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### **Introduction**

Data have consequences. The nature of these consequences is the outcome of peoples' interrelationships with the complex socio-material conditions they encounter as they think about and work with data. These relations frame peoples' engagement in practices of data production, processing, distribution and use, as well as their efforts to enable and restrict their own and others' data practice. At different sites of data practice and data governance, we can observe forms of data culture begin to coalesce in response to the socio-material conditions encountered by participants. These data cultures influence whether and how data are produced, processed, distributed and used; they shape what can, and cannot, be viewed through an informational lens, as well as the particular qualities of that lens. They shape the "material properties" of data - their persistence, durability, spatiality, size, mobility, etc. (Dourish and Mazmanian 2011), and influence the development of the physical infrastructures that data depend upon. Through their practice these data cultures contribute to how we understand the world around us, and to the development of material conditions of production. In this chapter, we consider what questions need to be posed of the emergent data cultures found at different sites of data practice and governance, and begin to explore how participants in these spaces are influencing our perceptions of cities and the socio-material conditions of their future development.

## **Big Data and the City**

In 2013, IBM (2013) calculated that 90% of all data in existence had been created in the previous two years. Significant amounts of these data are the by-product of our everyday interactions with digital information and communication technologies. For many in business, government and research funding, this is the era of big data and new sources of data and data analysis techniques that will fundamentally change how societies are governed, and business and science conducted (Kitchin 2014a). The World Economic Forum (2016) has proclaimed that such developments, in part, constitute a “Fourth Industrial Revolution”. Commercial organisations, universities, public bodies, governments and citizens are increasingly questioning how they should respond to developments within this shifting data landscape. Organisations currently face a variety of technical and labour barriers to processing these vast quantities of largely unstructured data. For many people, their priority is addressing how best to exploit these data in order to improve organisational intelligence, drive decision-making processes, and inform various other forms of value generation. However, these emerging practices of data production, processing, distribution and use also raise a multitude of complex social and ethical concerns that need to be addressed.

In cities, public and private efforts are converging to explore ways in which these data can be used to make cities more efficient, responsive and competitive within the global economy. A range of consultancy and data analytics firms, from major corporations such as IBM, CISCO and Pricewaterhouse Coopers (PwC) to smaller niche firms, are working with public authorities and other private sector organisations to assist them in extracting value from data in order to gain a deeper insight into urban dynamics, often generating even more data in the process. Across local and national government, and the wider public sector, organisations are beginning to explore the possibilities of data-informed public policy (Cabinet Office 2015), data-driven urban dashboards (Mattern 2015), and other ‘Smart City’

initiatives (Batty et al. 2012). Citizens and businesses have also demanded that data held by governments and public bodies be 'opened' for them to access and re-use so that they can develop their own information resources and applications using public data (Bates 2013; Kitchin 2014a).

The rationale behind many of these initiatives tends to be based upon a series of assumptions regarding the contribution data can make to developing and growing urban economies and improving the quality of life in cities, often with the intention of enhancing the city's competitive position in relation to other urban centres (Hollands 2008).

Developments often aim to improve the management of a range of socio-material aspects of cities from democratic engagement to public transportation. Investments of time and money are being made by businesses and public bodies in order to explore how best to draw out these, and other forms of, perceived value.

Within universities, academics are being called upon to join these efforts through engagement in collaborative and interdisciplinary projects that aim to develop insight through data, and in some countries significant investments are being made to tackle a perceived quantitative skills deficit amongst social science students and researchers (British Academy 2012). In some cases, these developments have contributed to academics being encouraged by funders and Universities to take on uncritical and enabling roles working closely with politically and economically powerful agents. In other cases, academics have aimed to understand and critically engage with the underlying assumptions and methodologies of collaborators, in order to try and influence the direction of projects away from the uncritical forms of empiricism that can be prevalent in data and computational science (Ruppert 2013; Kitchin 2014b). Such collaborative efforts are important, and whilst the agency of critical researchers engaged in them is necessarily constrained by the power dynamics of the collaboration and the wider societal context (Viseu 2015), such research has the potential not

only to increase understanding about cultures of data practice and governance at particular sites, but also to become part of and influence the development of the projects they are embedded within.

