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How do data come to matter? Living and becoming with personal data

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Abstract

Humans have become increasingly datafied with the use of digital technologies that generate information with and about their bodies and everyday lives. The onto-epistemological dimensions of human–data assemblages and their relationship to bodies and selves have yet to be thoroughly theorised. In this essay, I draw on key perspectives espoused in feminist materialism, vital materialism and the anthropology of material culture to examine the ways in which these assemblages operate as part of knowing, perceiving and sensing human bodies. I draw particularly on scholarship that employs organic metaphors and concepts of vitality, growth, making, articulation, composition and decomposition. I show how these metaphors and concepts relate to and build on each other, and how they can be applied to think through humans' encounters with their digital data. I argue that these theoretical perspectives work to highlight the material and embodied dimensions of human–data assemblages as they grow and are enacted, articulated and incorporated into everyday lives.

Keywords

Digital data, epistemology, ontology, personal data, social theory, sociomaterial

Introduction

An expanding array of technologies is directed at monitoring aspects of human lives and rendering them into digital datasets. People's encounters and interactions with digital technologies generate reams of digitised information about their bodies, habits, preferences and social relationships. This information is often referred to as 'small data' because it is about individuals rather than large populations. When they are aggregated, however, small data become Big Data. In the contexts of everyday lives, the voluminous personal data that are continually and automatically generated contribute to larger datasets about people than they have ever experienced. From their perspective, therefore, these data are 'big', posing the problem of how best to interpret and make use of them, and come to terms with how others may be using the data. Many of these data traces are collected, accessed and exploited by other actors and agencies, often without people's knowledge or consent. In some cases, however, people can view and use the data thus produced about them. They may choose to actively collect digitised information about themselves using devices and software specifically designed for this purpose, such as self-tracking apps, platforms and wearable devices. People can also sometimes review data about themselves collected by other actors, such as social media metrics, employee dashboards, educational outcomes, medical records and so on.

These technologies work to capture and materialise immanent dimensions of human embodiment, creating human–data assemblages. Unlike previous forms of digitised bodily informatics, which were often confined to medical domains and trained experts, many novel digital technologies offer any interested person the opportunity to document, monitor and measure details of their bodies. When bodily processes are monitored

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by digital sensors and rendered into digital data, they are made visible in unprecedented ways. Elements of their bodies that people may not otherwise have considered to any great extent – the number of steps they take per day, their sleep patterns, the kilometres and geographical locations they move through, their brain waves, moods and so on – are brought into sharp relief.

Digital monitoring practices tend to position the body as a data repository, with specific digital sensors and other monitoring devices used to target various parts or functions of the body to uncover and extract the information contained within so that it may be rendered useful (Amoore and Hall, 2009; Berson, 2015; Grinberg, 2017; Lupton, 2016b, 2017a). The body becomes a series of interrelating digitised informatics, which demand new ways of interpreting these signs and signals of bodily function and movement. In these situations, people can be confronted with making sense of the information, deciding how valid or valuable it is, and deciding how best to incorporate their data into their lives. They are called on to know their bodies better and more intensely, and to work to interpret these novel forms of information about themselves – to engage in data sense-making (Lupton, 2017b, 2017c).

The onto-epistemological dimensions of these assemblages and their relationship to human bodies and selves have yet to be thoroughly theorised. A growing literature has emerged under the rubric of critical data studies, examining and critiquing the role of digital data in everyday lives and social institutions. Several researchers in this area of scholarship have adopted a sociomaterialist perspective, acknowledging the co-constitutive relationship between humans, digital technologies and data (for example, Gabrys et al., 2016; Kitchin, 2014; Kitchin and Lauriault, 2014; Ruppert et al., 2017; Tahani, 2016; Tanweer et al., 2016). Thus far, however, only a small number have taken up this approach to consider how people make sense of their personal data (Michael and Lupton, 2016) or employed perspectives from feminist materialism, vital materialism and the anthropology of material culture. I argue that these issues and perspectives are key to developing a critical data studies that recognises that data about people can be experienced as 'big' in the contexts of people's everyday lives – as 'personal Big Data' – rather than simply anonymous, decontextualised large datasets used by institutional and corporate actors.

