; Thrift, 2014) and Kitchin and Dodge (2011) have all made important contributions to understanding how specific combinations of hardware and software control urban infrastructure and thus the spatial organisation of cities. The emphasis in this work is on software in particular as a form of "automated management" (Kitchin and Dodge, 2011: x) which operates without human intervention to generate data and trigger automated responses, from traffic light signals to advertising mailshots (see also Dodge and Kitchin, 2009; Kitchin 2014). An extensive body of work is also emerging that explores locative technologies of many kinds and their mediation of places and landscapes (see Boulton and Zook, 2013; Brighenti, 2010; Crampton, 2013; de Souza e Silva and Frith, 2012; Dodge et al., 2009; Kitchin et al., 2013; Leszczynski, forthcoming; Wilson, 2011, 2014a). It is also the case that cultural activity of most kinds is also being transformed by digital technologies. Fundamental shifts in many forms of cultural production, distribution and audiencing have been enabled by these technologies. Not only do most creative professionals now use digital hardware and software – from artists to special effects visualisers to architects – but digital devices like computers, scanners, digital cameras, ebook readers and smartphones, and online distribution platforms such as YouTube, Flickr, Vimeo, Instagram, Snapchat, Photobucket, Pinterest and Facebook, along with innumerable software packages and apps, have enabled many more people to engage in their own forms of creative cultural production. Images, for example, from the very simple to the highly complex, can be created, copied, repurposed, shared and modified by anyone with a smartphone and a computer, while the comment box, the 'like' button, and the blog are distributing the role of the critic much more widely. Because of the high levels of participation that these various innovations have unleashed, few of the scholars who have followed these changes speak of

'producers' and 'audiences' as two distinct groups and activities: the preferred term is 'user' (Hartley, 2012; Jenkins, 2008; Livingstone, 2005).

It is easy to fall into a vague and inflated rhetoric when discussing new technologies (Crang et al., 1999b; Kinsley, 2010). This section will therefore focus on a case study of a particular type of digital image, in order to specify empirically the challenges that this new form of cultural 'object' poses to toolkit offered by the new cultural geography: digital visualisations of new urban developments, which are intended to show developers, architects, planners and the inhabitants of urban public spaces what a new development will look – and feel – like when they are complete (see Figure 1). The digital visualisations to be discussed were made as part of the design and marketing of a large-scale redevelopment project in Doha, Qatar and they might thus be seen as 'representations' of a place (Degen, Melhuish, and Rose, n.d.; Rose, Degen, and Melhuish 2014). The thousands of visualisations made as part of this development include forty-two created to persuade the developer to invest in the project, and if those forty-two are studied, it is obvious that they represent the new development in very particular ways.<sup>2</sup> They display a leisured and family-centred lifestyle, with people strolling, shopping, relaxing and playing in a range of beautiful urban scenes. Their visual qualities are striking: they have a heightened definition, a scintillating glow, jewel-like colours; the sun flares around buildings, shafts of light fall into mosques and shopping malls, and dusk is often used to create gorgeous light effects. Ash (2010, 2012) has explored in detail the work that goes into the "affective design" of computer games in order to retain the engagement of players, and similarly a great deal of labour went into creating these seductive images. They are particularly effective at inventing, costuming and intensifying new urban spaces, and as such they exemplify the 'glamour' and 'atmosphere', which, as Böhme (1993; 2003) and Thrift (2008) among others have pointed out, is so crucial to selling commodities now.

Exploring these visualisations' production, circulation and use also indicates some of the fundamental ways in which cultural 'objects' are now changing form. The first of these is the mutability of these visualisations, which is typical of digital images more generally. Digital images can be changed endlessly by their users. This was true in our case study of the visualisations that accompanied the Msheireb Downtown redevelopment project. As one of the

visualisers who worked on that project remarked, "you can change [digital] content a lot more easily than you can change a physical thing". There was an extensive process of commentary and discussion between the architects, the visualisers and the developer in order to achieve the right atmosphere in each visualisation (see Degen et al., forthcoming), and visualisations were also altered as the design of the development evolved. Alterations in the visual content encoded in the image file is not the only way in which these visualisations were mutable, however. Not only are all digital images on screens "*transitory* images that need to be constantly refreshed by the scanning electron beam that forms an image on the screen" (Hayles, 2004: 74), but an image file itself has gone through multiple software transitions in order to become visible on a screen: source code, executable application and runtime experience (Galloway, 2010). Human meaning-making, and the software and hardware through which it is expressed, thus interact to create an inherently unstable, changing cultural object.<sup>3</sup> This *mutability* of digital images is one of the key characteristics of digital visual culture, then.

The instability of digital cultural objects is also a result of a second characteristic of digital images, again evident in the digital visualisations of Msheireb Downtown, which is that any digital file can be, and very often is, materialised in very different ways (and in different places). As well as on hoardings around the building site, the same visualisations appeared on the developer's website, YouTube channel and Facebook page; in the pages of various kinds of promotional literature produced by the developer; and as framed prints in the developer's offices. Some became large printed backdrops on the construction site, in front of which various hard landscaping and planting were placed in order to test their appropriateness. Others were printed and pinned up next to coffee machines in architects' office to encourage discussion about the design, and the architects' own websites carried visualisations of their Msheireb Downtown buildings. The visualisation studios who worked on the project showcased their work on their websites too. Both the architects and the visualisers used printouts of the visualisations as proof that a certain amount of design work had been completed and that they were due payment from Msheireb Properties. And finally, many of the visualisations appeared in an exhibition in London in 2013 (see Rose



et al., 2015). As that catalogue of the various material forms taken by the digital visualisations of Msheireb Downtown suggests, not only do such visualisations take on different material qualities (hard copy of different kinds, various screens), they were also materialised in specific forms in order to be put to very different uses: for example, to enhance the design process; to promote professional design expertise; and to sell the development to investors.

Both the mutability of these digital images and their multimediality challenge any notion of a stable cultural object. Because the qualities of an image change depending on the specific qualities of its transient content and materialisations, there is no 'original' object to be found. A further quality of digital images that challenges the new cultural geography's approach to cultural objects is the sheer number of them that are made, again obvious in the Msheireb Downtown project. It should be evident from the discussion of the forty-two visualisations' mutability and multimediality that there are many many versions of those forty-two. Moreover, creating a visualisation is in itself an iterative process, as layers of colour, texture and photographic images are added to a modified version of the architect's Computer Aided Design model; and the discussions of the Msheireb Downtown visualisations between the architects, visualisers and the developer led to multiple revisions. The forty-two, then were just a tiny proportion of the total number of visualisations that were created as part of this project.