## **Data cultures**

The concept of a data culture has been drawn upon in a variety of settings. In academia, the notion of a “local data culture” was articulated by Bowker (2000) in relation to the diverse range of data coding and classification norms and practices that exist amongst biodiversity researchers. More recently, the concept has begun to emerge within anthropology, with ethnographers in the Research Data Alliance beginning to document and analyse the diverse data cultures that exist within the alliance<sup>1</sup>. The idea of a data culture is also recognised within the corporate sector. For example, Microsoft has adopted the term for a series of ‘Data Culture’ workshops, delivered in partnership with KPMG, Hortonworks, and Hewlett Packard, which aim to assist data specialists in the development of ‘game changing’ data cultures within organisations<sup>2</sup>. All of these instances of the term data culture refer in some way to what others, including Kitchin (2014a) and Lauriault (2012), have identified as the different cultural norms, value systems and beliefs that inform, frame and justify peoples’ practices of data production, processing, distribution, or use (data practices), as well as their efforts to govern and shape particular forms of data practices through a variety of social and technical means. Sites of data practice and governance include small groups or teams, distributed networks, different types of organisations and other social collectives, each of which evolve their own complex data culture. Similar to Massey’s (1994) conceptualisation of space, we can recognise these sites of data practice and governance as historically

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<sup>1</sup> <https://www.rd-alliance.org/bof-session-data-across-disciplines-ethnographic-project-understand-diverse-data-cultures-practices>

<sup>2</sup> [http://www.microsoft.com/en-gb/enterprise/event/microsoft-data-culture-series.aspx#fbid=Hwa\\_58PJp9L](http://www.microsoft.com/en-gb/enterprise/event/microsoft-data-culture-series.aspx#fbid=Hwa_58PJp9L)

constituted, dynamic, open and porous. Each local data culture develops in relation to the specific ways in which it interacts with the complex socio-material conditions that stretch beyond that particular site of data practice: ‘the global as part of what constitutes the local, the outside as part of the inside’ (Massey, 1994: 5). From this perspective, a data culture can be understood as a specific articulation of socio-material relations situated within time and space. Whilst all data cultures are in some way interrelated, they are not all created equal. The socio-material conditions that these sites and cultures of data practice and governance emerge within enable and encourage some ideas and activities, whilst restricting and constraining others to varying degrees and in various ways.

Within the context of a single city, we can observe a multitude of interrelated data cultures across sites of data practice and governance located in public organisations, private enterprises, research settings, and amongst citizens. Further, the development of a city is also heavily shaped by data cultures external to its geographical boundaries, for example those of finance, corporations, government, etc. Close examination of the cultures of these sites of data practice can, in part, help us to begin to answer questions regarding how participants in these spaces are influencing our perceptions of the city and the socio-material conditions of its future development, and ultimately to uncover some of the power dynamics at play in these processes.

In order to illuminate such processes in relation to a particular data-driven initiative in a city a number of different questions might be asked:

- First, what **sites of data practice and governance** are engaged in the data-driven initiative both inside and outside the city? Where are these sites located? How are these sites interconnected? What is the relationship between them? How do data move between these different sites? What socio-material factors (e.g. policies,

infrastructures, finances, etc.) are influencing the development of, and relationships between, these sites?

- Second, what is the **data culture** of each of these sites? Who participates in each site? What are the demographics? How do participants perceive data? How do they imagine the relationship between data and the reality they aim to represent? What explicit and implicit values, assumptions and beliefs do participants bring to their data practice? What forms of value do they perceive in the data and practices they are engaged in? What are their overarching aims and how do participants perceive their practices contribute to them? What opportunities, risks, and limitations do they perceive? How do these perceptions frame and give justification for participants' data practices?
- Third, how does **power** shape relations between these data cultures, and between them and the wider socio-material context? What tensions exist within and between data cultures and how do these play out? How does the wider socio-material context influence how data cultures imagine and engage with data? Who has more or less power to shape data cultures and their practices?
- Fourth, what are the **possible implications** for how we perceive the city? How do these factors contribute to the socio-material conditions of its future development? And, who might this advantage and disadvantage?

The following section will go on to begin to explore some of these questions in more depth, drawing on illustrative examples from ongoing research examining cultures of data practice and governance in the UK.

## **Sites of data practice and governance**

Sites of data practice and governance are hugely diverse. They vary in relation to size, structure, longevity, connection to physical place, participants, purpose and, crucially, power. Important sites to consider in relation to the development of cities include those within local government, public bodies, regulatory agencies, universities, citizen led groups, and private sector data analytics firms and consultancies that are engaged in new forms of data work. Each of these sites of data practice and governance are interrelated with the wider socio-material context – an ‘assemblage’ of historically constituted public policy, legislation, political economy and various other factors that inform and shape how ideas and practices around data unfold (Kitchin 2014a).

