Digital turn, digital geography?

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Abstract

In this paper, we examine the relationship between the digital and geography. Our analysis provides an overview of the rich scholarship that has examined: (1) geographies *of* the digital, (2) geographies *produced by* the digital, and (3) geographies *produced through* the digital. Using this material we reflect on two questions: has there been a digital turn in geography? and, would it be productive to delimit 'digital geography' as a field of study within the discipline, as has recently occurred with the attempt to establish 'digital anthropology' and 'digital sociology'? We argue that while there has been a digital turn across geographical sub-disciplines, the digital is now so pervasive in mediating the production of space and in producing geographic knowledge that it makes little sense to delimit digital geography as a distinct field. Instead, we believe it is more productive to think about how the digital reshapes many geographies.

Key words: digital, geography, computing, digital turn, digital geography

Introduction

'No other technological innovation in human history has affected the practice of geography in such a profound way as the computer. It has drastically transformed both geography as an academic discipline and the geography of the world' (Sui and Morrill 2004: 82).

Geographers have been engaging with digital technologies since shortly after the invention of the first computers. Initially, this took the form of using computers to undertake new forms of quantitative geography and modelling, using the power of computation to perform calculations (Garrison, 1956; Haggett, 1966; Hagerstrand, 1967). This was accompanied by the first digital mapping projects (Tobler, 1959; Balchin and Coleman, 1967) and the development of nascent Geographic Information Systems from the mid-1960s (Tomlinson, 1968; Foresman, 1998). Even though early computers were very slow by today's standards, they were thousands of times faster and less fallible at processing large data sets and complex statistical calculations than previously possible and therefore were quickly adopted as an essential research tool (Sui and Morrill, 2004). Since then digital technologies (including computers, satellites, GPS, digital cameras, audio and video recorders, smartphones, data infrastructures) and software packages (including statistics programmes, spreadsheets, databases, GIS, qualitative analysis packages) have become indispensable to geographic praxis: generating, processing, storing, analysing and sharing data (the majority of which are born digital); creating and circulating visualizations, maps, ideas, documents, videos, podcasts and presentation slides; and sharing information and engaging in public debate via mailing lists, social media and mainstream media (Fraser, 2007; Kitchin et al., 2013). In other words, the production of geographic knowledge is now thoroughly reliant upon and mediated *through* the digital.

Since the early 1990s, geographers have engaged with the digital in two other principal ways. First, they have sought to identify and map out the geographies *of* the digital, applying geographical ideas and methodologies to make sense of the spatialities of digital technologies and associated socio-technical assemblages, and the geographies underpinning their production. This has included mapping cyberspace and virtual worlds (Dodge and Kitchin, 2002), charting the spatialities of social media and games (Ash, 2015), plotting the material geographies of ubiquitous computing (Kitchin and Dodge, 2011), and detailing the economic geographies of component resources, technologies and infrastructures (Malecki,

2002). Second, they have examined the geographies *produced by* the digital, investigating how digital technologies, and in particular ICTs, are mediating and augmenting the production of space and transforming the geographies of everyday life. Work in this vein has explored how the internet is reshaping economic and urban geographies and how businesses and cities are spatially configured (Castells, 1996); detailed how digital infrastructure and devices are being embedded into the fabric of the built environment leading to new forms of networked urbanism and reshaping modes of urban governance (Graham and Marvin, 2001); and charted the digital mediation of geographical imaginaries and socio-spatial practices and relations and how spaces are envisioned, planned, built, and interacted with (Rose *et al.*, 2014).

We are aware that in drawing together a range of literatures under the umbrella of the term 'the digital' we run the danger of using it in a rather reductionist, conflationary way to capture a diversity of thinking and foci (including computation, computers, computing, ICTs, etc). In the interests of avoiding such reductionism while providing specificity to the kinds of objects, practices and states of being that we engage with in this paper, we advance Lunenfeld's (1999) dialectical definition of digitality as both ontics and aesthetics. Lunenfeld's approach acknowledges both the origins of technologies we engage with as 'digital' in binary computing architectures and the ways in which these digital architectures have recoded multiple other technologies, media, art forms, and indeed spatialities in particular ways coincident with the binary nature of these architectures. As ontics, 'the digital' designates digital systems which 'translate all inputs and outputs into binary structures of 0s and 1s, which can be stored, transferred, or manipulated at the level of numbers, or 'digits' (Lunenfeld, 1999: xv). As aesthetics, 'the digital' speaks to the *effects* of the pervasiveness of digital technologies in the spaces and practices of everyday life in which we see and come to understand and experience space(s) and spatiality as always-already 'marked by circuits of digitality' that are themselves irreducible to digital systems (Murray, 2008: 40). For our intents and purposes, then, we use 'the digital' to make reference to both material technologies characterized by binary computing architectures, as well as a broad genre of socio-techno-cultural productions, artefacts, and orderings of everyday life that result from our spatial engagement with digital mediums.