These massive numbers of images are also typical of many contemporary forms of digital cultural activity. A hundred hours of video are uploaded to YouTube every minute. Sixty million photographs are uploaded to Instagram every day, which is dwarfed by the 350 million uploaded onto Facebook and the 400 million sent to SnapChat.<sup>4</sup> Such photos are most often taken frequently and casually, posted at once or edited, tagged and uploaded later, glanced at on a Facebook page or a Twitter feed or a Snapchat screen, 'liked' or not before the user moves on: these are images whose numbers indicate a practice that neither expects nor enables close, attentive reading.

Digital images, then, like many forms of digital cultural production, have three characteristics that are very different from the cultural objects on which parts of the new cultural geography built their arguments more than thirty years

ago. They are mutable; they are materialised in multiple media; and their numbers are massive. This presents at least two challenges for cultural geographers now. The first is the difficulty in identifying a stable cultural object. Because of their mutability and multimediality, which are consequences of both what the technologies enable and what people do with them, digital cultural objects are inherently unstable. Now, while it is also true that many auratic artworks also change over time, as paint fades and plastics become brittle (Rubio, 2014), the materialities of digital creation and circulation are fundamentally more mutable. In order for a digital image to become visible, electronic pulses of code must be translated through combinations of multiple softwares and device; digital images are materialised in quite different forms; and they are put to quite different purposes, including modification of their content. This makes identifying a single, inert object for close reading very difficult, if not impossible. The second challenge is how to deal with the massiveness of digital cultural production. The close reading of individual 'texts' simply does not work when the 'texts' to be analysed are made to be glanced at and exist in collections not of a few dozen but of a few million.

### **3 three concepts for engaging with digital cultural production: network, interface, friction**

The previous section argued that the close reading of stable cultural objects is ill-equipped to engage with the defining characteristics of contemporary, digitally-mediated cultural activity. Once cultural production and reproduction goes digital, that object both dissolves and disperses. How should cultural geographers interested in images and other cultural artifacts respond to this change?

This section will propose three conceptual terms that might enable cultural geography to grasp the particular qualities of digital cultural activity while also retaining its founding commitment to the importance of 'culture' as an analytical category. These terms are *interface*, *network* and *friction*. Together, they modify a focus on stable objects by understanding digital cultural 'objects' (and that term will shortly be replaced) as structured by a kind of immersive spatiality that is distinctively digital.

Several geographers have remarked on the importance of the spatialities through which 'cyberspace' or 'virtual geographies' are conceptualised, and this paper concurs (Crang et al, 1999b; Doel and Clarke 1999; Graham et al, 2013; Kinsley, 2014). So what is this 'distinctively digital' spatiality? Elsaesser (2013: 240) describes the "new default value of digital vision" as immersive. It is a fluid, three-dimensional space into and through which movement is expected. It is exemplified by the forty-two visualisations made as part of the Msheireb Downtown project. While there is one aerial view and several at a distance among the forty-two, most draw the viewer into their scenes with low points of view of small, almost intimate scenarios carefully composed to suggest that you are in the space, not just looking at it from a distance as an 'audience'. Several scholars have noted that, in contrast to the fixed point of view of geometric perspective and its 'visual control over space', so effectively diagnosed in relation to landscape paintings by new cultural geographers like Cosgrove, the spatiality created by visualisation software is not tethered to a fixed point. Instead, it invites movement through its three dimensions, just as the Msheireb Downtown visualisations invite us to enter their urban scenarios. This space is fluid, scaleable and malleable; rather than offer a fixed viewpoint to its user, it invites *navigation* (Verhoeff, 2012) by "doing away with horizons, suspending vanishing points, seamlessly varying distance, *unchaining* the camera and transporting the observer" (Elsaesser, 2013, 237; Hayles, 2012; Uricchio, 2011). In images, it is enabled by a wide range of digital visualisation softwares that are now used to create everything from advertisements to movie special effects to artworks to computer games to architectural visualisations, all of which are designed by combining different elements in an onscreen, animated, three-dimensional space (Manovich, 2013).

This invitation to navigate proposes a different understanding of cultural objects than that assumed by the new cultural geography. Instead of a printed paper map proffering the signs on its surface for attentive reading, in a Google map we move from map to satellite view, zoom in and scale back, look at a photo of a street and return; instead of reading a painting or a photograph that does not change its form as we do so, in an online archive we scroll, zoom, crop, download, follow links, share. Digital images very often invite not contemplation, but action, navigation into the larger mass of images of which they are a part, "keeping an eye

out for where to move or what do to next" ( Verhoeff, 2012: 13; and see Ash, 2015; Casetti, 2013; Elsaesser, 2013). (This is another way in which 'audiences' are increasingly 'users'.) This is the immersive spatiality that we can see *in* the digital image. It is also the spatiality *through which* the image has to be understood.

This claim can be theorised through the concepts of interface, network and friction. An *interface* is defined by Hookway (2014: 4) in the most general terms as "that form of relation which is defined by the simultaneity and inseparability of its processes of separation and augmentation, of maintaining distinction while at the same time eliding it in a mutualism that may be viewed as an entity in its own right, with its own characteristics and behaviours that cannot be reduced to those of its constituent elements." In the context of this discussion, an interface is where three kinds of biological and inorganic entities converge to create an interface performatively: human practices, hardware devices, and software code (Ash, 2015; Drucker, 2013; Kinsley, 2014; Leszczynski, forthcoming; Verhoeff, 2012). For example, much attention has been given to a particular interface that is an interaction between people, devices and softwares in very many places now: the screen. As Verhoeff (2012) and others have pointed out, everyday spaces, particularly in the Global North, are saturated with screens, and they describe a similar scenario that exemplifies this saturation: an urban street scene, where large screens carry advertisements and television programmes, smaller screens display ads and information, other screens are used to order food and pay for goods, kids play on consoles and smartphones are ubiquitous. What is visible on any one screen is a combination, or what Ash (2015) calls an "ecology", of hardware (the screen, its casing, its other physical components), the software code that makes things visible (the image file but also, for example, the app through which that image is being seen and the operating system of the device), and how it is being looked at by its user/s. The latter point is crucial (Bingham, 1996). Not only is the agency of digital hardware and software at work at interfaces, but so too is the agency of the people using it, which is shaped by the soft/hardware of the interface but can also interpret it actively. It is the *interface* as an intersection of these agencies that should now replace the notion of a stable cultural 'object'.

