Regine Buschauer:

Datavisions – On Panoptica, Oligoptica, and (Big) Data

Abstract:

In focusing on relations between data and vision and proposing to address big data in terms of currently dominant optical metaphors (and, quite literally, in terms of 'visions'), the paper makes a case for an approach that allows for clearer distinctions between big data as 'visions', and data technologies. (Re)assessing (present and past) notions and visions of panoptic data technologies, I outline three perspectives on the nexus between data and vision(s). Following Bruno Latour's counter-image of "oligoptica", I argue, more generally, in favour of a conceptual framework that understands big data as a sociotechnical infrastructure, and discuss, drawing on more recent studies, in which ways this approach allows to address social and ethical implications of present data technologies and practices in a more differentiated way.

Agenda:

Author:

Dr. Regine Buschauer

-   ✉ rebus@bluewin.ch
-   Relevant publications:
  - (Very) Nervous Systems. Big Mobile Data, in: R. Reichert, (Ed.), Big Data. Bielefeld: transcript 2014, pp. 405-436.
  - Mobile Räume. Bielefeld: transcript 2010, 361 p.

Introduction

What do we talk about when we talk about big data? Amongst the growing number of attempts to define this keyword of today's sociotechnical landscape, "Big Data" has been aptly identified as a buzzword that refers to a field who's object is difficult to narrow down and incites the (re-)introduction of metaphors – from oil and mining to footprints and data shadows – and of visual concepts. The debates on big data, and on surveillance in particular, have given rise to renewed recourses to the concept of panopticism developed by Michel Foucault (1975) based on his discussion of Jeremy Bentham's "Panopticon" (Bentham [1791]). As Tom Boellstorff (2013) pointed out, the optical metaphor provided by Bentham's architectural model of an 'all-seeing' surveillance seems, indeed, "prescient when an NSA surveillance program can be code-named 'prism'". It resonates, moreover, with habitualized metaphors used in the debates that surround data technologies, including metaphors of transparency such as the 'glass human being' or the transparent "panopticized state" (Fenster 2010), which are enmeshed with the notion of the Panopticon. On the other hand, uses of Foucault's or Bentham's concept as metaphors of a 'data society' have been widely criticized, rejected or replaced by new metaphors. Next to the revisions or modifications that have been proposed with concepts such as the "synoptical" (Mathiesen 1997) or "post-panoptic" (Boyne 2000), they have been more fundamentally challenged by Bruno Latour and his metaphor of the "oligopticon", coined as a theoretical counter-image to the Panopticon (Latour 2005).

To address (big) data in terms of these optical metaphors and, quite literally, of 'visions', as I want to propose, allows to consider some underlying assumptions that often remain unquestioned. In what follows the notion of a panoptical technology will thus be taken as the starting point of a discussion of (past and present) visions and practices of data and "datafications" with a particular focus on the relation between these metaphors and digital media and data. My aim will not be to (re-)examine Foucault's or Bentham's concepts, or the theoretical and historical issues they raise,[4] but to focus on how these concepts translate into notions of digital technologies, and in approaching big data through the 'lens' (so to speak) of presently dominant metaphors and their nexus between data and vision. This approach draws on conceptual considerations grounded in media studies as well as on more recent interdisciplinary debates on (big) data (see e.g. Kitchin 2014, Reichert 2014). More generally, I argue that the exploration of ethical and societal implications of an emerging field of data technologies cannot be separated from the question of how this field is conceptually framed and presents itself as a sociotechnical field in practice.

I will sketch out this argument proposing three perspectives on the relations between this field of metaphors and data. From a historical perspective, I will discuss relations between vision and digital data made in past visions of "smart machines" at work and their association with panopticism since the 1980s, arguing for an approach that situates big data in a history of information technology and its visions. I will then focus on these visions and optical metaphors in terms of visibility and vision, drawing on Latour's arguments in favour of a counter-image. Further developing this discussion, I will propose a perspective that follows Rob Kitchin's use of Latour's term and shifts the attention from visions of big data towards a notion of data technologies as a sociotechnical infrastructure. Based on some more recent studies, I will discuss in which way this perspective allows to address social and ethical implications of present data technologies and practices in a more precise way and discuss some findings and salient aspects of present day debates.