As an example, we can observe that in the last five years groups of citizens have formed open data groups in a number of cities around the world in an effort to extract data from public authorities and use it for a variety of ends – civic and commercial. These local groups can be conceptualised as sites of both data practice and governance. They are to varying degrees interconnected with other citizen-led open data groups and networks in different locations; other types of citizen-led interest groups – including open government and transparency campaigners who have been working for the release of public data for many years; policy makers at local, national and international levels; civil servants and employees of other public organisations; research and other staff based in universities; and commercial re-users of public data and other private interests – each of which have their own different data culture and different objectives regarding the opening of public data.

In the UK, the convergence of these different sites of data practice and governance, in a broader socio-material context of technological, political, economic, legislative and policy developments impacting the management of the national data infrastructure, led to these small city-based open data groups being able to have significant influence on other sites of

data practice and governance within their respective cities. For example, the Manchester Open Data group played an important role in the development of the Data GM open data portal and a range of data-driven projects in the city. Similar observations can be made in other cities, for example Sheffield and London. However, the specific changes in local authorities' data practices, for example which particular datasets have and have not been opened, have to a great extent been shaped by other sites of data practice and governance beyond the direct influence of these local open data groups. This demonstrates that it is important to map the complex network of sites and assemblages that are engaged in shaping emergent data practices, as well as considering the influence of the broader socio-material context that they exist within.

### **Cultures of data practice and governance**

Certain ways of thinking – beliefs, values systems, perceptions – tend to cohere as a form of 'common sense' (Hall 1987) at particular sites of data practice and governance as participants work together to respond to the wider socio-material conditions they encounter. These 'common sense' ways of thinking also emerge and spread across networks of interconnected sites. However, no site of data practice and governance is culturally homogenous. Common sense is 'necessarily fragmentary [and] contradictory' (Hall 1987), and tensions of varying degrees of magnitude emerge amongst participants as they work to construct shared understandings. The depth and nature of such tensions can help to illuminate the dynamics of power within a particular site, as well as its relationship with other sites of data practice and governance, and the wider socio-material context. The nature and relational dynamics of these 'common senses' that frame and give justification for data practices, can be identified as data cultures. As articulated above various questions can be asked of a data culture, here we draw out some of these in more depth, focusing specifically on philosophical beliefs, socio-cultural values and assumptions, and how the value of data practices is perceived.

## Philosophical beliefs

Important indicators of the nature of a data culture are the dominant epistemological and ontological beliefs it has about what data represent and how participants perceive the role of people in the construction and interpretation of data. Many that work with data on a regular basis are aware of the fallibility of data produced by poor quality methods or equipment, although this level of data literacy cannot be assumed across all data cultures. Beyond basic data literacy, it is also important to examine the more subtle philosophical assumptions of data cultures, such as whether there is a deep understanding of the ways in which data are socially constituted, or whether high quality data are perceived to be scientific or objective facts independent of social and cultural influence.

How a data culture perceives the nature of reality, and whether there is an assumption that all aspects of reality are empirically observable can also be explored. Observers of sites of data practice have identified a dominant empiricist orientation amongst the participants of many emergent data cultures (Kitchin, 2014c). Philosophical assumptions about the relationship between data and reality, and how these beliefs inform practice are therefore important to unpack. For example, is a simple relationship between empirical data and social reality assumed, or is the complexity of this relationship acknowledged? Is there an underlying assumption driving the data culture that social reality in its entirety is an observable phenomenon given the correct data collection and analysis techniques and tools? Empiricist assumptions are prevalent, to a greater or lesser degree, within many data cultures, however such approaches are limited in terms of what they can observe and say about the nature of social reality (Archer 1998). In order to address questions of power, for example, the concepts and frameworks of the critical social sciences and humanities can contribute to explaining and theorising patterns observed in empirical data. The degree of openness of a data culture to such forms of interdisciplinary engagement can illuminate how participants

imagine the nature of social reality, as well as how they perceive their role as producers of knowledge, how they understand and relate to different ways of knowing, and how the data culture imagines its position within the power infused processes of knowledge production (see Gaventa and Cornwall 2008).