The mutual constitution of human practice, digital hardware and software code creates what is visible on a screen – the interface, 'an entity in its own right', a

specific instantiation of a digital file's multimediality – let's say, a Twitter feed on a mobile, being checked by someone in a coffee shop. As an *interface*, this entity cannot be understood as an inert object: it is a transitory pulsing of electrons, temporarily convened on a phone screen, a consequence of relations between and among hardware, software and practices, showing a few of millions of other messages and snaps that reside on Twitter's servers, all the images poached from other devices/actions/software, being glanced at, scrolled along, tapped, retweeted by its user. Understanding the meaning of that Twitter feed, then, requires not only paying attention to that temporary interfacial entity of what the screen shows (as Grace [2014] also insists; and see Elwood and Leszczynski [2013]). It also requires being attentive to both the human practices in which it is embedded, and to the hardwares and softwares that enable it.

That hardware and software extends well beyond the Twitter-screen-entity just conjured. An interface should not be understood as a screen that hides or obscures that extension; rather, it must be conceptualised as a junction between such extensions. As theorists of digital cultural meaning, we must accept the screen's invitation to navigate its spatiality, and enter the 'innards' of the digital interface (Thrift quoted in Boulton and Zook, 2013: 438). To repeat, the immersive spatiality visible in digital images must also be the spatiality used to understand these images. This is an argument being made by several geographers examining locative media. Boulton and Zook (2013: 438), for example, insist that we need to probe the "behind-the-scenes processes that mediate apparently straightforward engagements with locative media". An interface is itself part of a whole range of software operations that are often not evident but of which the interface is inextricably a part, just as it is also part of the complex human practices that shape and are shaped by engagements with interfaces. The Twitter-feed-on-a-phone interface is not a screen that should hide things, then, but is rather a complex junction of components which must be explored in *all* directions.

It is here that the second concept necessary for cultural geography to grasp the form of digital cultural not-objects becomes evident: *network*. The conceptualisation of *network* that can address the three-fold agency of interfaces – hardware, software and humans – is that developed by Law (2002). He argues that a network is articulated in both physical space and also through the work that is

done by various actors to make things move or pause (for a fuller discussion, see Rose et al., 2014; and see Jazeel, 2010). In describing the networks that digital interfaces open onto, there is clearly an extensive and complex material infrastructure that stretches and locates digital cultural activity in physical space: cables, servers, drives, processors, exchanges, screen, keyboards and so on. All these objects are agents that work to circulate code. They all also need code to operate; code runs systems as well as carries data, and it has its own agency too. As Hartley (2012) and many other new media scholars point out, platforms like Facebook and Google depend on internal algorithms that sift their data in order to structure what their users see in quite particular ways: for example by offering advertising that corresponds to what users talk about in email messages, or, in Google Maps, by prioritising in search results locations that have received most 'likes' (Graham et al., 2013). Boulton and Zook (2013) describe this as the "duplicity of code", suggesting that the invisibility of the software code and its algorithms allows such structured results to appear 'natural' and obvious. Here we can see how the concepts of interface and network enable a focus on those patterns that structure the mass of digital cultural activity now.

There are also a whole range of human actors whose practice also constitutes this network, working within and beyond what its hardware and software allow: developers who program, visualisers who create advertising campaigns, factory workers assembling hardware (Grace, 2014), engineers laying cabling, as well as all those people who use all sorts of interfaces in their everyday work and leisure. (Indeed, we might also consider the labour of those who mine the materials required by hardware manufacture, and those who scavenge and recycle discarded hardware.) Again, the notion of a network performed in part by human labour guides attention to its diversity of forms of work, including different ways of seeing. A photo taken to be uploaded to SnapChat for an eight-second view before autodestructing invites a very different way of seeing from the intense engagement insisted on by big-budget computer games (on the latter, see Ash, 2015). The notion of network also emphasises spatial divisions of human (and other) labour. For example, the digital visualisations made of Msheireb Downtown only travelled between Europe and the USA as they were being made (bar trips to cheap render farms in China), which demonstrates the highly skewed global

distribution of this kind of creative expertise (McNeill, 2008; Ren, 2011). We also noticed many of the architects and visualisers in the case study doing discursive work to assert the creativity of European and US design professionals in contrast to 'immature' Gulf clients and Chinese renderers who 'don't get colour'. 'Network' is thus a useful term for sensitising analysis to complex relations between different actors in contemporary digital culture.

For in a culture where the tools of production and distribution of visual materials are much more dispersed than they ever have been, the enactment of different kinds of agency is highly complex, as signalled by the notion of a 'convergence culture':

convergence represents a paradigm shift – a move from medium-specific content towards content that flows across multiple media channels, toward the increased interdependence of communications systems, toward multiple ways of accessing media content, and toward ever more complex relations between top-down corporate media and bottom-up participatory culture. (Jenkins, 2008: 254)

In our case study, for example, the specific creative 'expertise' of US and European-based visualisers and architects was challenged by the Qatari client who had very clear ideas about how the redevelopment project should express a specific vision of Qatari cultural identity, and the money to insist on those ideas being taken seriously. Understanding the meanings of the visualisations thus has to engage with these dispersed actors and their diverse forms of cultural power and agency. Network is therefore an important term for analysing the highly *uneven* distribution of different kinds of digital cultural work, its 'power geometry', if you like (Massey, 1993; and see Graham et al., 2013; Leszczynski, 2012; Sparke, 2013).

The final conceptual term this section will discuss is *friction*. Galloway argues that friction is inherent to interfaces: an interface is "an autonomous zone of interaction... concerned as much with unworkability and obfuscation as with connectivity and transparency" (Galloway, 2012: 120). In short, interfaces don't always work smoothly. This is an important critical point, when digital interfaces are so pervasive and so many are complicit with the smooth and glossy 'aesthetic economy' of late capitalism (Böhme, 1993). The Msheireb Downtown images, for example, encountered many hitches in their circulation and a lot of work was

required to resolve the various difficulties (Rose et al, 2014): office computers that couldn't open the huge image files of complex digital renders; confusion over what version of a visualisation was to be worked on; instructions on how a visualisation had to be altered not being understood when received. Different kinds of friction affect the different components of the interface and network. 'Crashes' are caused by failure in some part of the network's material infrastructure: a ruptured cable, a power outage, a smartphone in a trouser pocket in a washing machine. Sometimes the software 'glitches' from software rot or data rot, digital decay, file incompatibilities, viruses and bugs (Newman, 2012; Nunes, 2011). And sometimes the human labour that also constructs digital images disrupts a specific ecology. For example, the labour that has created an image or a device may become visible where it is not expected: when the human figures that are cut-and-pasted from photographs into digital visualisations of urban development projects have wonky edges and the wrong lighting (Rose et al, 2015), for example, or when a worker in an iPhone factory leaves a photograph of herself on a phone that she is packing, to be found by the phone's buyer on the other side of the world (Grace, 2014). And, of course, as images circulate, pausing and materialising in specific places with specific people, cultural meanings are encountered, interpreted, ignored, lost, liked, resisted and deleted. All this is friction.