Visions of Smart Machines

A recent publication explaining IBM's new vision of an "era of cognitive computing" is entitled "Smart Machines" (Kelly/Hamm 2013) and directly echoes the title of Shoshana Zuboff's study published almost thirty years ago on the "future of work and power", in which she noted the arrival of a "panoptic power of

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[4] For a recent discussion of both Foucault's and Bentham's concepts of the Panopticon see e. g. Laval 2012.

information technology" in the working world.[5] Reconsidered at the light of a present 'era of smart machines', Zuboff's book provides an example of a "history of the future" (Carey/Quirk [1989]) and allows to address current visions of data technologies from the perspective of a history of visions of panoptic smart machines.

"Information Panopticons"

From the research she conducted on "smart machines" during the years 1981 to 1986 Zuboff concluded that digital information systems, "that translate, record, and display human behavior", could

"provide the computer age version of universal transparency with a degree of illumination that would have exceeded even Bentham's most outlandish fantasies. Such systems can become information panopticons that […] do not depend upon the physical arrangements of buildings or the laborious record keeping of industrial administration. They do not require the mutual presence of objects of observation. They do not even require the presence of an observer."[6]

This conclusion translates Bentham's model of the Panopticon – or "Inspection House"[7] – into a metaphor for transformations Zuboff observed in industries such as paper production, pharmaceuticals or finance. In contrast with their potential to give rise to a knowledge based 'informated' future, she argued – drawing on visions such as Daniel Bell's "Information Society" –, computerization and automation tended to generate "information panopticons". Above all they provided new ways to capture data on behaviour as, e.g., in the case of a production control system she observed in a paper mill: This newly introduced system – able to capture and store data every five seconds from across the production process – provided data from which to analyse not only the operations per se, but of the operator's performance as well. As Zuboff notes, it developed in practice into a panoptic medium 'by accident'. Another case drawn from her study concerns the communication system within a pharmaceutical company which developed from an informal communication platform of the company's research unit to a system increasingly geared towards management control, finally replaced by a more formal communication system. As Zuboff underlines, this shift was reflected by rather self-protecting or self-promoting uses of the new system "as a way of going 'on record'".[8] Such systems of – in today's terms – 'datafication' thus implied a "panoptic" scheme and an intimation to comply which Zuboff found to parallel Bentham's model of the Panopticon – the "counterpart" of Bentham's "central tower" being "a video screen".[9]

Discussing the rise of "Pervasive Computing" and the need for an "ethics of forgetting", Martin Dodge and Rob Kitchin (2007) have pointed out that capturing digital behaviour data at the workplace, under the form of, e.g., swipe cards or keystroke counts, has already been a widespread practice for a long time. Zuboff's study provides an account of these practices from the historical phase of the 'computerization of work' which she envisioned along the lines of two alternative futures (i.e. a future of opportunities, knowledge and learning, and a future of threats and enhanced control). Her study, in this respect, leads back to practices as well as to future visions of the 1980s, including such ideas of a new era of "smart machines", its promises and threats, that reappear today. Against this background, the notion of "panoptic" technologies, in Zuboff's study as well as often today, is associated to a kind of counter-image to the promises of an 'informated' future, as it were, and to a model of centralized control.

This notion, though, fails already in regard to Zuboff's observations, which include what she referred to as "horizontal visibility": Information systems could allow individuals "to see their own behavior reflected in the

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[5] Zuboff: In the Age of the Smart Machine, p. 322. On cognitive computing see also http://www.ibm.com/cognitive.

[6] Zuboff: In the Age of the Smart Machine, p. 322.

[7] Bentham's plan of the Panopticon (prototypically designed as a prison) envisioned single cells in a circular building around a central logde or tower from where a guard or "inspector" could oversee all of the cells without being seen; the "fundamental advantage", as Bentham puts it, being "the *apparent omnipresence* of the inspector (if divines will allow me the expression,) combined with the extreme facility of his *real presence*." Bentham: Panopticon, or the Inspection-House, p. 45.

