Original Research Article

BIG DATA & SOCIETY

Big Data & Society
July–December 2016: 1–16

DOI: 10.1177/2053951716661364
bds.sagepub.com

SAGE

Small moments in Spatial Big Data: Calculability, authority and interoperability in everyday mobile mapping

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Abstract

This article considers how Spatial Big Data is situated and produced through embodied spatial experiences as data processes appear and act in small moments on mobile phone applications and other digital spatial technologies. Locating Spatial Big Data in the historical and geographical contexts of Sydney and Hong Kong, it traces how situated knowledges mediate and moderate the rising potency of discourses of cartographic reason and data logics as colonial cartographic imaginations expressed in land divisions and urban planning continue on, in a world that increasingly values models of calculability, interoperability and authority. It draws on ethnographic material gathered through walking interviews in both cities, and in doing so, it argues that by using ethnographic 'moments', it is possible to decentre the focus on data processes to consider the critical potential of a politics of everyday experiences that produce and reflect the structures of data logics. Through these ethnographic moments, this article examines how mobile technologies are complicit in the production of Spatial Big Data, and the impact this has on the increasing regimentation and surveillance of modes of being and expression via mobile media. At the same time, it will argue that while spatial calculability has expanded from cartographic reason into data logics, the epistemological universality of Spatial Big Data is constantly being resisted – in moments of experimentation, failure, intuition, memory and desire, the ghosts of the incalculable epistemes, experiences and people, forgotten by the emphasis on calculation, continue to speak.

Keywords

Critical cartography, ethnography, postcolonial, Sydney, Hong Kong, Big Data

Introduction: Marianna maps her walk

Every day, Marianna tries to walk at least 7 km at a rate of 5 (or preferably 6) km per hour. Together, we wander through the labyrinth of streets in her local neighbourhood in Sydney, Australia, as tensions arise between her wish to maintain her pace and walk a certain distance, and the pragmatism of not wandering too far from home. The pushing and pulling between distance and proximity results in our circuitous path, winding through the labyrinthine streets of the inner city suburbs, measured, recorded and calculated through an application (app) on Marianna's smartphone: a pocket cartographer, calculator and fitness coach all-in-one. Stopping for a brief pause, she pulls out her smartphone and opens the user interface of the app in order to show me the kinds of data that it collects and the visualisations that it uses to represent her movements through space and time: minute-by-minute breakdowns of her momentum in graphic form are supported by wildly various updates of her average speed across the course of the walk, and a number of scattered GPS way points skipping and stumbling off the road and into other people's properties. This circus of numbers, lines and points, contradictory in information

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and strangely empty in narrative is a peculiar rendition of meaning, reflecting both the nature of space, and of Spatial Big Data. In the small moment, the interoperable calculations of Spatial Big Data both reassert and undermine its own authority by maintaining a foundational role in shaping spatial experiences through generalising landscapes across a Cartesian plane, aggregating numeric information, triangulating locational and personal data and representing it on mobile screens.

This article considers the implications of such data processes as they appear and act in small moments: the point at which Big Data – a term which usually refers to large volumes of quantitative data, until recently only processable on supercomputers (Manovich, 2001), rational forms of geographic data and cartographic imaginations intersect and erupt in everyday lives as *Spatial Big Data*. Furthermore, by considering how Spatial Big Data is situated and produced through embodied spatial experiences in specific space–times, it aims to decentre the focus on data processes to consider the critical potential of a politics of everyday lived experiences that produce and reflect data-based representations. To do so, it offers five ethnographic 'moments' (cf. Dodge et al., 2009) that are also critical provocations – Marianna maps her walk, Daren finds himself, Tanija questions everything, Ellen gets in and Sarah does not know. Each moment is a situated and spatial irruption of data pockets, where consideration of the political, epistemological and ontological ramifications of Spatial Big Data is underscored in relation to lived experiences rather than the data gazes established by urban control rooms (Kitchin, 2014) or data ubiquity (Wilson, 2015).

As Marianna maps her walk, space (as it becomes Spatial Big Data on her smartphone) works something like this: the world is overlaid, as if flat, with a digital Cartesian coordinate system, longitudinal and latitudinal lines that, at their intersection, assign every position two discrete numbers (x and y) and a time stamp to form a coordinate position A. This information is tagged to an increasing number of digital, mobile activities: photos, status updates, private chat windows, mapping interfaces, route-finding, location-based games with updates occurring in regular intervals determined by the mobile app's need for location-sensitivity. Next, with the spatio-temporal information that it has gathered, it is relatively simple for the app's code to use basic geometry and automatically run an algorithm to triangulate her distance between A and any other point. Then, calculating the time difference between the two time stamps, distance can be divided by time to produce an approximate average speed over that period. This average is then fed back to Marianna as one of the points on her data – if current, brought to the fore ('current pace, 5.4 km per hour'), if out of date, relegated to the archives for comparison, so she knows if she has to speed up or if she can relax a little in order to achieve her fitness goals for the day.

The breadth of calculations used by Spatial Big Data in Marianna's walk operates in a discursive mode: it does not merely appear as a representational tool to describe Marianna's movement or any other number of spatial activities. Instead, Spatial Big Data operates as a spatial order (Foucault, 2002b) of the same vein as the western geographic imaginations that overwrote the landscapes of colonised territories (Gregory, 1994), and the desire for universality and transcendence in modern European cartography which underpins 'cartographic reason' (Farinelli, 2000; Olsson, 2007). Literature in critical cartography has already discussed role of cartographic logic, reason and knowledge in producing spatial imaginaries and spatial experiences (cf. Crampton, 2006; Gregory, 1994; Harley, 1989; Pickles, 2004). More recently, 'critical' geographic information systems (GIS) (Harvey et al., 2005) and 'critical data studies' (Dalton and Thatcher, 2014) have begun to examine the impact of quantification and the political nature of data.Spatial Big Data necessarily reduces spatial knowledges and experiences to calculable, rational and interoperable information that can be mediated via digital, mobile, geo-locative technologies like smartphones and tablets (Wilson, 2011). Yet, while knowledge and experience may be ordered through such powerful epistemic logics, as they appear in the everyday, in embodied moments of *mobile mapping*, we must ask: what happens if we talk about mapping beyond the map, about big databases in small moments?