In this paper, we document the geographies *of*, produced *by*, and produced *through* the digital, devoting a section to each. Our aim is not to be exhaustive, given that it is impossible to document all studies that involve an engagement between geography and the digital, but rather to illustrate how the digital has become central to both the praxes and focus

of contemporary geographical scholarship and provide examples of the kinds of work that have been undertaken. We then use this material to reflect on two questions: *has there been a digital turn in Geography?* and, *would it be productive to delimit 'digital geography' as a field of study within the discipline?* We ask these questions in response to recent sessions and workshops that have focused on 'digital geographies'[1], and attempts within other social sciences to establish new fields of study, namely 'digital anthropology' (Horst and Miller, 2012) and 'digital sociology' (Orton-Johnson and Prior, 2013; Lupton, 2014).

Geographies *of* the digital

Geographers' initial engagement with charting the geographies of the digital took the form of a theoretical and empirical exploration of the digital as a particular geographical domain with its own logics and structures. These studies sought to apply pre-existing geographical ideas and methodologies to study what it considered to be a new material, spatial and technical realm of communication and interaction (the internet/cyberspace, virtual worlds, digital games) and their associated socio-technical assemblages of production. These geographies of the digital have examined five distinct, but overlapping, areas.

First, geographies of the digital conceptualised digitally mediated experience as a form of cyber or virtual space (Crang et al., 1999; Fisher and Unwin, 2003; Kitchin, 1998). Cyberspace serves as a kind of metaphor for understanding the worlds accessed by digital technologies, such as webpages, forums, multi user dungeons and online videogames and how those worlds are constructed through sets of information communication technology (Dodge and Kitchin, 2001, 2002). Here, cyberspace was understood as the outcome of a set of material objects, working in relation to a human body (Zook *et al*., 2004; Kinsley, 2013b). These objects included screens, computer hardware and network technology, such as routers and servers that connected different computer nodes to one another.

As Hillis (1999) has helpfully shown, this metaphor of cyberspace operated around a predominantly visual understanding of space, which was enabled by the technology of the screen as an optical mode of access to various computer generated environments. In other words, cyberspace was something to be surveyed, made sense of and experienced by the eye. In doing so, spatial experience was primarily understood as the co-production between a cognitively imbued human body, a set of objects that made up an environment and the mind, which operated to unify this set of disjunctive entities into a holistically experienced world. As a kind of spatial landscape, it then appeared logical to map cyberspace as one would any new terrain or area; both as a set of material infrastructures as well as a space for shared and

communicable experience (Shields, 2003). However, as Kinsley (2013b) and Graham (2013) have argued, the terms cyberspace and virtual space are problematic because they unhelpfully create a distinction between what are supposedly two different realms (the digital and analogue, or virtual and actual), which often covers over the complex processes through which digital objects generate the appearance of an environment or space. In line with such critiques, recent work by Blum (2012) and Starosielski (2015) amongst others has effectively served to ground metaphors such as those of 'cyberspace' and 'the cloud' by identifying and tracing the actual spatialities of internet infrastructures at both local and global scales. These spatialities include the instantiation of digital networks as internet exchanges, data centres, fibre optic cables, and their landing sites, as well as the contentious economic, social, political, and historical contexts of their geographies.

Second, geographers have charted the spatialities of video games and social media. What unites these areas of research is a concern for theorising the relationship between body and screen and how engaging and communicating through screens alters the spatial understandings, embodied knowledge, political awareness and social relationships of users. In the case of video games, Ash (2009, 2010, 2012) has suggested that engaging with video game environments cultivates new modes of spatial awareness, organised around ethologies of action that guide players without thinking, in order to capture and hold their attention (also see Lammes, 2008). As Shaw and Warf (2009) suggest these digital environments can also influence geopolitical understandings, by shaping how users imagine other people and places around the world, by creating negative stereotypes (also see Vanolo, 2012).

Working from a feminist perspective, writers such as Longhurst (2013) have argued that the visual nature of digital technologies, such as Skype, re-orientate bodily relations between family members and create feelings of connection that are absent when communicating through telephone or email. The ways in which digital technologies re-orientate social reproduction is also a key theme of others working in this area, such as Chan (2008), Larsen (2006) and Valentine (Valentine and Holloway, 2001, 2002; Valentine and Skelton, 2008; Holloway and Valentine, 2001). These geographers demonstrate how digital technologies reorganise socio-spatial relations between different activities such as work, rest and mobility and between different family members, such as adults and children. They also show how digital technologies challenge notions of place-based identity as defined by a shared location. In each case, pre-existing social relations are not done away with, but altered by the changing geographies of the digital.