[8] Zuboff: In the Age of the Smart Machine, p. 384.

[9] Ibid., p. 322.

system, while knowing that others (peers, subordinates, and superiors) could see it as well"; introducing a panopticon, "in which 'the many' view themselves and each views 'the other'".[10] Furthermore, she found that data shape organizations as a whole. An example is provided by a "cheating" case, concerning the work allocation and monitoring system of one of her study cases, in which the data was frequently manipulated (in order to meet the high performance expectations) in a practice that was shared across hierarchical levels. The point Zuboff noted as "striking" is that the system's data continued to be treated "as a legitimate reflection of the workplace". The system thus could "fulfill its role" irrespective of whether its data was known to be 'correct' or to be 'wrong'.[11]

Such examples, understood by Zuboff as reflecting an "evolution of the original concept", point towards issues that have been more broadly discussed in the light of increasingly pervasive technologies and of a rapidly emerging landscape of digital data and datafication. In Dodge and Kitchin's (2007) discussion of Pervasive Computing mentioned above, this change is referred to as a "shift from surveillance to sousveillance", drawing attention to the complementation of "external" data capture (in areas such as work, mobility, shopping or finance) by self-monitoring practices, and to the rise of a new and potentially panoptic "regime of recording".[12] Other authors have reassessed notions of "panoptic" technologies focusing more closely on the work sphere in a present "post-panopticism".

"Post-Panoptic[isms]"

"Post-panoptic" shifts have been identified in regard to changes in working environments related, e.g., to "networks of surveillance" – including social media and their connections to the sphere of work – and peer-oriented "lateral" surveillance (Brivot/Gendron 2011). They have also been related, more generally, to the potentially limitless (spatial and temporal) extensions of panoptic 'visibilities' granted, e.g., by mobile technologies. Summarizing their study of a knowledge management system in a large accounting company in the years 1999-2008, Marion Brivot and Yves Gendron stress the complexity of changes in which the "normalizing agenda" of the system was both circumvented and actively embraced while at the same time resulting in "lateral surveillance" among the employees. Similarly, in their study of mobile information systems in a smaller sized consulting company, Leclercq-Vandelannoitte et al. (2014) refer to "distributed control" and coin the term "free control", emphasizing how mobile connectivity, in the case they studied, was both shaped by and shaping a nonstop-working environment characterized by real-time control, a shared morale of coercive reactivity and performance expectations and a "new control logic, based on the total involvement of the professional".[13]

Such findings reflect contemporary 'visibilities' and a digital change that has indeed become pervasive, but that also points back to observations made by Zuboff; further examples e.g. of work-related data profiling and prediction practices add to this mixed picture.[14] What the above mentioned studies describe as "post-panoptic" or "beyond panopticism" is thus related to complex sociotechnical changes – expressed through keywords such as "bureaucratization", "normalization", or "self-monitoring" – and to a redefinition of "knowledge" as introduced by and framed within the confines of "knowledge management systems". These changes reinforce schemes of 'visibility', according to Brivot and Gendron who found that the "common denominator" of the changes studied was the "central role played by the notion of visibility – visibility to others, visibility to the self, as well as the fear or preoccupation of being visible or invisible to others".[15]

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[10] Ibid., p. 350f.

[11] Ibid., p. 354.

[12] Dodge and Kitchin: 'Outlines of a world coming into existence', p. 432; 434.

[13] Leclercq-Vandelannoitte et al.: Mobile Information Systems and Organizational Control, p. 554.

[14] An example in this regard is the claimed ability to forecast whether an employee is inclined to look for a new job; see, e.g., "The Algorithm That Tells the Boss Who Might Quit", The Wall Street Journal, 13.3.2015; cf. Kitchin: The Data Revolution, p. 178.

[15] Brivot and Gendron: Beyond panopticism, p. 153.