The ethnographic research in this article – of which Marianna, Daren, Tanija, Ellen and Sarah are but a few examples – was specifically designed to answer a call for further investigation into the ontogenetic nature of mapping practices by Dodge et al. (2009), as well as the need to investigate the shift from paper to digital maps in the spatio-historical conditions of landscape knowledges in (post)colonial cities. However, the intricacy and complexity of these moments, as different threads and themes fold and unravel means that these five 'moments' can also be used to understand the influence that Spatial Big Data has in structuring space through heterogeneous mobile mapping practices (with and without maps). Furthermore, these moments also draw attention to the relationships between Spatial Big Data and cartographic reason as interoperable discursivities and logics enabled an ever-expanded ordering of spatial knowledge. The five moments presented here were importantly recorded during field research in Sydney and Hong Kong (in that order) – cities that have a historical link as peripheral outposts of the British Empire in the 19th and 20th centuries. They

were specifically chosen because of the complex post-colonial cultures encountered in each city, which have been shaped by tension and suppression of conflicting epistemological and ontological world views (Abbas, 1997; Carter, 2009). Data has historically and geographically shaped both cities through charts, surveys and maps, shipping manifests filled with bio-political data on soldiers, settlers and prisoners, early census data on local populations, and military records of vantage points, sites for fortification and ordnance.

In order to better understand the transient and personal qualities of spaces, set against the quantified representations of Spatial Big Data (like those on Marianna's app) a number of video-recorded, participant lead walking interviews (cf. Evans and Jones, 2011) were carried out to foreground the performative, deeply situated, habitual and 'on-the-move' appearances of cartographic reason in cartographic, data-based, geometric and material form. This includes an extension of approaches that discuss mobile mapping and yet do not explicitly discuss space–times in their specificities (cf. Evans, 2015; Farman, 2012; Verhoeff, 2012).

Given the emphasis on discursive regularities, the analysis of this ethnographic data was informed by Foucault's archaeological method (Foucault, 2002a) which allows us to read, side by side, words, occurrences, documents and events that may not, at first glance, appear to have much in common but through archaeology reveal potent discursive formations that appear and reappear in different modes across space and time. Many hours of interview material were recorded in both cities, and so, admittedly, it cannot all be presented here: at some point, a 'cut' must be made (Kember and Zylinksa, 2014). Therefore, the moments here have been chosen specifically because they have something to offer the evolving conversation about Spatial Big Data, how it is conceptualised and the ways in which it is researched.

Returning again to Marianna in Sydney, she is being quite patient with me: as she quickens her pace to raise her average speed, I slow us down considerably with the tripartite distractions of pausing, chatting and exploring. This is Spatial Big Data *in action* whereby cartographic and data logics become embedded in Marianna's experience. These discursive logics remain consistent across scalar levels, from the massive to the minute and from the quantitative sciences of mathesis to the qualitative organisation of taxonomy (Foucault, 2002b). Yet, on this scale and in this moment, cartographic data logic stumbles. Curiosity and the openness of space compounds with the data being generated by the app resulting in a new conflict embodied in Marianna's walking style: on one hand, Marianna wishes to maintain her pace, as authoritative numbers sporadically chirp up from her phone and, on the other hand, she is excited to show me places where things have happened, spaces that have changed, and the stories of other people that she has encountered in her wanderings (Figure 1). Here, in practice, we encounter a situated limitation of Big Data in spatial forms (Bittner et al., 2013). Our smooth pace becomes a stilted rhythm that is underrepresented by averaging data geometries of the app that produce constant straight lines between coordinate points as we produce wobbling and weaving paths with arrhythmic momentum. Furthermore, Marianna knows this and uses this quirk in cartographic logic as a tactic to exploit the data to suit her desires – she hurries us to get to A quickly,

Figure 1. Marianna stops walking to show me the app on her phone.

so that we can dally at B, to walk down a dull street quickly so that she can show me the permaculture garden around the corner. Marianna's actions reassert the questions voiced by critical cartography, GIS and data studies about whether there remains an important interpretative and philosophical part to be played by the humanities and social sciences in being able to read around, through and outside of 'Big' Data and its influence, in order to be able to better comprehend and theorise our everyday lives.

By placing the representational processes of Spatial Big Data specifically in an ethnographic context, the socio-cultural mediation between data, space and people becomes more obvious: geographic information of places on digital online maps, for instance, is reflective of social practices, leaving some places well represented and recorded and others effectively non-existent (Graham, 2010). As Leighton Evans (2015) has argued, place (and perhaps space) becomes mediated through data technologies, algorithms and code: Marianna has already begun to conceptualise her walk in terms of the data that it produces, her path in terms of the line that it makes on the map. This is more significant in the context of data 'sweat' (Gregg, 2015) or 'fumes' (Thatcher, 2014), or, the data that we leak as we engage in the myriad digital data systems that shape our lives. This data can be aggregated together, sorted by either the IP address of the device (standing in for the user), the time stamp or the location coordinates, to consolidate a larger view of this data in context: personal, habitual narratives through time and space, what many people do at the same time or what kinds of things people do at a specific location.

Yet, from the other side of the data gaze, it is possible to see the way in which the relationship between how Marianna walks and how her data collected on the screen is abstracted and warped. This data acts as a lens that casts the detail of cartographic reason into focus (numbers, lines, boundaries and fix points) while blurring everything else, like the sweet scent of the bougainvillea and the sound of magpies in the trees. Spatial Big Data can only tell us so much about the world, depending upon the uncertain accuracies of the information inputted or generated through digital mobile activities. At the same time, data sets like Marianna's give the commercial holders of such data (and their opaque management and archiving systems) enormous power to not only locate a user through individual IP addresses but also to track their data sweat and correlate it with other geographic databases that contain information about businesses, public spaces and institutions, transport information, etc. (Crampton et al., 2013) in order to reconstruct and pass on spatial stories given authority from the discursive power of data, despite the imperfections of its generalisations.

The intersecting and interoperable data shadows cast by Marianna and others in their everyday engagement with digital technologies can be mapped in the contemporary fluidity of every city, not just in Sydney and in Hong Kong. In miniscule moments, geo-tagging and geo-locative capabilities in mobile applications combine with massive geographical data systems like the GeoWeb (Scharl and Tochtermann, 2007), GIS like the Google Maps engine and real-time data feeds like Waze (Hind and Gekker, 2014). All this data begins to add up, and, as I have argued elsewhere (Wilmott, forthcoming), becomes what Gregg (2015) calls a 'data spectacle'. The scalability of data means that the spectacle too becomes scalable. Marianna's data portrays a spatial story which she can see in near-immediacy – in this case, simultaneously looking (at a data on a screen) and doing (walking/recording) (cf. Lammes, 2016; Verhoeff, 2012). Meanwhile, this spatial story, unburdened by the lived reality of its situated embodiment, can also been found in the plethora of Spatial Big Data that is amassed every day and reappropriated into an imperfect and culturally abstracted view of the world. Marianna stops and looks at things that are not on her app (or any other), and recounts moments that have a poetic importance that seems to beyond the captivity of spatial data logic and its basis in cartographic reason. Pointing towards a house, she shows me a plant that was in flower last week, but this week is not; picks some geraniums and takes a photo of a poster stapled to a wooden telegraph pole. Marianna's walks are a like a fabric woven and rewoven through spaces that look the same on the map (and have done so for many years) but have heterogeneous textures and delicate memories threaded through them.