Third, geographers have plotted the material geographies of ubiquitous computing. Ubiquitous computing refers to digital objects and processes embedded into the environment, such as RFID tags and sonic data sensors (Galloway, 2004). Here, digital geographies are figured as sets of technologies that go beyond an engagement with an interface or screen as a virtual geography (Kinsley, 2013a), or as an infrastructure whose primary aim is to enable this virtual geography (Graham, 1998). Instead, a focus on the geographies of ubiquitous computing seeks to consider the 'actual geographies that evolve on the surface of the earth in the information age: the changes in and among places resulting from the increased ability to store, transmit and manipulate vast amounts of information, and the new patterns of geographical differentiation, privilege and disadvantage that these changes are bringing about' (Sheppard *et al*., 1999: 798).

As Galloway (2004: 387) argues, ubiquitous computing 'did not seek to transcend the flesh and privilege the technological. Instead, ubiquitous computing was meant to go beyond the machine – render it invisible – and privilege the social and material worlds. In this sense, ubiquitous computing was positioned to bring computers to 'our world' (domesticating them), rather than us having to adapt to the 'computer world' (domesticating us)'. With this emphasis in mind, geographies of ubiquitous computing have examined the insertion and uptake of digital objects and markers into environments, such as place tagged podcasts (Arikawa *et al*., 2007), barometric pressure sensors (Retscher, 2007) and wifi routers (Köbben, 2007).

Fourth, linked to a consideration of the 'actual' geographies of digital technologies such as ubiquitous computing, an economic geography has detailed the component resources, technologies and infrastructures that power digital networks and in turn how these networks shape economic processes. Malecki (2002) discusses the geography of internet backbones in the US and shows how access to high speed bandwidth is both unequal and localised and creates new industries and clusters of data centres to facilitate linkages between different areas, while reinforcing existing forms of urban hierarchy (also see Carbonara, 2005; Gillespie and Robins, 1989; Tranos, 2013). In a similar vein, Leamer and Storper (2001) suggest that while digital networks enable conversational activity between businesses and firms at a distance, urban concentration of business is still important to enable embodied interactions that are key to economic productivity (also see Longcore and Rees, 1996; Zook 2005).

Finally, geographies of the digital have begun to trace the generation and flows of big data. While geographies of the digital have understood data to be key to all digital

communication, big data refers to a quantitative and qualitative shift in the amount, velocity, variety, resolution and flexibility of data that is now collected and analysed by a range of devices (Kitchin, 2014a). For example, smart phones and RFID tags can be used to track and analyse financial transactions and purchases by collecting petabytes of data in a single day (Kitchin, 2013). Geographers have explored the spaces of big data, including volunteered geographic information in a variety of ways (Wilson and Graham, 2013). Crampton *et al*. (2013) have detailed how geotagged data from services such as Twitter can be used to understand how socio-spatial processes such as riots are discussed across geographical areas. Crampton *et al*. also recognise the limitations of such data, suggesting geotagged data is an outlier, in the sense that geotagged data are used by a relatively small number of people within any population under study (for other critiques of spatial big data analysis see Haklay, 2013). Graham and Shelton (2013) also argue that any spatial big data necessarily create large data shadows, where groups who are considered valuable are increasingly data mined, while other populations disappear from analysis. Furthermore, Thatcher (2014) suggests that many geographers analysing spatial big data have to work off the secondary 'fumes' of data that are visible to users of locative social media services, rather than full data sets, as these data sets remain commercially confidential and inaccessible to researchers (also see Arribas-Bel, 2014).

The geographies of big data point to the challenges of analysing large data sets and suggest that while big data offers a large amount of material to be analysed and is often geotagged, this does not mean it is easy to construct a geography of big data as such. Rather, as Delyser and Sui (2013) argue, analysing the spatiality of big data requires novel methodological approaches that cross between qualitative and quantitative methods because big data alone cannot offer a comprehensive geography of the digital.