In this essay, I seek to build on and extend my previous theoretical and empirical research addressing how people respond to and make sense of their personal data. In so doing, I position these assemblages as things which are made and used by humans, involving processes of articulation and improvisation. Some key perspectives expressed in feminist materialism, vital materialism and the anthropology of material culture, and particularly those that employ organic metaphors and concepts, are drawn on to make these arguments. I show how these metaphors and concepts relate to and build on each other, and how they can be applied to think through humans' encounters with digital data about themselves. While this essay is designed to focus primarily on conceptual development, I refer to some examples from my own and others' empirical studies to illustrate some of my arguments.

Data sense and lively data

The terms 'data sense' or 'data sensing/sense-making' have been used previously in various contexts, to denote a range of phenomena and practices. Because of their association with nonhuman entities such as digital devices and software, and because they are often viewed as non-material entities, digital data are often de-humanised and de-materialised in discourses. They are also often individualised, so that discussions of how people collect and make sense of their own data can be reduced to models of cognition or behavioural psychology. In information studies, the concept of data sense-making is closely related to those of information or data literacy. It refers to the ways in which people engage with and learn from information (Frank et al., 2016; Wolff et al., 2016). This perspective draws mainly on literatures in informatics, education and information literacy research, using the analogy of literacy as the ability to read: that is, understand and use text. For example, in their definition, Wolff et al. (2016: 23) describe data literacy skills as 'abilities to select, clean, analyse, visualise, critique and interpret data, as well as to communicate stories from data and to use data as part of a design process'.

More than a decade ago, Kang and Cuff (2005) referred to 'datasense' as part of their predictions about the rapidly-expanding world of digital sensors and the data generated from online interactions. They used the metaphor of the 'digital nervous system grafted onto the material world' (Kang and Cuff, 2005: 112) to describe potential interactions between digital technologies that could occur without human intervention (relationships that are now often referred to as the Internet of Things). Their approach, therefore, focused on nonhuman sensing and communication of information, rather than humans' interactions with digital data. Data Sense is also the title of a website featuring a research experiment run by Intel Labs, which involves a tool built by the company directed at making personal data easier to manipulate and analyse by people who are not expert in programming. It also takes a data literacy approach (Intel, 2017: 139).

These accounts of data sense-making often focus on cognitive or technical forms of data interpretation.

The role of the emplaced, sensory body in communicative and pedagogical activities – or how people live with their data – is often ignored. Despite personal data becoming increasingly generated by, on and with the human body, the interplay between the human senses and the digital sensors that work to document the body tends not to receive attention. The concept of data sense, as I seek to develop it here, brings the body back in, acknowledging that we learn in and through our bodies. It incorporates the entanglements of the digital sensors with the human senses in the process of sense-making (Lupton, 2017b; Lupton et al., 2018). In these enactments, bodies are not only knowing and perceiving (Latimer, 2008), but they are sensing, responding to and assessing the information returned by digital sensors. Data sense, therefore, may be conceptualised as the co-constitution of human and nonhuman sense-making.

I have previously proposed that one way of conceptualising digital data assemblages (which bring together humans-devices-software-data-space-time) is thinking of them metaphorically as 'lively' (Lupton, 2017b, 2017c, 2018b; Lupton et al., 2018) When first developing the concept of lively data, I drew on sociological discussions concerning the constant generation, circulation and recombination of digital data through people's online interactions and the implications for social research (Beer, 2013; Beer and Burrows, 2013; Savage, 2013). I have sought to extend the concept with specific reference to the implications of digital data about human bodies and lives, noting that such data possess other vital capacities because they are about human life itself, have implications for human life opportunities and livelihoods, can have recursive effects on human lives (shaping action and concepts of embodiment and selfhood) and generate economic value. I have also considered the notion of understanding personal digital data as companion species, drawing on Haraway's work (2003) on companion animals to position these data as co-evolving with their human progenitors (Lupton, 2016a). As I demonstrate below, further concepts and perspectives from Haraway's more recent work, as well as those offered by other feminist and vital materialists, and by anthropologists of material culture, provide greater depth and nuance to these arguments, particularly those involving vitality, growth, making, articulation, composition and decomposition.