Of course, to recognise that data practices are the product of a socio-material context and are limited in terms of what aspects of reality they can represent does not mean the scientific knowledge they might inform should be discredited (Edwards 2010: 436-8). Data can be very accurate and reliable enough for particular purposes. For example, the high quality climate datasets generated by weather stations such as Sheffield Weston Park are reliable enough to give climate scientists a strong understanding of changes to urban climates over the last century and more (Jones et al. 2012). Whilst such accounts of reality remain partial and are an informational representation of the world emerging from a particular socio-material context, they are in many cases good enough for the ends to which they are being put.

#### Socio-cultural values and assumptions

The socio-cultural values that are part of the data culture at Sheffield Weston Park Museum weather station have contributed significantly to the accuracy, completeness, and reliability of its 135 year climate dataset. The museum curator who currently looks after the weather station, its historic written logs, and more recent digital records, takes great pride in ensuring the quality of the data produced by the station. He recognises the weather station as part of the fabric of the city, and the data it produces as part of the cultural heritage of Sheffield that belongs to the people of the city. Drawing on a cultural value system that champions public service, civic duty, scientific integrity, and responsibility to his local community, data users, and previous generations of curators who have maintained and run the station, the curator

works hard to look after the physical infrastructure of the station and ensure the data it generates abide by international standards and are as accurate as possible.

Such cultural values are not unbiased in relation to the social world, however. When they surface in other contexts of data practice their influence may not always be as benign, for example when observing the social world such value frameworks may hide unacknowledged and implicit biases and assumptions that are brought into play as practitioners produce and engage with data (Greenwald and Krieger 2006). These biases might be political, social or cultural, and can impact significantly upon what people perceive to be of interest, what they prioritise, and whether and to what extent they look for and try to identify their own and others' underlying biases. It's important to gauge how much critical attention a data culture pays to the ways in which data practices are influenced by these subtle socio-cultural assumptions that enable some forms of data production and restrict others, and how they shape what data practitioners observe and desire to observe, how they perceive the relevance of the things they observe, whether they decide to try and capture these observations as data, and if so, how they influence how that data gets produced, processed, distributed and used.

As observed across diverse fields, from cartography to librarianship, critically reading the outputs of data practices as texts can begin to illuminate some of the hidden biases at play when people produce informational representations of the world, whether they be maps (Crampton and Krygier 2005), library catalogues (Bates and Rowley 2013), classification systems and standards (Bowker and Star 2000), or other forms of information resource. Often these hidden biases go unnoticed both within data cultures and amongst users of their products. Data produced by experts in trusted institutions such as national statistics offices are often assumed to be objective and complete representations of the world (Burkert 1992), with little recognition that those data are a representation of the world from a particular

perspective. Whilst the perspective offered might be good enough to meet the needs of some data cultures, it may simultaneously be limited from the perspective others, particularly less powerful, marginalised subjectivities. As an example, it is clear that there is an often unacknowledged masculine culture driving many sites of data practice that are engaged in projects aimed at the datafication of cities (e.g. local authority technical teams, consultancy firms, open data groups, data analytics companies, and academic researchers etc.). Where such demographic biases of gender, class, race and so on are perceived in a data culture, it is especially important that critical attention is directed at how dominant subjectivities may be becoming embedded into the data and data-driven insights that these cultures are producing.

#### Perceived value of data practices

What value a data culture perceives in producing, processing, distributing and using data is also a product of its socio-material context, and will shape decisions about investments of time and money in data practices. A data culture's perception of the value of their and others' work can give insight into the underlying drivers behind data practices and forms of data governance, as well as how the data culture relates to other sites of data practice and governance, and the wider socio-material context. Different value frameworks may place greater or lesser emphasis on factors such as scientific, commercial, economic, social and cultural value of data practices.

In many data cultures, emphasis is placed upon the commercial and economic value of data practices, for example their contribution to generating private profits, research funding, economic growth, or organisational efficiencies and cost-savings (e.g. see Manyika et al. 2013; Kitchin 2014a). At some sites of data practice, for example in private firms and some parts of the state, extracting economic value from data is likely to be a primary concern, albeit tempered in some cases with consideration of social, ethical, environmental, and other values. Similarly, at sites of data governance, creating a policy environment that promotes

data's contribution to economic growth might be of central importance. However, at other sites the relationship between different value systems can be more complex, and not immediately discernible to either participants or researchers. For example, surface level political or social values may obscure underlying economic drivers, as seen in some forms of data-driven corporate wellbeing initiatives or data-driven innovations in public service design which are framed by a need to respond to deep public spending cuts. Similarly, participants in a data culture might recognise and welcome the economic value of data as important given these socio-material contexts they encounter, but ultimately see this value as secondary to other forms of value production that they are engaged in e.g. social, cultural, political. Observations of data cultures shaping urban spaces in the UK suggest that many people perceive that data analytics offers a valuable opportunity for tackling the complex challenges faced by public organisations and citizens in the context of late neoliberal capitalism, particularly the challenge of providing more personalised services, to more people, for often significantly less money.