Geographies *produced by* the digital

Since the early 1990s there have been a series of studies that have examined how the digital is mediating and augmenting the production of space and transforming socio-spatial relations. Initially, this work concentrated on how ICTs, and the internet in particular, were transforming economic, cultural, social, and political geographies. The internet, it was documented, helped usher in a new information economy, leading to changes in how companies and employment patterns were spatially structured, and induced significant urban-regional restructuring and the creation of a post-industrial landscape (Castells, 1996; Graham and Marvin, 2001). ICTs produced a transformation in space-time compression and

distanciation, enabling more spatial and temporal fluidity in the flow of information, services and goods, and facilitating the internationalisation of production and financial and consumer markets (Langdale 1989), and increased international co-operation, joint ventures, strategic alliances and mergers (Robinson, 1991). Rather than having a series of largely autonomous sites/plants serving a specific region, ICTs were used to centralise and coordinate services within a single global company system.

These processes of globalisation, and employment and organisational restructuring, had profound effects on urban-regional systems. Cities were designed as places to overcome time with space, making communications easier. However, ICT networks overcome space with time by enabling the instantaneous transfer of information (Graham and Marvin, 1996). However, rather than leading to the dissolution of city life, ICTs have largely reinforced urban hierarchies through the concentration of command and control, and the agglomeration of information-rich business into key places (Moss, 1986). At the same time, many office activities, business services and production centres could be decentralised to the suburbs, more peripheral cities, or other countries to avail of cheaper rent and labour costs (Breathnach, 2000).

At the same time, cities were starting to become much more reliant on digital systems with respect to their planning and management, and digital infrastructure and devices were starting to routinely be embedded into the fabric of cities themselves becoming, as denoted by Bill Mitchell (1995), 'Cities of Bits'. Although city managers had been experimenting with using computer models and management systems to inform policy and govern cities since the early 1970s (Flood, 2011), it was only from the mid-1980s onwards that GIS and other land-use, planning and architecture software packages became common tools for urban management, along with updated urban control rooms for different utility and transport infrastructures. Moreover, many cities sought to pro-actively 'wire' themselves to attract inward investment and position themselves in the global informational economy (Warf, 1995). By the turn of the new millennium, software-enabled and networked devices and infrastructures had become a common feature of urban life, augmenting and mediating production, consumption, travel, communication, and home life, with Amin and Thrift (2002: 125) declaring that '[n]early every urban practice is becoming mediated by code'. Dodge and Kitchin (2005a) argued that such was the importance of software to the production of space that in many cases code and space were mutually constituted as 'code/space': if the software failed the space could not be produced as intended (e.g., if a computerized till crashes a shop is simply a warehouse as there is no alternative means to process a payment).

Within the new informational economy, and society more broadly, it was quickly noted that a digital divide had formed, with on one side those that had access to ICTs, and all they had to offer, and on the other, those with limited access. For Castells (1996), the social and spatial polarisation inherent in the digital divide was characterised by a separation between what he termed the 'space of flows' (well-connected, mobile and more opportunities) and the 'space of places' (poorly connected, fixed, and isolated). This digital divide takes many forms, including differentials between people of different classes or living in different parts of a city, or between urban and rural areas, and between nations (Dodge and Kitchin, 2002). This continues to be an on-going issue, both with respect to access to digital technologies and infrastructures, but also the content of the internet, which is decidedly skewed in its focus (Graham *et al*., 2014).

The power geometries produced through ICTs have also been mapped with respect to how they facilitated control and regulation of space. ICTs enabled the roll-out of networked forms of surveillance, including digital CCTV and internet use, but also machine readable, automated forms, for example, automatic number plate recognition systems, that generated indexical data about peoples' actions and behaviour (Dodge and Kitchin 2005b). These data can be used to profile populations via geodemographic segmentation that can influence local policy formulation and service provision, or to socially sort individuals with respect to key decisions such as whether to approve credit, offer a job, or provide tenancy (Graham, 2005). As Kitchin and Dodge (2011) contend, while some of these technologies seek to monitor and discipline how space is used, others actively seek to reshape behaviour by only enabling certain prescribed forms of action.

The 'city of bits' produced by ICTs has been variously labelled in the literature, including 'wired cities' (Dutton *et al*., 1987), 'cyber cities' (Graham and Marvin, 1999; Graham and Zook, 2011), 'digital cities' (Ishida and Isbister 2000), and 'intelligent cities' (Komninos, 2002). More recently these notions have been somewhat subsumed into the term 'smart cities'. As with many buzz phrases, 'smart city' lacks a well delineated and agreed upon definition. In general it is understood in three ways. First, as an instrumented city in which ICTs and the internet of things (networked sensors, actuators, transponders, meters) augment urban regulation and governance and produce data-driven urbanism (Kitchin, 2014b). Second, as a city in which advances in ICT are used to reconfigure human capital, creativity, innovation, education, sustainability, and management in order to improve urban policy, development, governance and economy (Caragliu *et al*., 2009). Third, as a city in which ICTs are used to promote a citizen-centric model of development that fosters social

innovation and social justice, civic engagement and hactivism, and transparent and accountable governance (Townsend, 2013). The first two visions are largely underpinned by a neoliberal ethos of market-led and technocratic solutions to city governance and development, whereas the third is forwarded by some either as a counter-weight to the first two or as an alternative. In general, these three visions are not mutually exclusive, with smart city strategies seeking to blend elements of them in varying proportions and emphases.