This section has argued that, in order to move away from a methodology that understands meaning as contained in stable cultural objects which can be subject to close reading, geographers concerned with digital cultural artifacts should work with three terms: interface, network and friction. Each is constituted by multiple kinds of hardware, software and human practice. The interface is a specific and temporary entity created by the convergence of multiple forms of all three: the family photo displayed on a smartphone screen being shared during a workplace coffee break, a digital visualisation being revised on a screen in a visualiser's office. The notion of the interface thus addresses the multimediality of digital cultural activity. Every interface, however, is less a screen that obscures and more a portal that opens out into the extensive, uneven networks of hardware, software and other practices. Interfaces are "transit hubs for the images that circulate in our social space. They serve to capture these images, to make them momentarily available for someone, somewhere – perhaps even in order to rework



them – before they embark again on their journey. Therefore screens function as the junctions of a complex circuit, characterized both by a continuous flow and by localized processes of configuration or reconfiguration of the circulating images" (Casetti, 2013: 17). Networks, then are one way to address the mutability of digital cultural work. The task now is surely to occupy those 'junctions', and to navigate the practices, hardware and software that circulate through them in all directions.

#### **4 some methodological implications**

Which raises the question: what methods might enable that navigation?

There will be many different answers to that question, and I can only offer a few preliminary thoughts here (see also Elwood, 2011; Kitchin et al., 2013; Morrow et al., 2014; Wilson, 2014b). Certainly established methods are by no means obsolete: Ash's (2015) account of computer games entails, in part, close readings of particular moments in specific games (and see Blok and Pedersen, 2014; Elwood and Leszczynski, 2013, Grace, 2014), and exploring the production of the Msheireb Downtown visualisations depended in large part on a multi-sited workplace ethnography, as have studies of computer game production (Ash, 2015; O'Donnell, 2011).

However, it is also the case that new methods are needed that can engage in some way with the massiveness and the networks of digital cultural production, and in particular with the huge number of images on image-sharing and social media platforms. Hayles's (2012) work suggests that identifying meaning as it emerges from a mass of images requires a shift from close, diagnostic reading of individual items to what she describes as hyper reading: readings that are fast, casual, scanning, skimming. Such a form of reading, at scale, will have to be computational: that is, it will have to use the processing power of computers to analyse huge numbers of images in some way. There are in fact already a number of software packages that can retrieve large numbers of images automatically, and others, mostly commercial, that can recognise patterns in the visual content of very large numbers of image files. The Software Studies Initiative has also made software available to allow the analysis and visualisation of large numbers of images (Manovich and Douglass 2011).<sup>5</sup> However, as Hall (2013) argues, the methodological challenge is not simply one of scale which simply requires bigger

and faster forms of content analysis. Instead, methods are required that can explore the processes and forms through which these huge numbers of images are organised. Without this, any new method will be unable to address the 'power geometry' which shapes the creation and circulation of digital images. It is important, therefore, that new methods engage with both the scale *and* the distribution of contemporary cultural production.

Grace (2014) and Hartley (2012), for example, understand the vast numbers of unstable cultural objects now being created by huge numbers of people making, modifying and sharing images, among other things, as "a new form of mass expression, possessing its own patterns and structures of innovation" (Grace, 2014: 14). For them, it follows that significant meaning emerges from those patterns; it does not reside in specific individual contributions but rather results from "the generalized sphere of expression" created by their cumulative effects (Grace, 2014: 17). "We need to understand cultural, creative, and knowledge-systems *across whole populations*", insists Hartley (2012: 54); "we need to focus on probabilities in large-scale systems (e.g. 'what can I find on YouTube?') rather than on essences found in single texts (e.g. the signed work of art in a museum)" (57). Image-rich online platforms such as Instagram or Facebook are more than the sum of their individual pictures; quite apart from the written text that accompanies them, they are shared through specific routes (to 'followers' or 'friends', for example), and they become visible according to particular criteria (such as being tagged as 'public' or 'the most favoured' or 'the editors' pick'). That is, there are uniquely digital – often but not always algorithmic – procedures that sift, sort and select how images are differentially made visible on a platform. Rogers (2013) argues that examining those procedures must therefore entail using specifically *digital* forms of enquiry: tracing links, for example, coding queries addressed to Application Programming Interfaces, analysing the tags attached to images (Highfield and Leaver 2014).

There are some significant problems to be overcome before such digital methods can achieve the task of examining both the content and the circulation of massive numbers of online images, however. There are significant technical challenges. As Kitchin (2014: 105) points out, image files are designed for display and storage, not content and search. Many image-rich platforms do not allow

access to their API, and neither Facebook nor Instagram permit their images to be downloaded. There are significant technical issues in analysing any text related to an image, other than that held in a file's metadata, so examining how images have been commented on is not easy. Nor is it clear how such methods might address the interfaciality of the images they analyse. All of these issues, particularly the latter, means that many researchers argue that a mixed methods approach might be better than a complete reliance on quantitative and/or computational methods. Grace's (2014) study of mobile phone images messaged between migrant workers in Hong Kong, for example, combines ethnographic analysis of sharing practices with close readings of the images sent, the quantitative analysis of 9000 images and also Grace's own familiarity with that image population. And all methods, new and old, should be alert to various forms of friction (see for example O'Donnell, 2011).

Projects experimenting with such methods are already underway;<sup>6</sup> perhaps one of the most exciting things about the present moment is precisely that this question of methods is so open.

## **5 conclusion**

This paper has argued that the making of cultural meaning has changed fundamentally over the past thirty years. It is now difficult to imagine any form of cultural practice entirely untouched by digital technologies. The changes wrought with those technologies are very diverse, of course. An artist committed to canvas and oilpaint may only use a website to gain commissions, for example. However, much cultural practice is now created, distributed, displayed and circulated entirely online; the conventions of established art forms like cinema and architecture are being "remediated" by new technologies (Bolter and Grusin, 1999); and more-or-less new forms of cultural production have emerged, such as computer games, digital art, selfies and memes. This paper, using the specific example of digital visualisations of an urban redevelopment project, has argued that there are three characteristics shared by very many of these new forms of cultural production: mutability, multimediality, and massiveness. Digital cultural production is changeable; it materialises in different forms; and it is massive, not

only because of its mutability and multimediality but also because digital technologies have enabled a huge extension in the numbers of people who can create, share, modify and critique digital cultural works.