Proponents of techno-utopian visions such as the arrival of neo-geography and the dreams of a digital earth have argued that digital transitions auger a heavily democratised and by association, fairer and more accurate engagement with geographic data (cf. Warf and Sui, 2010). In this argument, the era of Big Data is a liberating force – free from the shackles of ideology, the information age has resulted in the rise of the amateur and the end of the need for experts: we can all make, use and analyse the maps and data that rule our lives. Now, we find that Spatial Big Data now enables large tech companies, such as Google, to establish correlations and patterns without the scientific practices of hypothesis, modelling and testing, and most importantly, without the need for context (Anderson, 2008). Yet, this political tour de force has a 'complicated and fraught' past and present (Barnes and Wilson, 2014: 1) which seems unduly abrasive against the context-dependent moments of Marianna, Daren, Tanija, Ellen and Sarah. Twirling the geranium

in her hand, Marianna gets distracted again – this time by the app itself as it updates us on our falsified pace. This data floats across the surface of Marianna's experience – gimmicks and passing fancies. Once again cartographic data logics imply regularity while we stop again to check what the app is telling us. Our walk maintains a rubato pushing and pulling towards speed on one hand and stillness on the other, masked under the generalised and incorrigible data that keeps being fed to us.

Moments like Marianna's walk offer an opportunity to situate Spatial Big Data in everyday life through mobile mapping. Through these moments, Spatial Big Data can be conceptualised as an epistemological agent of spatial reason, found in minute interstices of everyday life, rationalising, structuring and regulating everyday experiences and practices in ways that are deeply political. The walking app with its incessant interruptions and updates complicates the rhythm and momentum of Marianna's pace – but it does not contain it. Thus, the working definition of *mobile mapping*: a situated practice of drawing relations and performative reading, representing and navigating between spaces and objects, specifically but not always using mobile technologies and geo-locative apps. As mobile mapping encompasses both space and users more broadly, it can be considered as already being in flux with data and non-data processes, a field upon which Marianna's practices become hybridised between maps and spaces (cf. Del Casino and Hanna, 2005) and the digital and virtual (de Souza e Silva, 2006).

Marianna's spatial practices – as well as space itself – transform her walk into something beyond the data gaze of aggregation, triangulation and analysis. This is not a case of gathering data, and looking back on it as a way to track her fitness levels and speed. In the moment, when it inserts itself into Marianna's everyday walking practices, it works between her own assessment of 'fast enough' and 'far enough' by providing data for her to establish, support and resist the role of Spatial Big Data in her life. Here, there seems to be more data sweat than actual sweat – yet the data she shows me only reveals half the story.

The way in which space and time have shaped the experiences of navigating in space, finding where you are, losing histories and being denied access to certain places indicates that space and time are important socio-cultural phenomena that produce power and discourse, as much as they reflect it. To reconceive of space as a transforming object, imbued with potential but also conflicted with a priori discourses, apparatuses and structures, brings to the fore the discontent with the way in which data discourses structure knowledge and lived spaces. In postcolonial contexts, this reframes the database and Spatial Big Data practices as the latest iterations of historical spatial ordering practices produced through colonialism and imperialism. Marianna remains distracted and the data seems an absurd reduction of the uneven textures of Marianna's experiences to geo-data, numbers and lines – failures in the informational eyes of the app. Furthermore, the information on the app holds her interest somewhat less than the spatial fabric of the landscapes through which she walks and her unhappiness at declining averages does not entirely deter her from her detours. Instead, the data blends oddly with Marianna's subliminal and esoteric paths – and so, after stopping to smell the flowers, we set-off again, this time at a slightly faster pace.

From Marianna to the four provocations that follow, this 'moment'-based analysis of Spatial Big Data in mobile mapping makes a number of suggestions: first, there exists a priori a volume of spatial experiences formed through the weaving together of space–times that run through, alongside and contrary to Spatial Big Data; second, in modern cities, Spatial Big Data has a discursive history rooted in the western logics of cartographic reason which mesh spaces, people and representations together in very specific but limiting ways; third, Spatial Big Data cannot be a neutral epistemological agent because such interactions have textures that shift and transform as various discourses irrupt, subside and cause friction, (especially in postcolonial contexts) and finally, that even though global discourses like cartographic reason and their associated data-based spatial logics continue in and beyond moments of irruption, these moments, even in their most banal, are important precisely because of the previous three points.

In refocusing Spatial Big Data practices into the spatio-temporal, the everyday and the postcolonial (and specifically in the context of mobile mapping), these moments also question the impact of this fixation on data: to what degree is Spatial Big Data actually reshaping everyday practices? In understanding how Spatial Big Data operates in these provocations, it is important to decentre data logic and to give voice to alternate and differential narratives of what happens. Each of the moments described here are impacted by the manifold relationships between data logic, cartographic reason and space, yet, the problems posed by the data-fication of space are solved in novel ways involving complex mental triangulations, social interactions and ordinary reticence.

The wider problems – those of colonial discourse, encroaching privatisation of public spaces, cultural inequality and subjugated knowledges – are also revealed to be more complex than a simple issue of Spatial Big Data captured through mobile phones. This then, in part, is accompanied by a secondary

set of questions about our role as researchers and commentators: by centring on the capabilities of Big Data and by tracing how impacts everyday practices rather than asking the inverted question of the how it does *not* impact everyday practices, are we too capitulating to the terms of debate and by placing Spatial Big Data at the forefront of any kind of analysis we might do, to what degree are we already predetermining the predominance, the omnipotence and the ubiquity of data logics in everyday lives and obscuring other ontological and epistemological practices (Burns, 2015)?