The promise of smart cities is to solve a fundamental conundrum of cities – how to reduce costs and create economic growth and resilience while at the same time producing sustainability and improving services, participation and quality of life – and to do so in supposedly commonsensical, pragmatic, neutral and apolitical ways. As a number of critiques are now documenting, the smart city is far from neutral and pragmatic (Greenfield, 2013; Kitchin, 2014b). Nonetheless, smart city policies and technologies are reconfiguring how cities are known, managed and governed, largely reinforcing neoliberal political economy and existing power geometries and social and spatial inequalities rather than eroding or reconfiguring them (Datta, 2015). As such, smart cities are now becoming one of the key landscapes *produced by* the digital.

Geographies *produced through* the digital

As noted in the introduction, geographers have been producing geographic knowledge through the digital since the mid-1950s. Here, rather than to try to document all the ways that the digital mediates geographical research, we focus on one element that is perhaps more reflexive of this relationship than others, namely Critical GIS and studies utilising geospatial big data. As noted by Rose (2015), the digital has figured prominently as a site, mode, and object of critical geographical praxis, particularly over the last three decades or so. The origins of the contemporary tradition of doing human geography *with* digital technologies may be located in the critical cartography enterprise, principally in its incorporation of computerized cartography to map for social, political and economic change (see, for example, Bunge's 1988 Nuclear War Atlas). As geographic information systems became entrenched as a mainstream presence within the discipline, critical cartography informed the ascendance of Critical GIS, which constituted a concerted effort at incorporating what were, at the time, trenchant critiques of geographic information systems into nuanced deployments of the technology. This engendered a series of practices organized around 'feminist GIS,' 'queer GIS', 'qualitative GIS,' and 'participatory/public participation GIS' amongst others (see Leszczynski, 2009; Schuurman, 2000). These praxes repurposed quantitative methodologies

and geovisualization techniques within mixed-methods approaches that sought to effect and make visible subaltern and counter-hegemonic political, economic, social, and cultural geographies through appropriations of digital assemblages (in this case, GIS; see Cope and Elwood, 2009).

Feminist GIS interventions are illustrative in this regard. For instance, Kwan's (2002) work mapped the space-time paths of ethnic minority women as they sought access to urban employment opportunities in Columbus, Ohio. Kwan captured women's experiences of place, and marginalization in space, using innovative geovisualization techniques to communicate these dimensions of women's embodied mobilities as 3-D paths in space-time. Similarly, Pavlovskaya (2002) used GIS as part of a mixed methodology to account for women's strategies for coping with economic transitions in post-Soviet Russia. Through examining women's lives on a household and neighbourhood scale, she made visible highly classed and gendered micro-economies that were otherwise not accounted for by macro-economic approaches and analyses. These two examples are emblematic of the Critical GIS impetus towards enacting alternative geographies through engagements with the digital. Yet equally importantly, they capture the ways in which the digital itself is – and very much continues to be – a mode and object of geographical knowledge production (i.e., a means of producing knowledge *with* the digital), and a site of knowledge production in geography more generally.

Brown and Knopp (2008) asserted geographic information systems constitute a spatial epistemology – specifically, a way of knowing that truncates and stabilizes the world. In so doing, GIS eschews 'queerness,' which cannot be represented within a formal schema and the 0s and 1s of digital registers. Many of the poignant critiques of GIS in the early 1990s sought to dismiss the technology from the discipline on the basis of objectionable epistemologies considered to be capable of only generating ethnocentric, empiricist, and disembodied ways of knowing associated with colonialist militarism, masculinist positivism and cartographic rationalities (for examples, see Bondi and Domosh, 1992; Dixon and Jones, 1998). Yet Critical GIS interventions demonstrated precisely the opposite - that digital objects could and may be appropriated and repurposed to enact and produce spatial knowledges that are situated, reflexive, non-masculinist, emotional/affected, inclusive and polyvocal, and flexible rather than foundational (Aitken and Craine, 2009; Elwood, 2006; Kwan, 2002, 2007; Pavlovskaya, 2006; Schuurman, 2002).