This paper has argued that this shift poses a fundamental challenge to scholarship that depends on a broadly semiological analysis of relatively stable, relatively few cultural objects. For sure, cultural production in the pre-digital era also always created different versions of the final object – drafts, sketches, rehearsals – and the finished product usually circulated to different audiences in different places, in the form either of the original object or as copies of various kinds; and some new cultural geographers have examined both of these processes. But the sheer amount of cultural production now – a result of both its constantly changing content and materialisation and the massive numbers of its producers – is new.

Moreover, "algorithmic interventions between the viewing subject and the object viewed" (Uricchio, 2011: 25) are now pervasive. There is good reason to think that they are changing both forms of contemporary subjectivity and the geometry of contemporary spatiality (Ash, 2015; Crogan and Kinsley, 2012; Wilson, 2011), and there are important questions to be asked of both these shifts about the meanings and power relations embedded in them. What are the implications of online subjectivity and, for example, the data-generation, idiocy and thoughtfulness of the maps of meaning that are made through them (Goriunova, 2013; Leszczynski, 2012; Wilson, 2011)? Is that giddy, digital spatiality simply another iteration of the all-seeing god-trick, or does it hold possibilities for provisional, multiple interventions (Steyerl, 2012)? These are crucial questions to be asked of the current moment, too important to be left to those uninterested in human agency.

The paper has therefore suggested three terms that might contribute towards re-orienting the new cultural geography to the present cultural moment. It began with the *interface*, where the agencies of hardwares, softwares and humans meet to create a temporary entity (the entity formerly known as a cultural object) assembled from code, gadgetry and practices. Requesting more or less insistently on being navigated, these interfaces are not inert; they are junctions in extended *networks* enacted by hardwares, softwares and practices. They are

composed by different forms of work that keep them connected: the materiality of cables and servers; the patterns created by software algorithms; and all the complex work done by humans, staring, swiping, glancing, writing. The geometry of these networks shows clearly the power dynamics that they constitute, as certain forms of agency shape these undulating constellations more than others. In this immersive geometry, meaning becomes distributed, diverse, and driven as much by hardware and software as by human reflection, creativity and routine. All of this is vulnerable to the frictions of crashes, glitches and error. And it is these agencies and their effects on the representations of places, spaces and landscapes to which new cultural geographers interested in cultural production must now pay attention.

This argument has various implications, several of which the paper has already touched on. One is the need for a richer analytical vocabulary for the power relations performed through this convergent network than that of 'power' and 'resistance' (Barnett, 2004; Hartley, 2012). Another implication is that, as well as engaging with the emerging canon of digital art forms, cultural geographers should plunge into the popular and the mass, looking at both big-budget cultural productions like many computer games (Ash, 2015) but also at the popular, the prosaic and the silly of everyday digital cultural production (Goriunova, 2013; Hartley, 2012; Kingsbury and Jones III, 2009). A further implication is that to do so, cultural geographers must invent some new methods that can address the distinctive qualities of digital cultural production: its mutability, its multimodality, its massiveness and in particular the uneven spatiality and dynamics of its interfacial, frictional networking.

Finally, an implication that this paper has not directly addressed: what happens to the usefulness of 'representation' in networks of cultural interfaces? For Hartley (2012: 3), the answer is a move "from representation to productivity". Cultural meanings are no longer *represented* by cultural objects, but are *produced* at multiple sites and interfaces, between hardware, software and humans. They are emergent across distributed networks and they move and mutate between sites and over time. Extended, spreadable (Jenkins et al., 2013) and multiple, meaning is performed and materialised at specific sites; it is accessed, made to travel, searched for, modified, patched and laboured over in an uneven, variable

and frictional network held together by diverse forms of work which do not always succeed in making meaning move. The contemporary task of the cultural scholar, then, must surely be not to read an object but to navigate that productive network in all its multiple generativity.

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- <sup>1</sup> Since two early projects (Crang et al, 1999a; Bingham et al, 1999; Bingham et al, 2001; Holloway et al, 2000), the sum total of cultural geographers exploring digital technologies seems to be Davidson (2008), Jazeel (2010), Longhurst (2013), Mclean and Maalsen (2013), Parr (2002) and Parr and Davidson (2008).
  - <sup>2</sup> The visualisations can be viewed at <http://mdd.msheireb.com/default.aspx>.
  - <sup>3</sup> It is perhaps useful at this point to flag my continuing commitment to notions of human meaning-making, albeit always mediated through (many kinds of) technologies. Non-representational theory has engaged with both cultural 'objects' (see for example Anderson, 2004; Latham and McCormack, 2004) and the agency of the digital (Thrift, 2014); this paper's commitment to 'culture' as a category, in contrast, is a commitment to Geertz's (1973, 4) definition of culture as "webs of significance" spun by humans agency.
  - <sup>4</sup> <https://www.youtube.com/yt/press/en-GB/statistics.html>;  
<http://instagram.com/press/>;  
<http://www.digitaltrends.com/social-media/comes-photo-uploads-snapchat-facebook-beat/> ; all accessed 10 September 2014.
  - <sup>5</sup> see <http://lab.softwarestudies.com/>. This project is led by Lev Manovich, who also created the Selfie City project at <http://phototrails.net/> He describes his work as 'cultural analytics'.
  - <sup>6</sup> Such experiments include the Phototrails project <http://phototrails.net/>; the Contagion project <http://contagion.org.uk/>; and the Visual Social Media project <http://visualsecialmedialab.blogspot.co.uk/>. Digital methods for analysing texts are more advanced than those analysing images, in part because the analysis of text by digital code is relatively more simple than the analysis of images.