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From a theoretical point of view, it can be debated whether such findings indicate a "post-panopticism" particularly when one considers that "panopticism" is a term that arises from Foucault's discussion of Bentham and which already indicates a move 'beyond the Panopticon'. What is described in these studies indeed points back to issues also raised in Foucault's discussion (Foucault 1975). "Post-panopticism" may be considered more fundamentally as an ambiguous or even as a "dubious concept"[16], following Roy Boyne (2000) who introduced the term to denote the puzzling role played by panopticism he found in his survey of social theory and recent sociotechnical change. On the one hand, the concept could be considered as outdated while, on the other hand, remaining topical. Boyne's term therewith summarizes an ambivalence that can be seen in the broad theoretical debate on panopticism and in a range of newer derivative terms. As he pointed out, an increasing number of comparably unspectacular digital systems could appear to support the concept, while there were also powerful arguments against it; such as the link between surveillance and simulation, that alters the temporality of the panoptic frame; or a 'visibility' that Thomas Mathiesen (1997) termed "Synopticism", of the "few" by the "many", corresponding to a reverse panopticon.[17]

Taken together, these (more or less historical) visions and their association with different digital "smart machines", systems and practices, suggest a history of visions of "panoptic" data that indeed brings to the fore 'visibility' as the common denominator linked to, in Zuboff's terms, the idea of "universal transparency". This idea encompasses both surveillance and transparency, intertwined in a "visibility" that may be seen today, as Shiv Ganesh (2016) argues, as a "major 21st century trope".[18] As such, it underlies seemingly opposite concepts and metaphors including the 'glass human being', the 'transparent state' or, as has been critically pointed out, "the panopticized state".[19] It also underlies the characterization of the internet as, respectively; a "medium of transparency par excellence" or as something "structurally resembling a Panopticon",[20] resonating with Boyne's finding that 'somehow' panopticism is not outdated, but topical. The concluding question Boyne raised is what that 'somehow' means, and what this notion refers to. Emphasizing a difference "between actual social contexts and an updated ideal type [...] in contemporary technoculture", he came up with the idea to "draw a line" through terms such as "Panopticon"; therewith allowing this vision "to be seen at the same time as denying its validity as description".[21] Boyne thus highlighted a distinction that shifts the attention from the uses of metaphors of data technologies to the question of their vision.

Oligoptica and (big) data

'What do we see?'

Using the example of a traffic monitoring system on Paris' Boulevard Périphérique, Bruno Latour (1998) emphasized that digital technologies actually give rise to something quite different from a Panopticon, which he called "Oligopticon". The oligoptic view, he argues, "is not what sees everything, but what sees a little bit", or related to "places which have a total view under a very very small perspective". This counter-image is further described by Latour (2005) as opposite to the "absolutist gaze" and "utopia" of the Panopticon: Oligoptica, he explains, provide "sturdy but extremely narrow views of the (connected) whole".[22] Asking 'what we see', Latour thus arrives at a metaphor that puts in question the vision of an all-seeing 'panoptic' technology, associated with 'universal transparency' or a digital 'illumination', and replaces it by a theoretical and analytical concept

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[16] Boyne: Post-Panopticism, p. 303.

[17] Mathiesen: The Viewer Society, p. 218f. The principle of a reverse panopticon is also worked out in Bentham's "Constitutional Code" (1830). Cf. Brunon-Ernst: Deconstructing Panopticism into the Plural Panopticons, p. 24.

[18] Ganesh: Managing Surveillance, p. 164.

[19] Fenster: Seeing the State, p. 668.

[20] Cf. Baumann: Die schöne Transparenz-Norm und das Biest des Politischen, p. 399 ("Transparenzmedium schlechthin", quot. Zehnpfennig 2013), p. 401 ("Das Internet selbst gemahnt von seiner Struktur her an ein Panoptikum").

[21] Boyne: Post-Panopticism, p. 303.