That digital artifacts serve as objects, sites and modes of knowledge production is not limited to GIS. We now live in a present characterized by an abundance of a diversified array of spatially-enabled and –oriented digital devices, platforms, and applications and services

11

that have become pervasive presences in the spaces and practices of everyday life. As a result of their pervasiveness, new spatial media are intensely bound up in the production of myriad, though often highly quotidian, spatial knowledges (Elwood and Leszczynski, 2013). Their public nature, the openness of their platforms, and their ease-of-use have been upheld as being generative of a polyvocality of spatial narratives by lowering barriers to digital participation for historically marginalized groups, such as women and indigenous peoples. For example, the Surui, an indigenous Amazonian people, repurposed location-enabled Android handhelds used to chronicle and geolocate instances of illegal logging and mining within their territory to document sites of cultural, historical and spiritual significance and uploaded them to Google Earth as an interactive layer for navigation and exploration (Forero, 2013).[2]

Examples like the Surui attest to the pluralization of spatial ontologies and epistemologies enacted via appropriations of networked spatial media (Warf and Sui, 2010). At the same time, Stephens' (2013) work on OpenStreetMap (OSM), an open-source online mapping platform for the crowdsourcing of spatial data, demonstrates that the politics of spatial knowledge production often belie the purported epistemological openness and flexibility of spatial media. Examining the history of editing disagreements over the inclusion of new amenities (kinds of places) to OSM, Stephens identified that venues associated with highly visible, stereotypically masculine activities such as the public consumption of alcohol and sex were often finely distinguished from each other on the basis of subtle differences considered by OSM editors sufficient to warrant their designation as separate amenities (e.g., *pub/bar/beer garden* and *stripclub/swingerclub/brothel*). Meanwhile, substantive differences between 'feminized' spaces of childcare, namely between the amenities of *baby hatch* (a space for the minding of babies) and *kindergarden* (a learning environment for early school aged children) were considered too similar by an all-male editorship to justify the inclusion of an additional amenity type (*baby hatch*).

The proliferation and public accessibility of digital platforms for spatial knowledge production "[poses] epistemological challenges to the dominant theory of truth, in particular advancing a shift away from the correspondence model of truth towards consensus and performative interpretations" (Warf and Sui, 2010: 197). But the politics of geographical knowledge production with the digital – which involves questions of how particular knowledges come to be considered legitimate (Elwood and Leszczynski, 2013) - remain influenced and marked by hegemonic social relations of, amongst others, race, class, and gender. Moreover, they increasingly reflect the interests of the corporate entities which own

and exert control over dominant digital spatial platforms by managing the use of APIs (Application Programming Interfaces) to which they may revoke access, without explanation, at any time (see Leszczynski, 2012).

A critical human geography *produced through* the digital has, always been a dual project: one of engaging with the digital as a site, mode, and object of/for spatial knowledge production in the service of enacting alternative economic, social, political and cultural geographies; and simultaneously, one of engaging with digital technologies and platforms by critically evaluating the ways that they themselves engender particular modes of knowledge production that make possible and circumscribe particular kinds of spatialities and spatial epistemologies. The necessity for geographers to continue to move between engaging with the digital in practices of critical geographic praxis and critiquing digitally-mediated knowledge production is imperative as the visual nature of digital spatial artefacts is being both intensified and dislodged in a present characterized by locative media and spatial big data (Graham and Shelton, 2013; Leszczynski, 2014). Much of our interaction with and experience of the digital is now geographically oriented via, for example, the spatialization of interfaces (Leszczynski, 2014). The map based interfaces that constitute the front end of apps for services such as Uber, much like the vertical scopic regimes of Google Earth, impose particular spatial epistemologies/ways of 'knowing' space. These must continue to be critically interrogated (Rose, 2015).

Digital turn, digital geography?

If the definition of a 'turn' is a concerted re-orientation of focus of attention and approach, then it is fair to say that over the past two decades Geography has undergone a 'digital turn'. Across all sub-disciplines there has been a recognition of the ways in which the digital is reshaping the production of space, place, nature, landscape, mobility, environment, etc. In this paper we have only had space to focus on just a small sample of such work, principally that concerned with the relationship between the digital and the urban, but there are thousands of other geography papers we could have discussed that chart, either explicitly or more obliquely, how digital technologies recast economic, political, social, cultural, health, and other geographies. Moreover, the geography of the digital itself has become a focus of attention, with studies mapping out the spatialities of the internet, games, ubiquitous computing, big data and their materialities. Furthermore, the epistemologies and methodologies of geographical scholarship and research are now thoroughly mediated by

digital technologies, altering in all kinds of explicit and subtle ways how questions are asked and answered and how knowledge is constructed, communicated and debated.