## references

- Anderson, B. 2004. "Recorded Music and Practices of Remembering." *Social and Cultural Geography* 5 (1): 3–20. doi:10.1080/1464936042000181281.
- Anderson, Kay, Mona Domosh, Steve Pile, and Nigel Thrift. 2003. "A Rough Guide." In *Handbook of Cultural Geography*, edited by Kay Anderson, Mona Domosh, Steve Pile, and Nigel Thrift. London: Sage.
- Ash, James. 2010. "Architectures of Affect: Anticipating and Manipulating the Event in Processes of Videogame Design and Testing." *Environment and Planning D: Society and Space* 28 (4): 653–71. doi:10.1068/d9309.
- . 2012. "Attention, Videogames and the Retentional Economies of Affective Amplification." *Theory, Culture & Society* 29 (6): 3–26. doi:10.1177/0263276412438595.
- . 2015. *The Interface Envelope*. London: Bloomsbury.
- Atkinson, David, Peter Jackson, David Sibley, and Neil Washbourne. 2005. "Editors' Preface: On Cultural and Critical Geographies." In *Cultural Geography: A Critical Dictionary of Key Concepts*, vii – xviii. London: I. B. Tauris.
- Barnes, Trevor J., and James S. Duncan, eds. 1992. *Writing Worlds: Discourse, Text and Metaphor in the Representation of Landscape*. London: Routledge.
- Barnett, Clive. 2004. "A Critique of the Cultural Turn." In *A Companion to Cultural Geography*, edited by James S. Duncan, Nuala Christina Johnson, and Richard H. Schein, 38–48. Oxford: Blackwell.
- Benjamin, Walter. 1973. "The Work of Art in the Age of Mechanical Reproduction." In *Illuminations*, translated by Harry Zohn, 219–53. London: Fontana.
- Bingham, Nick. 1996. "Object-Ions: From Technological Determinism towards Geographies of Relations." *Environment and Planning D: Society and Space* 14 (6): 635–57. doi:10.1068/d140635.
- Bingham, Nick, Gill Valentine, and Sarah Holloway. 2001. "Life around the Screen: Reframing Young People's Use of the Internet." In *Reframing Bodies*, edited by N Watson and S Cunningham-Burley, 228–43. London: Palgrave Macmillan.
- Bingham, Nick, Gill Valentine, and Sarah L. Holloway. 1999. "Where Do You Want to Go Tomorrow? Connecting Children and the Internet." *Environment and Planning D: Society and Space* 17 (6): 655–72. doi:10.1068/d170655.

- Blok, Anders, and Morten Axel Pedersen. 2014. "Complementary Social Science? Quali-Quantitative Experiments in a Big Data World." *Big Data & Society* 1 (2): 2053951714543908. doi:10.1177/2053951714543908.
- Blunt, Alison, Pyrs Gruffudd, Jon May, Miles Ogborn, and David Pinder, eds. 2003. *Cultural Geography in Practice*. London: Arnold.
- Böhme, Gernot. 1993. "Atmosphere as the Fundamental Concept of a New Aesthetics." *Thesis Eleven* 36 (1): 113–26.
- . 2003. "Contribution to the Critique of the Aesthetic Economy." *Thesis Eleven* 73 (1): 71–82. doi:10.1177/0725513603073001005.
- Bolter, J. David, and Richard A. Grusin. 1999. *Remediation: Understanding New Media*. Cambridge, MA: MIT Press.
- Boulton, Andrew, and Matthew Zook. 2013. "Landscape, Locative Media, and the Duplicity of Code." In *The Wiley-Blackwell Companion to Cultural Geography*, edited by Nuala Christina Johnson, Richard H. Schein, and Jamie Winders, 437–51. Chichester: Wiley.
- Brighenti, Andrea Mubi. 2010. "New Media and the Prolongations of Urban Environments." *Convergence: The International Journal of Research into New Media Technologies* 16 (4): 471–87. doi:10.1177/1354856510375528.
- Casetti, Francesco. 2013. "What Is a Screen Nowadays?" In *Public Space, Media Space*, edited by Chris Berry, Janet Harbord, and Rachel Moore, 16–40. Basingstoke: Palgrave Macmillan.
- Cook, Ian, David Crouch, Simon Naylor, and James Ryan, eds. 2000. *Cultural Turns/Geographical Turns: Perspectives on Cultural Geography*. Harlow: Prentice Hall.
- Cosgrove, Denis E. 1984. *Social Formation and Symbolic Landscape*. London: Croom Helm.
- Cosgrove, Denis E., and Stephen George Henry Daniels. 1989. *The Iconography of Landscape: Essays on the Symbolic Representation, Design and Use of Past Environments*. rev. ed. Cambridge : Cambridge University Press,.
- Cosgrove, Denis, and Peter Jackson. 1987. "New Directions in Cultural Geography." *Area* 19: 95–101.



- Crampton, Jeremy. 2013. "Mappings." In *The Wiley-Blackwell Companion to Cultural Geography*, edited by Nuala Christina Johnson, Richard H. Schein, and Jamie Winders, 423–36. Chichester: Wiley.
- Crang, Mike. 2004. *Cultural Geography*. 2nd ed. London : Routledge,.
- Crang, Mike, Phil Crang, and Jon May, eds. 1999a. *Virtual Geographies: Bodies, Spaces, Relations*. London: Routledge.
- . 1999b. "Introduction." In *Virtual Geographies: Bodies, Space and Relations*, edited by Mike Crang, Phil Crang, and Jon May, 1–20. London: Routledge.
- Crogan, P, and S Kinsley. 2012. "Paying Attention: Towards a Critique of the Attention Economy." *Culture Machine* 13: 1–29.
- Daniels, Stephen, ed. 2011. *Envisioning Landscapes, Making Worlds: Geography and the Humanities*. London : Routledge,.
- Davidson, Joyce. 2008. "Autistic Culture Online: Virtual Communication and Cultural Expression on the Spectrum." *Social & Cultural Geography* 9 (7): 791–806. doi:10.1080/14649360802382586.
- Degen, Monica, Clare Melhuish, and Gillian Rose. n.d. "Producing Place Atmospheres Digitally: Architecture, Digital Visualisation Practices and the Experience Economy." *Journal of Consumer Culture* forthcoming.
- De Souza e Silva, Adriana, and Jordan Frith. 2012. *Mobile Interfaces in Digital Spaces: Locational Privacy, Control, and Urban Sociability*. London: Routledge.
- Dodge, Martin, Rob Kitchen, and M Zook. 2009. "How Does Software Make Space?" *Environment and Planning A* 41 (6): 1283–93.
- Dodge, Martin, and Rob Kitchin. 2009. "Software, Objects, and Home Space." *Environment and Planning A* 41 (6): 1344–65. doi:10.1068/a4138.
- Doel, Marcus A, and David B Clarke. 1999. "Virtual Worlds: Simulation, Suppletion, S(ed)duction and Simulacra." In *Virtual Geographies: Bodies, Space and Relations*, edited by Mike Crang, Phil Crang, and Jon May, 261–83. London: Routledge.
- Drucker, Johanna. 2013. "Performative Materiality and Theoretical Approaches to Interface." *Digital Humanities Quarterly* 7 (1).  
<http://www.digitalhumanities.org/dhq/vol/7/1/000143/000143.html>.
- Duncan, James S. 1990. *The City as Text: The Politics of Landscape Interpretation in the Kandyan Kingdom*. Cambridge: Cambridge University Press.