[22] Latour: Reassembling the Social, p. 181.

that focuses on how data and datafication take place and work in practice. In their discussion of Pervasive Computing, Dodge and Kitchin (2007) draw on Latour's terminology and raise precisely the question of this difference between oligoptic data technologies and a panoptic scheme particularly associated with the emergence of sousveillance. In his analysis of (big) data, Kitchin (2014) further develops this approach. Reconsidering (small and big) data and examining the ramifications of (big) data technologies, he dissociates digital systems from an overall vision and from metaphors of transparency. The notion of data as oligoptic, in contrast, raises the question of how data – collected or captured, processed and presented in particular ways – are produced and translated into 'what is seen'. This shift of attention to data and data technologies conceptually reframes big data in terms of "assemblages" or of ensembles that make up a complex sociotechnical infrastructure. It provides a perspective on the interplay between data technologies and their intertwined technical and social implications that focuses on the practice of big data, taking into account the actually different ways in which data technologies are shaped and shape today's sociotechnical landscape.

Latour's counter-concept to the "absolutist gaze" and "utopia" of the Panopticon also questions the idea, or contemporary trope, of visibility, whether it is linked to digital data, to the internet or to computing in general. This relation is indeed somewhat dubious when considering the basic fact that digital data have little to do with vision. Although digital media include visual media (as far as this categorization makes sense),[23] neither data not computer – even the "cognitive computer", up to now[24] – are traditionally considered as having the ability to 'see', and computation is, in itself, quite distinct from vision. Visual metaphors are, of course, useful, even needed due to a lack of visibility of computing. Articles on big data make use of them, and the vision of an "era of cognitive computing", as communicated online by IBM, is presented in videos; thus contributing to a nexus between vision and computing.[25] To refer to eyes, focus or perspectives as metaphors is also a common practice, including Latour's counter-metaphor. What his opposition brings to the fore, however, is how a vision of data or computing associated with an idea of universal transparency ends up being remote from usual metaphors or images of vision. It would, by contrast, correspond to no imaginable vision and no perspective at all, but to a 'vision' (or "gaze") of data by (or to) which everything would be immediately and incontestably evident.[26] A trope of visibility associated with such an "utopian" vision and transparency would thus associate both data and vision per se with incontestable evidence. In practice, such ideas add to the risk of "data determinism",[27] a term used by Kitchin to point to social and ethical issues arising from unquestioned general assumptions without consideration of the particularities of data and data technologies, or of the particular insights they provide.

Big data as a sociotechnical infrastructure

Such considerations suggest that issues of big data may be more appropriately addressed in terms of a complex sociotechnical infrastructure, apart from a trope of visibility. The question then becomes not only 'what is seen', metaphorically speaking, but also, what is in which way connected within the dynamic ensembles of an emerging infrastructure of data technologies and practices. This shift draws attention to data in the vast array of ways in which they are part of social practices (of classification, ordering or signification), as well as to the ways in which data and data systems are – and become ever more – connected. As the examples above

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[23] Cf. Mitchell: There Are No Visual Media. Mitchell argues that, first, there are only mixed media, and, second, there is no such thing as a pure visual perception or an unmediated vision.

[24] See http://asmarterplanet.com/blog/2015/08/seeing-believing-bringing-cognitive-image-analytics-healthcare.html.

[25] Wendy Chun has emphasized the "decline in and frenzy of visual knowledge" computers – "[o]paque yet transparent" – have given rise to. Chun: Programmed Visions, p. 15. In the presentation of cognitive computing and image analytics mentioned above both, the "prolieferation of digital images (new media as 'visual culture')" and "'total information' systems (new media as 'transparent')" (ibid.) can be seen, and conflate with the topic featured – image analytics – in one video. The question 'what we see' is, here, not easy to answer.

[26] This would correspond to "digital metaphysics" following the term coined by Raffael Capurro. Cf. Capurro: Beyond Humanisms, p. 11. A further discussion of 'vision' and 'cognition' might be opened by Mitchell's reference to Oliver Sacks' "To See and Not See"; and by Bruno Latour's notion of "Visual Culture": As Latour has pointed out, a "new visual culture redefines both, what it is to see and whatthere is to see"; Latour: Visualization and Cognition, p. 9; cf. Mitchell: There Are No Visual Media.