Lost in connection: Daren finds himself

The GPS signal does not work in Hong Kong, Daren explains, because the buildings are too tall and the city is too dense. Moreover, he tells me that he turns off the GPS function because it drains the battery on his phone, so most of the time this does not matter anyway. However, today, Daren is struggling. We are in Central on Hong Kong Island, standing along the busy and bright Gage Street, surrounded by the wet market. Daren is using Google Maps to try (without much success) to figure out the easiest route to Soho, further south on the island and up the hill towards the mid-levels (Figure 2). That part of Soho is quite particular: it has a few art galleries and some graffiti walls that Daren would like to show me – and so, standing with skyscrapers vertiginously looming overhead, he tries to determine where we are, so he can show me the path we need to take. Like the back part of town where Marianna and I found ourselves walking quickly (and slowly, and sometimes not at all) in Sydney, this part of Central is peppered with tiny alleys, laneways and streets that are not much wider, and perhaps generally more narrow than those in Sydney.

As Daren taps on the screen, working between the Google Pinyin that latinises the Traditional Chinese characters, and the cartographic interface as it jumps from one location to the next as he tries to pinpoint our location, it is clear that the slippage from cartographic reason into data logics is specific not just because it enables spatiality to be quantified, but also its augurs computability, as routes are calculated, locations determined and users tracked. As both sets of logics become combined in Spatial Big Data – Cartesian coordinate systems are not useful merely because they combine algebra and geometry according to a single fixed point – but rather because they enable space to be calculated according to a universal system (Farinelli, 2000) and for other kinds of information to then be spatialised.

Between language, taxonomies, images and geometries, *emergent interoperability* (Laurier et al., 2015; Mendonça et al., 2007) ties discourse and knowledge together *in* space, creating data language systems and syntaxes so that databases containing different sets of information can be combined (Bishir, 1998). Locational data is a part of an integrative process whereby information is gradually and axiomatically spatialised through (often obscured) geo-tagging, georeferencing and checking-in to sites – all of which is catalogued through geographic databases and information systems. By geo-tagging places, *place* can be situated on the coordinate plane, and then calculated in relation to other places under a single unified semiotic system. The ability to do this is foregrounded by the way in which philosophical systems may be interoperable, or not, and whether there is a harmony or disconnect between ways

Figure 2. Daren searches for his location on the phone, with the Graham St sign in the background.

of thinking – for instance, between geometry, reason and order, or real estate, space and the urban plan. This can be seen in a heuristic that Zook and Graham term 'DigiPlace' described as a mixing of 'mixing of code, data and physical place' (Zook and Graham, 2007: 1326). DigiPlace has three main components which characterise its usefulness: automation, individualisation and dynamism. In this way, it also reflects the major changes more generally found in geographic mobile phone applications: an automated, personalised environment, which is constantly updated, sometimes crowd-sourced and needs few skills to read.

Daren's eyes dart about, staring at market stalls, restaurants and grocers nearby. As they bustle with people, he explains that he is trying to find a shop or building near us that he can look up in Google, and it will show him where we are. There is no GPS, so he is using the location search function to negotiate between the database of DigiPlaces on Google Maps and the surrounding streetscape, with its haphazard shops and ramshackle architectures. Central to Daren's difficulty is that Gage Street is simply too long for him to easily find the precise location. When he inputs the search term 'Gage Street' into Google Maps, the pin keeps landing somewhere up the road and so, in this instance, knowing the name of the street does not help us find our coordinate location. Yet, DigiPlace with its ties to Spatial Big Data also relies on particular axioms, a hierarchy and typology of places that do not necessarily take into account cultural and spatial contexts. As this continues, Daren's inability to locate his own position becomes a complex triangulation between the places he sees, the phone, and the geographic place database that upholds the mapping interface.

Furthermore, Daren has a foundational distrust in the translation between Chinese and English street names – because maps on mobile phones are still largely based in written language (scripts, not sounds). The naming of streets in Hong Kong happened haphazardly between English and Cantonese. Sometimes streets were named first in Chinese and then Anglicised and at other times, vice versa. Efforts were made several times in the 19th century to homogenise the toponymy, primarily so that foreigners could communicate their destinations in English to Chinese cab drivers. But this was never a complete process, and the difference between the languages maintains a contemporary consternation that erupts in the negotiation between the dual databases of geographic names – in traditional Chinese characters and in the English Latin alphabet. This has led to a hodgepodge of inter-lingual transduction, where sometimes names are metaphoric and sometimes phonetic translations. Problems in translation have been transposed into incompatibilities in common script coding languages (Unicode, for instance) where Romanised alphabets like English do not work easily with the Traditional Chinese character set used in Hong Kong. To work between this, Daren is using Google pinyin, a Latin phonetic approximation of Chinese words, hoping to bring up the correct character that he is reading before him – but he cannot seem to find it.

Here, in this moment, the discursive structures of Spatial Big Data result in a cultural leap between the digital, global database of Google locations and the ad hoc and vernacular shops in the wet market. Daren attempts to bridge this gap by guessing which sites might exist across both the digital and material planes. The problem is that the curators of the Hong Kong Google database do not agree with him about what places should be important (such as the small restaurant where we just had lunch) and so he is increasingly absorbed and irritated by his battle with the map. He patiently enters and re-enters in the names of the local restaurants and shops that surround the remnants of the Central district wet market – and he begins to get frustrated when he keeps coming up short.

In everyday moments like these, what matters is not so much the sheer volume of the data involved, but, following boyd and Crawford (2012), the patterns which can be established and the connections that can be drawn between that data. In short, Spatial Big Data is important precisely because it can be aggregated and correlated, spatially and often erroneously, and calculated to auger certain specific information containing a certain value. Sometimes, as is the case with Marianna, through personal data, information about exercise routines, consumer habits and leisure activities can be aggregated and connected with technologies embedded in the landscape to allow access to the spaces and places. Yet, on occasion, the allure of Spatial Big Data and its promises of calculability through interoperability also overshadow other ways of knowing – a phenomenon in which cartography has been complicit in producing and reasserting particular world views of territory, space and time (Crampton, 2011). As the Spatial Big Data(base) represented through the map fixes Daren's attention, it may be that his earlier experience failing to find the correct position on Gage Street has shifted the authority of the map from streets to places in Daren's mind; or that the spectacle of finding himself on the map is consuming and pleasurable; or that he wants to use the map for the purpose of this ethnographic exercise; or simply, that he is extremely short-sighted but he does not notice the street sign for Graham St lying easily before us, pointing out the crossroads.