- Duncan, James S., Nuala Christina Johnson, and Richard H. Schein. 2004. *A Companion to Cultural Geography*. Oxford: Blackwell.
- Elsaesser, Thomas. 2013. "The 'return' of 3-D: On Some of the Logics and Genealogies of the Image in the Twenty-First Century." *Critical Inquiry* 39 (2): 217–46. doi:10.1086/668523.
- Elwood, Sarah. 2011. "Geographic Information Science: Visualization, Visual Methods, and the Geoweb." *Progress in Human Geography* 35 (3): 401–8. doi:10.1177/0309132510374250.
- Elwood, Sarah, and Agnieszka Leszczynski. 2013. "New Spatial Media, New Knowledge Politics." *Transactions of the Institute of British Geographers* 38 (4): 544–59. doi:10.1111/j.1475-5661.2012.00543.x.
- Galloway, Alexander. 2010. "Networks." In *Critical Terms for Media Studies*, edited by W. J.T. Mitchell and Mark B.N. Hansen, 280–96. Chicago: University of Chicago Press.
- Galloway, Alexander R. 2012. *The Interface Effect*. Cambridge: Polity Press.
- Geertz, Clifford. 1973. *The Interpretation of Cultures: Selected Essays*. New York: Basic Books.
- Goriunova, Olga. 2013. "New Media Idiocy." *Convergence: The International Journal of Research into New Media Technologies* 19 (2): 223–35. doi:10.1177/1354856512457765.
- Grace, Helen. 2014. *Culture, Aesthetics and Affect in Ubiquitous Media: The Prosaic Image*. London: Routledge.
- Graham, Mark, Matthew Zook, and Andrew Boulton. 2013. "Augmented Reality in Urban Places: Contested Content and the Duplicity of Code." *Transactions of the Institute of British Geographers* 38 (3): 464–79. doi:10.1111/j.1475-5661.2012.00539.x.
- Graham, Stephen, and Simon Marvin. 2001. *Splintering Urbanism: Networked Infrastructures, Technological Mobilities and the Urban Condition*. London: Routledge.
- Hall, Gary. 2013. "Toward a Postdigital Humanities: Cultural Analytics and the Computational Turn to Data-Driven Scholarship." *American Literature* 85 (4): 781–809. doi:10.1215/00029831-2367337.
- Hansen, Miriam Bratu. 2008. "Benjamin's Aura." *Critical Inquiry* 34 (2): 336–75.

- Hartley, John. 2012. *Digital Futures for Cultural and Media Studies*. Chichester: John Wiley.
- Hayles, Katherine. 2012. *How We Think: Digital Media and Contemporary Technogenesis*. Chicago: University of Chicago Press.
- Hayles, N.K. 2004. "Print Is Flat, Code Is Deep: The Importance of Media-Specific Analysis." *Poetics Today* 25 (1): 67–90.
- Highfield, Tim, and Tama Leaver. 2014. "A Methodology for Mapping Instagram Hashtags." *First Monday* 20 (1). doi:10.5210/fm.v20i1.5563.
- Holloway, Sarah L., Gill Valentine, and Nick Bingham. 2000. "Institutionalising Technologies: Masculinities, Femininities, and the Heterosexual Economy of the IT Classroom." *Environment and Planning A* 32 (4): 617–33. doi:10.1068/a3238.
- Hookway, Branden. 2014. *Interface*. Cambridge, Massachusetts: MIT Press.
- Jackson, Peter. 1989. *Maps of Meaning: An Introduction to Cultural Geography*. London: Unwin Hyman.
- Jazeel, Tariq. 2010. "Sri Lanka inside-out: Cyberspace and the Mediated Geographies of Political Engagement." *Contemporary South Asia* 18 (4): 443–49. doi:10.1080/09584935.2010.526200.
- Jenkins, Henry. 2008. *Convergence Culture: Where Old and New Media Collide*. updated edition. New York: New York University Press.
- Jenkins, Henry, Sam Ford, and Joshua Green. 2013. *Spreadable Media*. New York: New York University Press.
- Johnson, Nuala Christina, Richard H. Schein, and Jamie Winders. 2013. "Introduction." In *The Wiley-Blackwell Companion to Cultural Geography*, edited by Nuala Christina Johnson, Richard H. Schein, and Jamie Winders, 1–13. Chichester: Wiley.
- Kingsbury, Paul, and John Paul Jones III. 2009. "Walter Benjamin's Dionysian Adventures on Google Earth." *Geoforum*, Themed Issue: The "view from nowhere"? Spatial politics and cultural significance of high-resolution satellite imagery, 40 (4): 502–13. doi:10.1016/j.geoforum.2008.10.002.
- Kinsley, Samuel. 2010. "Representing 'things to Come': Feeling the Visions of Future Technologies." *Environment and Planning A* 42 (11): 2771–90. doi:10.1068/a42371.

- . 2014. "The Matter of 'virtual' Geographies." *Progress in Human Geography* 38 (3): 364–84. doi:10.1177/0309132513506270.
- Kitchin, Rob. 2014. *The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences*. London: Sage.
- Kitchin, Rob, and Martin Dodge. 2011. *Code/Space: Software and Everyday Life*. MIT Press.
- Kitchin, Rob, Justin Gleeson, and Martin Dodge. 2013. "Unfolding Mapping Practices: A New Epistemology for Cartography." *Transactions of the Institute of British Geographers* 38 (3): 480–96. doi:10.1111/j.1475-5661.2012.00540.x.
- Latham, Alan, and Derek P. McCormack. 2004. "Moving Cities: Rethinking the Materialities of Urban Geographies." *Progress in Human Geography* 28 (6): 701–24. doi:10.1191/0309132504ph515oa.
- Law, John. 2002. "Objects and Spaces." *Theory, Culture & Society* 19 (5-6): 91–105. doi:10.1177/026327602761899165.
- Leszczynski, Agnieszka. 2012. "Situating the Geoweb in Political Economy." *Progress in Human Geography* 36 (1): 72–89. doi:10.1177/0309132511411231.
- . n.d. "Spatial Media/tion." *Progress in Human Geography*.
- Livingstone, Sonia. 2005. "Media Audiences, Interpreters and Users." In *Media Audiences*, edited by Marie Gillespie, 9–50. Maidenhead: Open University Press.
- Longhurst, Robyn. 2013. "Using Skype to Mother: Bodies, Emotions, Visuality, and Screens." *Environment and Planning D: Society and Space* 31 (4): 664–79. doi:10.1068/d20111.
- Manovich, Lev. 2013. *Software Takes Command*. London: Bloomsbury. available open access at [http://issuu.com/bloomsburypublishing/docs/9781623566722\\_web](http://issuu.com/bloomsburypublishing/docs/9781623566722_web).
- Manovich, Lev, and Jeremy Douglass. 2011. "Visualizing Change: Computer Graphics as a Research Method." In *Imagery in the 21st Century*, edited by Oliver Grau and Thomas Veigl, 315–38. London: MIT Press.
- Massey, Doreen. 1993. "Power Geometry and a Progressive Sense of Place." In *Mapping the Futures: Local Cultures, Global Change*, edited by Jon Bird, Barry Curtis, Tim Putnam, G Robertson, and Lisa Tickner, 59–69. London: Routledge.
- Matless, David. 1998. *Landscape and Englishness*. London: Reaktion.