This digital turn begs the question as to whether a field of digital geography should be established within the discipline. Similar such attempts have been underway in Anthropology and Sociology for a number of years. In both cases, the focus is broad encompassing the anthropology and sociology 'of', 'produced by', and 'produced through' the digital. The consequence, we believe, is to recast just about all anthropology and sociology as 'digital anthropology' and 'digital sociology' to some degree, especially given the reliance of digital technologies in knowledge production. But if everything becomes 'digital' then it becomes an empty signifier and unworthy of denoting it with a label. As such, while we do believe that there is a need to think critically about the relationship between geography and the digital, it makes more sense to think about how the digital reshapes many geographies and mediates the production of geographic knowledge, and how the digital has many geographies, rather than to cast all of those geographies as digital geography. For example, examining the ways that the internet of things is reshaping urban management is best framed within urban geography; investigating the use of mobile phones in the delivery of aid in parts of the Global South is best framed within development geography; exploring how telemedicine is changing the spatialities of health care is best framed within health geography.

By framing the digital in this way, the focus remains the primary knowledge domain, placing the emphasis on developing our understanding of the urban, development, and health (and politics, economy, social, cultural, environment, etc). This we believe should also be the case when the object of study is the geography of the digital: a focus on digital communication cuts across the domains of media and social geographies; a focus on online gaming intersects with interests in social and cultural geographies; a focus on internet-based mapping falls within the purview of cartography and GIScience; a focus on the geography of rare metals used in the production of digital technologies raises questions in the fields of resource and development geographies, as well as geopolitics; a focus on spatial big data generated by locative social media straddles the subdisciplinary boundaries of GIScience and social geography and so on. This enables the differences the digital makes to be contextualised within a broader knowledge base and the history of theory, concepts, models and empirical findings within and across geographic sub-domains. For example, it makes sense, we feel, to frame smart city developments within debates around the long history of urbanisation and urbanism, rather than to set them within a field of digital geography.

This has largely been the way that geographical research concerning the digital has progressed and been framed to date, though there were initial dalliances around the notion of virtual geographies (Batty, 1997; Crang et al., 1999) and cybergeography (Dodge, 2001). More recently, there have been conference sessions and workshops framed around 'digital geographies', suggesting there might be an attempt to follow Anthropology and Sociology's lead. This, as we have argued, would be a folly. That said, there is substantially more that needs to be done conceptually, methodologically and empirically to make sense of and research the relationship between the digital and geography. There is also much to be gained through sustained engagement with the theory and praxis of disciplines that focus more substantially on the technical aspects of the the digital, such as Science and Technology Studies, Software Studies, Critical Data Studies, Game Studies, Platform Studies, New Media Studies, Informatics, and Human-Computer Interaction.

In particular, we believe it would be profitable for geographers to critically reflect upon the wider dispotif or assemblage of the digital. Foucault's (1977) concept of the 'dispositif' refers to a 'thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, [and] philosophical, moral and philanthropic propositions' (in Gordon 1980:194), which enhance and maintain the exercise of power within society. Unpacking a digital dispotif involves charting the wider discursive and material practices that interact in relational, contingent and contextual ways to shape the deployment and use of digital technologies. Kitchin (2014a) sets out a similar notion with respect to mapping out what he has termed data assemblages, arguing for the need to examine digital objects and infrastructures comprehensively, both examining critically their interlocking technical stack (platform, operating system, code, data, interface) and their forms of knowledge, political economy, capital, governmentalities, legalities, institutions, etc. Such an unpacking can usefully draw on Ian Hacking's (1982, 1986) positioning of computing and data ontologies and epistemologies as systems formulated to do work in the world, whilst simultaneously legitimating and reinforcing the dispotif (Kitchin and Lauriault 2014).

In particular, we believe geographers are uniquely placed to interrogate the materiality of digital computation in innovative ways. Geographers' theorisations of space, time and relationality can be fruitfully developed to consider how digital computation and its associated objects are both singular things, with particular capacities, that also create shared space times for both other technical objects and the humans who use those objects. In other words, geographers can attend to the work that non-human infrastructures perform that

always exceeds the technical parameters of their performance. Drawing upon the work of Object Orientated Ontology, Tim Schwanen (2015) develops three potential strategies for studying digital computation in this way. In relation to smartphone apps, he suggests that researchers begin with the app itself rather than 'the human individual, her needs, preferences, valuations or even the social practices she is enrolled in' (Schwanen 2015, 682). Practically, this can take the form of understanding the script design of the app and then understand how users engage with the script design for example. Schwanen also suggests that we consider how engagements between the objects of digital computation and humans creates new objects: in terms of apps, this might be senses of reward or competition. Finally, Schwanen suggests that these new objects also have their own impacts and effects worthy of study. For example, we might investigate how fitness tracking apps encourage new forms of habit in the human user and how these habits feed back into the design and operation of the digital app itself.