[27] Kitchin: The Data Revolution, p. 45.

underline, big data and the social and ethical issues that arise from the field of connected data and datafication can be seen against the background of digital change and thus in a frame that differs from the "before-after model"[28] underlying some of the present debates. Drawing on studies by Kitchin and other authors, three focal points of such a frame may be distinguished, corresponding to different aspects of big data as a sociotechnical infrastructure related to personal data and data capture; to algorithms and their 'opacities'; and to the increasing number of connections between previously separate data and data technologies.

Data, or "capta" (Agre 1994), as has been pointed out by many authors, have not only become a "data deluge", but have also changed in terms of measurement and production, capture, collection, and classification of personal data. Produced ever more as a 'by-product' of activities and behaviour (from social media to smartphones, smart cards or sensors in cars), (big) "data" today refers to a variety of data, or of ways of producing data which have broken down traditional clearly defined borders. From the point of view of quantitative social science research, Plantin et al. (2015) refer to a "fracturing of the [traditional] control zone", suggesting that the "uncertainty about the provenance of data", rather than volume or variety, is the main characteristic of big data.[29] From the point of view of the individual, the capture of data by an array of applications and measurement devices results in heterogeneous 'traces' quite different from traditional notions of 'personal data', and produced in ways that depend on particular applications. What ends up being captured (or selected to be measured) how and in which framework of signification, is based on defined models and their underlying assumptions, independent from any personal involvement or conditions.[30] While in many cases data is captured without the individual's or the user's knowledge, sousveillance, or practices of self-monitoring and self-measurement on a voluntary basis, contribute in particular ways to a normalization of personal data capture – as already noted by Dodge and Kitchin (2007). Today, tracking-App's and Wearables, embedded in cultures of gamification, fitness and body-measurement, are popular 'persuasive' media that raise, at the same time, issues of the uses, the value and interpretation of the data, as well as of the thin line separating voluntary from "pushed", or even "imposed", self-monitoring.[31]

While (big) data are associated with a vision of 'transparency', big data technologies and algorithms are associated with "opacity", as Jenna Burrell (2016) notes, emphasizing a conflation that underlies this association between algorithms and the number of factors that contribute to an "inherent [...] uncertainty of big data", as Kitchin puts it, or to issues that arise from "a state of not knowing".[32] Burrell suggests that three different forms of "opacity" may be distinguished, resulting from protected access (in case of corporations or institutions); from a lack of specialist skills; and from a "mismatch between mathematical optimization in high-dimensionality characteristic of machine learning and the demands of human-scale reasoning and styles of semantic interpretation."[33] She thus makes a case for a more precise distinction between the mathematical logic of (different) algorithms and issues of their interpretation, commercial and institutional applications and use. Further aspects of interpretation may be added, in particular the role of visualization and visual data analysis "as a sense-making tool".[34] In practice, data technologies may be seen as (particular) applications that raise issues in precisely this mixture of 'opacities', while they are increasingly, as Dominique Cardon (2015) argues, shaping societal cognitive and cultural frames; including hypotheses underlying future predictions. Cardon focuses on the development of data technologies in the web and, from this point of view, distinguishes between four types of calculation, related to (1) votes and a principle of popularity (based on views); (2) meritocracy and a principle of authority (based on links); (3) benchmark and a principle of "gloriometric" reputation (based on likes); and (4) machine learning and a principle of prediction (based on traces).[35] His analysis thus brings

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[28] Kaschuba: Die Überwindung der Distanz, p. 97 ("vorher-nachher-Modell").

[29] Plantin et al.: Big data is not about size.

[30] "Digital footprints" may thus rather be seen as particular "oligoptical views" following Kitchin: The Data Revolution, p. 167.

[31] Deborah Lupton quot. in Reichert: Digitale Selbstvermessung, p. 75.

[32] Burrell: How the machine 'thinks', p. 1; Kitchin: The Data Revolution, p. 102, cf. pp. 149ff.

[33] Burrell: How the machine 'thinks', p. 1f.

[34] Bollier: The promise and peril of Big Data, p. 9; cf. Kitchin: The Data Revolution, pp. 106ff.