- McClean, Jessica, and Sophia Maalsen. 2013. "Destroying the Joint and Dying of Shame? A Geography of Revitalised Feminism in Social Media and beyond." *Geographical Research* 51 (3): 243–56. doi:10.1111/1745-5871.12023.
- McNeill, Donald. 2008. *The Global Architect: Firms, Fame and Urban Form*. London: Routledge.
- Mitchell, Don. 2000. *Cultural Geography: A Critical Introduction*. Oxford: Blackwell.
- Morrow, Oona, Roberta Hawkins, and Leslie Kern. 2014. "Feminist Research in Online Spaces." *Gender, Place & Culture* 0 (0). doi:10.1080/0966369X.2013.879108.
- Newman, James. 2012. "Ports and Patches: Digital Games as Unstable Objects." *Convergence: The International Journal of Research into New Media Technologies* 18 (2): 135–42. doi:10.1177/1354856511433688.
- Nunes, Mark. 2011. *Error: Glitch, Noise, and Jam in New Media Cultures*. London: Continuum.
- Oakes, Timothy S., and Patricia Lynn Price. 2008. "Introduction." In *The Cultural Geography Reader*, edited by Timothy S. Oakes and Patricia Lynn Price, 1–8. Abingdon: Routledge.
- O'Donnell, Casey. 2011. "Games Are Not Convergence: The Lost Promise of Digital Production and Convergence." *Convergence: The International Journal of Research into New Media Technologies* 17 (3): 271–86. doi:10.1177/1354856511405766.
- Parr, Hester. 2002. "New Body-Geographies: The Embodied Spaces of Health and Illness Information on the Internet." *Environment and Planning D: Society and Space* 20 (1): 73–95.
- Parr, Hester, and Joyce Davidson. 2008. "Virtual Trust: Online Emotional Intimacies in Mental Health Support." In *Researching Trust and Health*, edited by J Brownlie, A Greene, and A Howson. London: Routledge.
- Ren, Xuefei. 2011. *Building Globalization: Transnational Architecture Production in Urban China*. Chicago: University of Chicago Press.
- Rogers, Richard. 2013. *Digital Methods*. London: MIT Press.
- Rose, Gillian. 1993. *Feminism and Geography: The Limits of Geographical Knowledge*. Cambridge: Polity Press.
- . 2011. *Visual Methodologies: Interpreting Visual Materials*. third. London: Sage.

- Rose, Gillian, Monica Degen, and Clare Melhuish. 2014. "Networks, Interfaces, and Computer-Generated Images: Learning from Digital Visualisations of Urban Redevelopment Projects." *Environment and Planning D: Society and Space* 32 (3): 386–403. doi:10.1068/d13113p.
- . 2015. "Dimming the Scintillating Glow of Unwork: Looking at Digital Visualisations of Urban Redevelopment Projects." In *Cities Interrupted: Visual Culture, Globalisation and Urban Space*, edited by Shirley Jordan and Christoph Lindner. London: Bloomsbury.
- Rubio, Fernando Domínguez. 2014. "Preserving the Unpreservable: Docile and Unruly Objects at MoMA." *Theory and Society*.
- Shurmer-Smith, Pamela, ed. 2002. *Doing Cultural Geography*. London: Sage.
- Sparke, Matthew. 2013. "From Global Dispossession to Local Repossession: Towards a Worldly Cultural Geography of Occupy Activism." In *The Wiley-Blackwell Companion to Cultural Geography*, edited by Nuala Christina Johnson, Richard H. Schein, and Jamie Winders, 387–408. Chichester: Wiley.
- Steyerl, Hito. 2012. *The Wretched of the Screen*. Berlin: Sternberg Press.
- Thrift, Nigel. 2008. "The Material Practices of Glamour." *Journal of Cultural Economy* 1 (1): 9–23. doi:10.1080/17530350801913577.
- . 2014. "The 'sentient' City and What It May Portend." *Big Data & Society* 1 (1): 1–21. doi:10.1177/2053951714532241.
- Thrift, N.J., and S. French. 2002. "The Automatic Production of Space." *Transactions of the Institute of British Geographers* 27 (4): 309–35.
- Thrift, N. J., and Sarah Whatmore. 2004. *Cultural Geography: Critical Concepts in the Social Sciences*. London: Routledge.
- Uricchio, William. 2011. "The Algorithmic Turn: Photosynth, Augmented Reality and the Changing Implications of the Image." *Visual Studies* 26 (1): 25–35. doi:10.1080/1472586X.2011.548486.
- Verhoeff, Nanna. 2012. *Mobile Screens: The Visual Regime of Navigation*. Amsterdam: Amsterdam University Press.
- <http://www.oopen.org/search?identifier=413033;keyword=mobile%20screens>.

- Wilson, Matthew W. 2011. "Training the Eye': Formation of the Geocoding Subject." *Social and Cultural Geography* 12 (4): 357-76.  
doi:10.1080/14649365.2010.521856.
- . 2014a. "Continuous Connectivity, Handheld Computers, and Mobile Spatial Knowledge." *Environment and Planning D: Society and Space* 32 (3): 535-55.  
doi:10.1068/d14112.
- . 2014b. "Morgan Freeman Is Dead and Other Big Data Stories." *Cultural Geographies*, 1474474014525055. doi:10.1177/1474474014525055.