In addition to theorizing the materiality and spatiality of digital computation, geographers must continue to interrogate the epistemologies ensconced within, and engendered by, the proliferation of spatial big data that result in part from our continuous quotidian interactions with the digital. Non-curated, piecemeal digital artefacts such as natively geocoded Tweets may be enrolled within critical modes of spatial knowledge production.As demonstrated by Shelton *et al*.'s (2015) analysis of Twitter activity across Louisville, Kentucky's '9th Street divide', Tweets can be used as a basis for examining the spatial mobilities of socioeconomically marginalized and racialized residents of cities. However, the appropriation of spatial big data must continue to follow Crampton *et al*.'s (2013) imperative of going 'beyond the geotag' and the simple plotting of geocoded content onto a map (see also Miller and Goodchild, 2015). This necessitates not only enrolling spatial big data within praxes of spatial knowledge production, but also accounting for the myriad contextualities, power geometries, and knowledge politics of modes and practices that inform those data productions themselves. This includes, but is by no means limited to, the ways in which spatial big data are tied to and reinforce synergies of dominant platforms (Wilson, 2014), the highly performative nature of generating content across social platforms (Kinsley, 2014), the persistent colonialism and masculinism that inform big data economies (Cupples, 2015), as well as the purported inclusivity of volunteered geographic information (Sieber and Haklay, 2015).

Furthermore, geographers need to be increasingly attuned to the ways in which spatial big data - namely, personal locational traces - participate within epistemologies that equate

data with definitive evidence of spatial presence, movement and behaviour in what Crawford (2014: n.p.) terms 'data-driven regime[s] of truth.' As a function of the relationality of big data phenomena, data indicative of spatial presence, movement and behaviour are being used to infer social, political and religious affiliations about individuals, as well as their involvement and complicity in events and occurrences such as protests and their predisposition or likelihood towards participation in particular kinds of activities (see Leszczynski, 2015). Such data-driven correlations are deeply informed by, and reproduce, longstanding socio-economic inequalities and their persistent geographies, which must continue to be made visible.

As a consequence, there is much work to be undertaken in mapping out the politics and ethics of spatial big data, open data initiatives, and the drive to create smart cities. This includes the need to examine the ownership and control data; the integration of data within urban operating systems, control rooms, and data markets; data security and integrity; data protection and privacy; data quality and provenance; and dataveillance. It is clear that ideals such as the OECD's (1980) Fair Information Practice Principles concerning notice, choice, consent, security, integrity, access, use and accountability are treated as redundant, with data being generated without consent and repurposed in all kinds of ways to create data-driven urbanism in which data practices are directly enacting and influencing modes of urban governance, often in real-time (Kitchin, 2013b). As Greenfield (2013), Kitchin (2014a) and Datta (2015) note, there is a strong neoliberal ethos underpinning such moves, with the technological solutionism deployed and the corporatisation of city services designed to serve certain interests, reinforce inequalities, and enforce a new securitised regimes of law and order. Geographers are well placed to unpack the socio-spatial materialities of these various data regimes and to chart such data-driven urbanism, its promises and perils, and it socio-spatial processes and political economy, but also to undertake more normative analyses as to what might be a more fair, equitable and ethical smart city. At present this barely consists of more than platitudes by corporations and states towards citizen-centric design (which usually means to the benefit of citizens in their view).

Regardless of how we want to position the digital within Geography there is little doubt that there is a growing body of work considering the geographies of the digital, geographies produced by the digital, and geographies produced through the digital. The digital has reshaped how geographical research is conducted and it has become a central focus across Geography's various sub-disciplines. Moreover, this work has bled through into a variety of other disciplines, in part through the wider spatial and mapping turns in the social

sciences and humanities. As the digital becomes ever more pervasive -- mediating, augmenting and regulating everyday life -- it will undoubtedly become even more central to geographical scholarship, both as a focus and as a media. As a consequence, whilst geographers have made important contributions to understanding the difference the digital makes, there is much future work to undertake.

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Notes

1. For example, the 'digital geographies, geographies of digitalia' sessions at the Association of American Geographers conference, Tampa Bay, April 8th-12th 2014; the 'co-production of digital geography' sessions at the Royal Geographical Society conference, London, August 27th-29th 2014; and the 'Digital Geography' workshop organized at the Open University, March 24th 2015.

2. The Surui cultural map Google Earth layer (.kmz) may be downloaded at https://www.google.co.uk/earth/outreach/stories/surui.html

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