Thus, the view of interoperability may be limited to the epistemological agents which allow this process and blinded to other kinds of information. As noted earlier,

interoperability requires discursive and linguistic compatibility in order to work, and as we see here, this also extends to semiotic and cultural compatibility. This is still a work in progress when it comes to the multicultural toponymy in Hong Kong, auguring myriad and vernacular mapping (Gerlach, 2014) practices that engage Spatial Big Data in undefined ways. Daren's spatial exchanges are a discursive struggle: the Google database (and indeed Spatial Big Data) does not see the world the same way that he does, and so it is he who must adjust his own reading of the urban landscape to suit the hegemonies underscored by Spatial Big Data. This is further reflected in the bias of Google Maps towards official chain stores and restaurants against local and independent market stalls and eateries that Daren attempts to type in to the Google Maps interface.

More broadly, this momentary conflict also troubles the potential for total omniscience, and thus, omnipotence of Spatial Big Data, data logics and even cartographic reason. In this moment of failed negotiation, Spatial Big Data becomes *undone*, if only temporarily. For those lauding or critiquing the rise of Big Data in spatial form, when the fallibility of data logics is revealed – through Marianna swindling them or Daren struggling to interact– their power structures are laid bare. Here, in Daren's futile attempts, we can both see how Spatial Big Data does and does not work; when and where it loses jurisdiction. The provocations of both Daren and Marianna's experiences suggest that the totalisation of spatial practices under data logics, even for people who own phones and use maps, is not a complete project. Despite clear stances within critical GIS against binary oppositions in spatial data, especially within participatory map-making communities (Cinnamon, 2015), there still remains an ominous and unresolved concern of the discursive practices of spatial data that have been informed by a long history of binary thinking, on both the big and the small scale. Cinnamon (2015) states that it is time to move on from these binaries: in response to which these provocations suggest a return question – are we ready to move on? Binaries continue to emerge in mobile mapping and to be embedded in Spatial Big Data. Dialectics of unresolved conflict, discursive disharmonies and multiple vantage points read and understand the same Spatial Big Data experiences. Where one conclusion emerges, so too do others with equal ferocity: sometimes inverted, sometimes suppressed and silent, sometimes haunting shadows, a multiplicity of experiences and practices. Eventually, and not without some despair, Daren makes his way through the misconnections of interoperability and eventually gives up. He has found roughly where he is on the map on his phone – or at least an approximation of his position some 50 yards down the road at the restaurant that sells yum cha for lunch.

The illusion of accuracy: Tanija questions everything

Tanija needs to go to the Apple Store on George Street in Sydney, and she thinks she knows the way. George Street forms the main spine of the Sydney CBD, yet as we walk down Clarence Street, and weaving between other parallel streets, I suspect she has chosen a rather complicated route (Figure 3). Like Hong Kong, the Sydney CBD is dense with skyscrapers, and it is nearly impossible to gauge a visual path through the city from A to B, unless you find yourself facing down

Figure 3. Tanija walks down Clarence Street, pointing toward the salsa studio.

one of the few long streets that structure the north-south axis of the city. Although it is one of these streets, our path down Clarence Street is not the route that Google Maps would suggest. Before we left, Tanija searched for a route using Google Maps, and the blue line that forms the navigational path directed us onto George Street and through the centre of the Sydney CBD where we would have eventually stumbled upon the Apple Store. Instead of following these directions, Tanija has decided to rely on her memory and is now attempting to differentiate between cross-streets with the hope that she will pick the correct one of the 10 or so that lay before us and we will not go too far. However, when I ask her which way we are going, her wayfinding is more intuitive than well-rehearsed as she transitions between several familiar landmarks, including a salsa studio on Clarence Street and a pub where her cousin used to work (she thinks).

Tanija remembers where the salsa studio is located on Clarence Street because she encountered significant difficulties finding it the first time. To show me, she pulls out the phone and opens Google Maps. Even then, she continues to struggle through her saved locations on the phone. Walking and talking at an incredible pace, Tanija seems unwilling to give her full attention to inputting search queries and trying finding the studio on the map – much unlike Daren. Eventually she finds its location, but settles for having the 'blue dot' on the screen to approximate our position and then pointing at the studio as we walk towards it.

Tanija's story is one which sheds light on the hesitant relations that form between spatial data, embodied space and calculative ways of thinking. Elden (2006), writing on calculation, suggests that technology depends on its ability to be *used*. In the context of Spatial Big Data, we may say that although size is emphasised in the rhetoric around Spatial *Big* Data, more crucial to its appearance is its ability to be used to compare, aggregate, subtract and multiply – in short to be deployed – to comprehend geographic or spatial phenomena. As Tanija stares at the blue dot on her screen, myriad calculations defining our position on the map, it becomes clear that it is not so much the descriptive knowledge of where she is that is useful for Tanija, but that she can *use* that information to navigate, to describe or to explain. Furthermore, in this moment, there is a muddling between the structure of the calculative discourses which produce the blue dot on the screen, and the spatio-temporal processes by which Tanija understands where (and how) she is. She explains how, when she was first trying to find the studio, the calculations failed to follow her position closely enough (presumably for the same reason as in Hong Kong – the density and height of the surrounding skyscrapers blocks the signal), resulting in her 'walking past it three times'. The second time, when the blue dot stopped updating and then suddenly skipped and showed that she had wildly overshot her mark, Tanija says:

> So it's got, like, this little dot and I walked past it and I was like, no no no, I didn't see it because I'm like looking for [street number] Clarence Street, and so I walked past it and then, it takes so long for your little thing to catch up, so it kind of jumped and I was way past it, and so I thought, shit, it's behind me. And then I was like, well sometimes it's really inaccurate so I'm like is it actually on this side of the road - no no no no no, I'm just a moron.

Tanija's experience has ontological implications about the way in which existence comes to be framed through these measures, a waning separation between spaces, knowledges and subjectivities that Elden (2006) argues is symptomatic of calculative discourses:

> *Calculation* is grounded by the science or knowledge of the mathematical, and is set into power by the machination of technology.[...] This sense of calculation requires all things to be adjusted in this light; the incalculable is only the not yet calculable, and organisation is given priority. (Elden, 2006:140, emphasis added)

The logic of calculation (as Spatial Big Data appears) at the minute level, organises knowledge in such a way that, as we see in Tanija's case, it comes to frame what it is to be in a space at a time. This concerns the way in which Big Data begins to shape and define everyday existences – whether through the calculation of embodied phenomena such as calories burnt, or spatial phenomena such as location or position in space and time.

In these provocations, where we see just glimpses of the enormous data sets which structure spatial experience, the lived consequences of calculative discourses are already becoming apparent. What it means to be, the subtle discussion about the separation between ontological and epistemological grounds for thinking with respect to critical GIS (cf. Crampton, 2009; Leszczynski, 2009a, 2009b), the ontic qualities of being-in-space and being-with-technology (Richardson, 2005), become subsumed under a regime that equates being understood and being able to be located in data terms to, increasingly, only being able *to be* in terms of calculation, and if not, in Tanija's own words, well you are 'just a moron'.