The development of urban dashboards that present a range of quantified metrics about the functioning of a city are one way in which people are using data to inform decisions and drive efficiency savings within such a context. Whilst used differently in different cities, in some cities these dashboards are being shaped by data cultures in an effort to supplant more complex, messy and situated forms of knowledge with the cleaner, more efficient quantified metrics offered by dashboards, without full consideration of their relationship with social reality or their efficacy for addressing the complex challenges cities currently face (Kitchin et al. 2015). Similarly, some smart city initiatives aim to utilise data analytics and other emergent technologies supplied by the global technology industry in order to drive efficiencies in urban systems and management, without critical examination of the underlying

drivers for such efficiencies, or their compatibility with the development of sustainable, ecologically sound forms of political economy (Sadowski and Pasquale 2015).

Differences in perceptions of what is important and valuable across sites of data practice can also impact upon the production of data about cities, and feed into how people choose to respond to encroaching forms of 'dataveillance' (Clarke 1988). In sectors with heavily quantified audit cultures, it can be observed that the value of such data production and processing is seen differently by different actors, and that power relations between such actors play out in peoples' data practices. For example, people will fail to provide accurate data for a variety of reasons including resistance or apathy towards requests, attempts to game the system, or simply an inability to produce the data being demanded. These subtle forms of struggle and resistance identifiable at such sites impact upon the representation of social reality provided by the data they generate. Similar forms of agency are also seen when people engage in activities that manipulate the data traces that their digital devices generate, for example through selectively limiting or subverting the production of accurate by-product data that capture particular forms of behaviour. These various biases and exclusions have a significant impact upon data-driven representations of cities that are increasingly informing various forms of urban governance and decision making.

### **Data cultures, power and the city**

As data-driven insights, decision making and automation become more deeply embedded in the development and governance of cities, it is important to step back and address critical questions about what sort of future these practices are in the process of creating. The consequences of our data practices are not independent of the complex and contested socio-material contexts from which they emerge. The nature of these consequences is the product of peoples' interrelationships with the socio-material conditions they encounter as they think about and work with data. At various sites of data practice, people are attempting to extract

different forms of value from data in an effort to prosper, survive, understand, engage with, and explain the world around them given the socio-material conditions that they find themselves within and which, in some cases, are attempting to ameliorate. It is in these spaces, where structure meets agency, that the data cultures that frame and give justification for data practices coalesce.

Through illuminating the nature of these data cultures, we can begin to understand how power is being worked out in data-driven urban developments. We can observe the ways in which subtle biases and philosophical assumptions arise and advance within and across data cultures, and how they become embedded into digital artefacts such as urban dashboards and open data platforms that are increasingly being used to inform urban processes and developments. We can also recognise how different types of value framework influence the development of data practices, and better understand how the material conditions of data's production, processing and use, for example external funding priorities and the need to be commercially competitive, frame and give justification for data practices, and whether and how social, ethical and cultural factors are taken into consideration when economic considerations are driving practice.

It is important that rather than focusing predominantly on what these data-driven platforms and initiatives can tell us about cities, we also read them for gaps and silences, biases, and underlying agendas. In this way we can bring to the surface the ways in which these data-driven accounts are always partial, and always framed by both the limited possibilities of data and the particular subjectivities of the data culture that generate and process them. In so doing, we can draw attention to the data-driven gaze of these cultures of data practice, and increase understanding of the implications of such biases on the social world.

It is important to address such questions, not because the cultures of data practice are interesting for their own sake, but because they are shaping the world we live in. In asking such questions of the data cultures that are responsible for generating and using these data-driven insights about cities, we can begin to illuminate how power relations are being reproduced, disrupted, hidden, and made visible through these practices, and ultimately contribute to the development of more critical and reflexive forms of data practice.

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