[35] Cardon: A quoi rêvent les algorithmes, p. 17ff. The term "gloriomètres" (p. 30) is quot. from Gabriel Tarde.

to the fore the range of procedures of classification, ranking, sorting and scoring that are associated with the rise of big data.

Furthermore, as Burrell and other authors point out and as a more historical perspective makes clear, the rise of big data can not be isolated from earlier and parallel developments, particularly in the area of mobile and pervasive media, computing, and data collection techniques. In ever more environments of work as well as private life, data capture and processing are involved, and data technologies shape and continuously transform areas such as, among others, finance and retail, energy, mobility, health, education, and science. The role of increasingly automated decision making on individuals, in particular in regard to work and employment, has been associated with implications of "data discrimination" (Barocas/Selbst 2015), a keyword that embraces the socially discriminatory effects of the use of data mining applications.[36] In parallel, data are increasingly aggregated, analysed in real-time, repackaged and traded as a commodity. Data brokers collecting and selling personal data can have a significant impact, as has been shown, on decisions over individuals, including predictive analysis, without knowledge of the individuals concerned; thus leading to a "data determinism" in which individuals are classified and judged based on profiles not only of data about what they have, or maybe have done in the past, but also of predictions "of what they might do" in the future.[37] The increasing number of such multiple connections, reflected in the (above mentioned) characteristic uncertainty about the provenance of (big) data, and of the "re-scalings and reorderings" they imply require more attention, as Kitchin argues, and run counter to ideas that tend to 'reify' big data.[38] He suggests, in particular, that the implications of this increasing interconnection of previously separate, 'oligoptic' data, data technologies and systems, and of an increasingly pervasive data infrastructure raise issues that need be addressed.

Conclusion

'Big data' can be considered as a field of both major visions and major implications of present data technologies. As a rapidly emerging field of digital change, it raises questions which, as Kitchin points out, "we have barely begun to ask and answer".[39] The goal of this paper was to approach the field, not from the (range of) issues that arise from the definition of big data, but through shifting the attention to the role of optical metaphors and relations between data and vision that shape concepts and present debates of data and datafication. (Re)assessing notions and visions of panoptic data technologies, I have proposed to address (big) data from three perspectives. I have, first, argued for a historical perspective that situates big data in a history of digital change, allowing to more precisely reframe its newness, and in a "history of the future" – of promises/threats and visions of a future "already out there".[40] As shown, the notion of panoptic, all-seeing data technologies can itself be situated in a history of information technology and its visions. Second, I have proposed to address this notion quite literally in terms of vision, arguing in favour of a perspective that allows to separate data technologies from a vision associated with universal transparency, and from a contemporary trope of visibility. Finally, based on Latour's notion of vision, I have argued in favour of an approach that draws attention to issues of (big) data which have been overshadowed by this trope and proposed to address them in terms of a complex sociotechnical infrastructure. As discussed, such a perspective can provide a more precise view that goes beyond generalized notions of big data and allows to distinguish between different ways in which present data technologies and practices raise particular social and ethical questions. This includes different aspects of 'opacity' (or transparency, respectively) of present technologies of (big) data.[41] The notion of big data as an

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[36] The authors note that, of course, by "definition data mining is always a form of statistical [...] discrimination" in the sense that data mining is intended "to provide a rational basis upon which to distinguish between individuals", but suggest, in regard here to US-American law, that "[n]evertheless, data mining holds the potential to unduly discount members of legally protected classes and to place them at systematic relative disadvantage." Barocas and Selbst: Big Data's Disparate Impact, p. 7.

[37] Kitchin: The Data Revolution, p. 45; see, e.g., "The Dark Market for Personal Data", The New York Times, 17.10.2014.

[38] Kitchin: The Data Revolution, p. 99; cf. p. 181.

[39] Ibid., p. 99.

[40] Carey and Quirk: The History of the Future, p. 150.

[41] Cf. for the related discussion on auditing algorithms, Burrell: How the machine thinks; Cardon: A quoi rêvent les algorithmes, p. 83.

infrastructure, moreover, draws attention to the increasing interconnection between previously separate, different systems and societal domains, and to its implications.

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