The links between position in material space and on the screen of the phone that Tanija axiomatically navigates, or Daren's frustration at his digital invisibility, or the fascination with corporeal data through which

Marianna mediates her walk are examples in the several of the provocations so far where calculation becomes *semi-embodied in space*. Tanija's experience also underscores a complex relationship between spatial data, geographic data and location tracking, in which the authority of the system and the degree to which it is embodied and ontologically absorbed is dependent upon its smooth and accurate functioning. When the application works, it establishes a deep ontological relationship between the user, space and the data, in this case between Tanija and her 'little dot'. However, where calculative accuracy is undermined or disrupted, Tanija questions everything, not just the accuracy of her location but also the accuracy of the geographic data – at least until the data is proven to be correct.

Locked gates and data barriers: Ellen gets in

On the MTR map it says LOHAS Park, and on the Google Map on her mobile phone, the polygon is coloured green, so Ellen assumes there will be a park. Because of the New Year, she has an extra day off from her job as a domestic helper, but she was not allowed the full weekend. Her friends have gone on a trip to Macao, and so to cheer herself up about not being able to accompany them, she has decided to go somewhere she has not been before, somewhere green, somewhere nice. The panorama from the suspended concrete walkway that leads from the LOHAS Park MTR gives less signs of a park than of a massive high-rise housing development project aimed at Hong Kong's burgeoning middle class. As we make our way through the steel twists and turns between construction hoardings raised for the development of the area, Ellen spots a green space below the walkway through a gap in the fence. Before we reach the stairs leading down, however, we are thwarted by a locked gate (Figure 4) which can only be opened by a resident key card that contains the requisite informational data – name, address, ID number.

Because digital, spatial data logics and languages are inherently numeric, calculative and geometric, the Cartesian vision now has increasing semantic unity: in digital devices, the number forms of cartography (geocode) can operate according to interoperable logics with numeric economic systems, government systems of identification, technological systems (code, algorithms, IP addresses, signal codes) and spatial systems (such as alphanumeric street names and street numbers). The everyday manifestation of such large-scale interoperabilities makes itself known in each of the provocations so far, and in this moment with Ellen, even where mobile maps are not being used, data logics still permeate spatial order in a modus operandi akin to cartographic reason. Gating spaces like parks to those who have pass cards (or those who are able to cajole their way in) operates on a level of personal biopolitically controlled access, regulating what spaces may be occupied by whose bodies (Thrift and French, 2002; Harvey, 2003). In Ellen's case, this is directly linked to class and hierarchy in a city where private and public boundaries are blurred (Solomon et al., 2012), and identity is directly linked to access to places and spaces. This interoperability is also reflected in less obvious shifts in practice where, for example, Daren is, in his own words, looking for a place 'big enough', or adequately institutionalised enough by Google to appear on the map or the tacit conversation that Tanija has with her map as she walks up and down the street trying to figure out where she is.

As Ellen and I stand at the locked gate of a park we can see, but cannot access, context is hugely important – especially alongside controversial claims that the spatial knowledge hierarchies upheld by data logics are a-contextual. For instance, Haklay criticises GIS as laden with unrecognised political structures and hierarchies of knowledge (Haklay, 2013), much like those we came across with Daren, DigiPlace and the wet market. This is not to say that this aversion to criticality is a foundational component of Spatial Big Data and Spatial Big Data methods. Rather, it is to argue, like Haklay, that the political dimensions of databases when they become materialised and embedded in spatial access systems cannot be ignored – especially in the visceral moments in which they create new inequalities between who is included and who is excluded reified in metal gates.

Ellen, however, is undeterred by her brief setback at the secure gates. Instead, she turns right, dragging me along and starts walking towards one of the tall glinting skyscrapers nearby to see if she can ask if there is another way into the park. LOHAS Park is a series of steel and glass residential high rises forming a curved battalion standing above us, connected by the raised walkway upon which we stand. Ellen refuses to use the data on her phone to check the map to see if this is in fact the park, or if this is just part of the mirage of contemporary gated communities. When I ask her why she will not, she smiles and appears a bit confused at my emphasis on the map. Normally, she says, she just asks people nearby, even though, in Hong Kong, this often puts her on the wrong side of gated space. Once we reach inside the lobby, she is less than politely refused: if she wants to have a right to this space (both in the lobby and the park), then she needs to be a resident.

This provocation and the others here may well be outliers in the geographical datasets of the world, blips in the petabytes of information that can be correlated together. But what they do underscore is an ideological

Figure 4. Ellen approaches the gate to the park.

tension between ways of thinking and doing, and the potent limitations of Spatial Big Data in everyday settings. Interoperability and calculability is also a question of accessibility: data needs to speak the same language as other data in order for it to be aggregated, otherwise gates remain locked and mobile cartographic apps do not work. Furthermore, data logics and languages need to function at every scale, from the minute line of GPS data to the massive datasets transformed into visualisations and maps by spatial analysts, in tune with Leibniz's universal system of philosophy and his work on binary (Elden, 2013). However, people and space do not yet exist as pure data, hostage to the geometries of power that structure the world. The apolitical desires for interoperability by spatial scientists (cf. Goodchild et al., 2012) have diverse impacts on everyday socio-cultural and spatial practices like mobile mapping, and so their resonance with less apolitical commentators like Anderson, whose claims at the beginning of this article still ring with Boosterist, positivist vigour, should give pause for breath as their shortfalls become embodied in everyday spatial lives.

As Ellen is hustled out of the lobby by the door man, a local resident accosts me (presumably as I am the palest person around) because her daughter needs to interview 'a tourist' for a school project. After asking me some questions about what I enjoy in Hong Kong, she asks me what Ellen and I are doing in LOHAS Park since it is not a heavily touristed area. Ellen explains that we are looking for the park that was promised on the MTR map. The woman explains that there is no park, save for the gated one and the gate is the only way into the garden. Yet, there is a qualifier – since I have answered her daughter's questions (and possibly because I hold a cultural capital not accessible to Ellen) she offers to let us to the park, exchanging my 'tourist' data for the school project, for her key-card data to open the gate. Here, interoperability once again ties spatial discourse and politics together. Only one half of Ellen's story is based is data, but already we can see how exchanges of cultural and spatial capital are increasingly being mediated by spatial technologies and technologies in space. An exchange, as it operates in conversation, becomes an exchange in terms of data. Interoperability is materially and semantically evident in this moment, significantly in the structure of fixed-location urban landscapes, such as electronic barriers. It is also evident in the other moments – in 'DigiPlaces' and satellite towers, and their communication with mobile identification systems such as ID cards or geographic databases such as digital maps on phones.

Spatial Big Data is evident in each of the moments discussed thus far, and none of them are untouched by these emerging relationships in both contemporary and historical forms. Furthermore, Spatial Big Data creates a hierarchy of places mirroring Google search rankings, quantifies spatial experiences and bodily movement, determines who gets to go where, and whose history gets to be remembered, irrespective of lived realities, and regardless of the everyday use of mobile technologies. When we consider Spatial Big Data beyond 'big' and beyond 'data' (as terms ultimately limiting in scope), we can begin to understand how Spatial Big Data is not an axiomatic presence of data, nor any particular obligation to massive data sets, but rather, inculcated with recent iterations of epistemological and ontological phenomena that are deeply political, situated, historical and imperial. On the user end, rather than the app end, the interoperability in Spatial Big Data of data logics, digital languages, coordinate

Figure 5. Sarah walking under the Moreton Bay Figs in Hyde Park, Sydney.

systems builds what Gunnar Olsson and Ole B Jensen (in Olsson, 2007) call a 'geometry of power'. This is a political ordering based in cartographic reason (Farinelli, 2000) which reaches into spaces beyond an immediate association with data and maps. With this in mind, it is important to note that, despite the 'labyrinth of mirrors' (Guarrasi, 2001), created by the toponymic misnomer on the MTR map, and misleading green graphical representation on the Google Map which have lead Ellen on a merry chase, an odd exchange of differential data means that Ellen gets into her park: my data about my international mobility is exchanged for the ID data, registered in a card that opens the gate to let us into the park. This unexpected exchange at once reinforces how data can structure and assist segmentation of space according to wealth and class, but also at the same time undermines the data-based spatial control by offering an off-grid exchange between people.

Conclusion: Outside spatial data: Sarah does not know

Hyde Park lies in the centre of the Sydney, bordered by three train stations on the City Circle line and connected by a long avenue running along its centre axis flanked by well-matured Moreton Bay figs. I am walking with Sarah, a young Aboriginal woman, on her way home from work. The light sneaking through the dark boughs of the trees scatters across our faces, as we dodge workers from every side of the city racing along the geometric routes to get to the most convenient train station. Gesturing up towards the trees with her chin, Sarah reflects that the figs were planted here during the construction of Hyde Park, a kind of refiguring and revisioning of the original arid sandstone landscape of the Sydney Basin to resemble the well-ordered parks of England (Figure 5). In Sarah's interpretation, the neat geometric layout of the park becomes a material reminder of colonial processes – a ghost that appears as evidence of what Avery Gordon calls haunting, of 'seething absences and muted presences' (Gordon, 2008: 21).

This concluding moment is a more delicate example of how, beyond data, scientific *authority* can erupt in everyday lives, accelerated by conversations that forget the stories of people and spaces in lieu of abstracted calculability and interoperability. The same epistemic authority lent to both Big Data (Burrows and Savage, 2014; Schuurman, 2000) and to cartography (Harley, 1989; Pickles, 2004) is underpinned by the philosophical and scientific predilection for calculation (and calculative epistemologies) in social and cultural arenas. The expansive authority granted to 'scientific' forms of knowledge since the 18th century has already been discussed at length in postcolonial studies as a political and colonial expansionism (Said and Rose, 2003), as well as by Foucault (2002a, 2002b) as an ordering, ruling and bio-political discourse. In both these contexts, the epistemological authority that numbers have borne is also a political authority that privileges calculative, data-driven geographies (Crampton and Elden, 2006) – an authority which everyday users must negotiate and meet on those terms with embodied and ontological consequences. Furthermore, those who resist and dispute the discourses of authority – in Tanija's terms end up being just 'morons'.

In Sarah's case, this is shaped, at least in part, by the representation of space in a systematic, scientific and rationalised manner. From Ellen to Sarah, simultaneously spatialising data and datafying space engages a

geometry of power across places, in different histories and alternating (post)colonial contexts. Away from mobile phones and away from the interfaces that represent Spatial Big Data to us, the same discursive modes of thinking can be found embedded in space, enacted through technological and human agents (if they can be considered at all distinct). The discursive interoperability of these geometries of power become retied to the authority of data logics, linked at once to the very real and visceral, but also digitally invisible emotions that erupt through spaces: in Sarah as she sees the callousness of colonialism, and in Ellen as she refuses to believe that the gate means that the park is off-limits.

Cartographic reason links the authority of Spatial Big Data to deeper roots in ontological and epistemological calculation: a history of reason, not just a history of data. The role of the cartography, survey and the census in categorisation, calculation and subsequent control of space is evident in the choropleth mapping of 19th century London by Charles Booth, and the census data (spatialised by residence) that Dalton and Thatcher (2014) argue are predecessors of what we now recognise as 'Big Data'. As these conceptual frameworks evolved over time, the practices of order and reason that they augured became founding philosophies of imperial and colonial expansion. Now, in Sydney and Hong Kong, we can see these philosophies converging into everyday mapping practices through the control of information, of navigation, of placemaking and access to space. When we consider this in contemporary terms, it is possible to see how the history of data technologies (from mobile technologies to automated identity systems) is embedded in the imperial relationship between data and cartography.

Moving through Hyde Park, no breeze brushes against our faces. Earlier, standing at the gates of Hyde Park at the intersection of Market and Elizabeth Streets, Sarah stared at the art nouveau style of St James underground train station and described how she only ever uses Spatial Big Data in app form if she needs to be somewhere on time. Otherwise, the particularities and power of cartography and data logics did not matter – to quote: 'If I've never been there, then it doesn't exist in my mind'. As we discuss the landscape, Sarah's disquiet about not being able to have as much knowledge as she would like about Aboriginal spaces and stories from the Eora in Sydney becomes apparent. Sarah is from several hundred kilometres away, and so she does not know these stories. She has heard whispers about a burial mound near Central Station, but that is not something she will confirm – secrecy is a kind of power in itself, to struggle against the discursive desire for global knowability. Under the terms of Spatial Big Data, Hyde Park exists as series of coordinate locations – local businesses, points of interest, bus stops and train stations, waypoints left by phones whose GPS trackers have not been turned off, statistics about who checks in and out, and geo-tagged photographs, tweets and status updates. Outside of this scope, through Sarah's eyes, this visibility is marked by the seething absences of the stories of the Eora who once were custodians of this land that have been lost as a part of this process, and the muted presences of the battles fought between two irreconcilable landscape imaginaries. Colonisation has changed this space irreparably, overtaken the landscape with cartographic discourses that draw straight avenues and plant-ordered rows of trees. This kind of space is more interoperable under cartographic reason because the discourses that created it are more amenable to cataloguing, calculating and control. Furthermore, the data positivism that has overcome much of academia (where major proponents welcome the role Big Data plays in continuing to frame the terms, the scope and the outcome of the debate), washes over a phenomena that has become increasingly progress-driven, profit-driven, number-focused and quantity-obsessed (Sui and Goodchild, 2011).

In postcolonial contexts such as Hong Kong and Sydney, this power has historically been enacted with particular brutality on both landscapes and those who inhabit them: brutalities that we can see in Ellen's disappointment and in Sarah's sadness at lost stories. In contemporary iterations, this authority sandpapers against the vernacular knowledge of each of the people in these stories: where Ellen is locked out of the park, Daren cannot find a local place, where Marianna tries to maintain a certain speed, Tanija chases the skipping blue dot, and now, where Sarah tries to keep secrets. Tension, friction, irritation and ordering are abundant as Spatial Big Data is navigated in everyday moments.

As users, we see just glimpses of the enormous datasets which structure spatial experience. Yet, as Sarah and I walk, it is already possible to uncover the lived consequences of Spatial Big Data as our everyday lives increasingly become rationalised under the authority of calculative interoperability. It becomes more complicated in forms of Indigenous and postcolonial counter-mapping where the desire to be heard often means relenting to the epistemological structures favoured by those in authority (Louis et al., 2012; Sparke, 1995).

The knowledge once held by the Eora, the custodians of the land where Sydney now lies, about the sites where people went and lived has almost disappeared. Now, the oral, visual and spatial knowledge of fishing and hunting grounds, of walking tracks and camp sites and sacred spaces cannot be recovered

except through further encroachments and colonisations via archaeological digs or anthropological investigations. And now these stories are drawn over by the (omniscient) and dismissive eye of Spatial Big Data. As the tangled tendrils of space and memory become interoperable with cartographic reason and Spatial Big Data, the ideologies of calculability and reason (as they have operated in colonial histories) become mobilised at the personal level.

But data logics, here, do not appear to promise a resolution. There is no database, no app, no coordinate system or identity card, no lived and recorded data, to my knowledge, or Sarah's, that will tell her if, at any moment, she may be unknowingly trespassing on a sacred site – no less sacred due to the changes in the landscape. Sarah's own spatial discourse sits adverse to the rationalised way in which geographical knowledge (Gregory, 1994) is structured, and that worries her. The problem, she says, is a matter of rights – that white people are obsessed with their right to know things and to do things and to use this information to own and to build things – and that means that in Sydney, at least, property is more important than the past, and knowledge is only valued if it has a usefulness under the terms of calculability, interoperability or profitability. Data is more visible than secrets: over time, different configurations of governments, planners and developers have all but erased one history and landscape, along with its original custodians, and replaced it with other data forms that are more taxonimisable and calculable, more interested in quantifying than qualifying spatio-temporal relationships and the people who live in them.

Like many papers past and future, this article too ends with a call for further research. The five provocations above, established from miniscule moments, pulled out of hours of ethnographic video data, can only represent a drop in the ocean of situated knowledges that shed light on how Spatial Big Data functions, structures and disappears in social–spatial interaction. Where Zook and Graham (2007) argue that Google's geographic ambitions are fundamentally restructuring and reordering place by analysing Google search rankings, what we see in the provocations above is that the interoperable logics of big, geographic data ever more rapidly scale from the massive to the minute and the social to the personal to produce new calculable territories of bodies, subjectivities, experiences and ontologies in automated and algorithmic ways. The lengths and depths to which interoperability acts as a Rosetta Stone between the spatio-temporal, the discursive and the bodily is the subject of a much larger research project. How Spatial Big Data is reflected in a long history of interoperable epistemes and discourses and how it establishes its own authority through calculable epistemologies and ontologies, a bigger project even still.

These five moments are five provocations for the way in which Big Data and associated discourses are understood to intersect with everyday life. They do not all involve mobile mapping, or Big Data in the conventional sense. Rather, they question the totality of the information economy and cartographic reason by looking beyond and around it – reimagining the epistemological and ontological constitution of Big Data spaces. In these stories, the totality of calculative knowledge is revealed to be limited: data works to either reduce the textures of experience to coordinate positions on generic map interfaces or if such a reduction is not possible, experience is ignored completely. Missing components are revealed, in these cases appearing as the unwillingness of the user to fully engage with the app, interruptions of the satellite signal or the realities of social inequality. And so failure too casts light on these limitations (Hind and Lammes, 2015) where in each of these stories, the fallibility of data is both ideological and functional. The calculability of space and bodies, informational authority of Spatial Big Data and data interoperability sometimes do not work, and at other times, we find that they simply cannot fulfil the universal expectations with which they were underwritten. These moments also cannot fully answer the questions laid out at the beginning of this article – indeed, such an undertaking must be on a far larger scale than it would be possible to achieve here. Instead, what they hope to do is provoke possible ways to think differently about Big Data and how it is theorised. However, there *are* things that we can say at this end. Big Data has many applications and many positive aspects in producing knowledge on a massive scale, to inform good policy and help us understand relationships in the world. At the same time, its scope remains limited, because people do not solely live their lives in a Big Data world, and so a lens chosen to sharpen certain kinds of information will always be short-sighted to others.

Errors, faults, failures and miscommunications mean that the stories spatial Big Data can tell us about how and why it works are poorly punctuated: it struggles to establish its own context, even in the face of functioning technology and maintains an intermittent authority with those who use it. It does not fully shape the ontological and epistemological lived worlds of everyday users, who adapt, ignore and resist its calculative confines. Finally, in interoperability of discourse as well as language, we can begin to see that spatial Big Data is not necessarily as neutral a player, nor as 'dimensionally agnostic' (Anderson, 2008), as early proponents hoped. It restructures spaces and bodies by linking them to other discourses of power, economy and

technology, it is used to restrict access to some, while allowing others in, it creates hierarchies of much-needed visibility for some places, while for others, it ignores them, and in some cases, the stories, the moments and the lived experiences which do not and cannot be underwritten by data discourses remain absent, off the map and in small moments of Big Data.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The research leading to these results has received funding from the European Research Council under the European Community's Seventh Framework Programme (FP7/2007-2013)/ERC Grant agreement no 283464.

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