Vital capacities and human–nonhuman assemblages

Recent feminist material perspectives have become influential in sociomaterialist scholarship. Donna Haraway and Karen Barad are key figures here. Both view humans as assemblages of human and nonhuman actors, in which humans can never be separated from the environments in and through which they move. Haraway (Franklin and Haraway, 2017; Haraway, 2003, 2008), for example, has proclaimed in her recent work that she rejects the idea of the posthuman, preferring to position humans as compost, intertwined with companion species of other living and nonhuman entities. For her part, Barad calls for a perspective on the human in which bodies are discursive as they enact practice, and therefore 'matter and meaning are mutually articulated' (2007: 152). Barad (2003) draws attention to the importance of focusing attention on how boundaries between phenomena are enacted, always involving choices about exclusions as well as inclusions. The practices of making these distinctions (including discursive practices which delimit what can be said), which are continuous and dynamic, are part of agency: 'Agency is not an attribute but the ongoing reconfigurings of the world' (Barad, 2003: 818). Barad (2003) further notes that humans do not know about the world because they are observing from outside it. Rather, they know the world because they are inseparably part of it. Epistemology and ontology cannot, therefore, be separated. 'Onto-epistem-ology – the study of practices of knowing in being – is probably a better way to think about the kind of understandings that are needed' (Barad, 2003: 829). For Barad (2003), a key question is 'understanding how matter comes to matter'.

The vital materialism perspective takes up some of these issues, directing particular attention to the lively agencies of nonhumans as well as humans, including non-organic actors such as technologies (Bennett, 2004, 2010). The emergent, unpredictable, non-linear and dynamic nature of materialist enactments is again emphasised in this literature, which builds on the work of many social theorists, including Spinoza, Foucault, Deleuze, Merleau-Ponty, Latour and Bourdieu. This approach also refuses a dualistic approach to agency and matter and focuses attention on the ways in which actors are inextricably entangled, together generating vitality (Bennett, 2004, 2010; Coole, 2013). Bennett's concept of 'thing-power', or 'the curious ability of inanimate things to animate, to act, to product effects dramatic and subtle' (2004: 351) is important in emphasising the vibrant agential capacities of human–nonhuman assemblages. Thing-power is a dynamic flow of energy between and with the components of assemblages. Bennett argues that the concept of thing-power emphasises the intimacy of humans and nonhumans, the ways that they are so closely intertwined in the moments when 'human being and thinghood overlap' (2004: 349). She further elaborates that thing-power is not located in one specific object

alone, but rather is a function of the grouping of different things in an assemblage, each operating in conjunction with the others (including humans) (Bennett, 2004: 354).

The ethnographic and historical scholarship of Tim Ingold and his collaborator Elizabeth Hallam, both anthropologists who write about material cultures, also contribute to concepts of perceiving and learning as part of embodied practices with lively objects. Ingold and Hallam have written about processes of making and living with things, emphasising the role of creativity, improvisation and learning by doing. In his book *Making* (2013), Ingold focuses his ethnographic analyses on the practices involved in making objects, and how learning is part of these processes. Using the organic metaphor of growing, Ingold connects embodiment and learning. He argues that: 'the only way one can really know things – that is, from the very inside of one's being – is through a process of self-discovery. To know things you have to grow into them, and let them grow in you, so that they become a part of who you are' (Ingold, 2013: 1).

This perspective goes well beyond the idea that information generates knowledge or self-understanding. It focuses on lived practices and how they develop and change over time. Learning is viewed as a continuing process, therefore, rather than a fixed-term event, and one which involves acts of making, improvisation and adjusting to change. It is also a profoundly embodied experience, not just located in cognition. Ingold argues that when artisans are making things, they are not working *on* them, but rather *with* them. He contends that making is a process of correspondence, in which artisans seek to draw forth the potentials of matter: 'In the act of making the artisan couples his [sic] own movements and gestures – indeed his very life – with the becoming of his materials, joining with and following the forces and flows that bring his work to fruition' (Ingold, 2013: 31).

Ingold (2013) contends that material artefacts are never fixed or completed. Because they are open to new meanings and uses, they are always in a process of becoming something else. As they move into new or different contexts, artefacts change in meaning, even if not always in shape. With Hallam, he discusses the emergent properties of artefacts, emphasising the new ways in which artefacts can be used and re-used and change during the process. Just as making and learning are never finished, artefacts 'pass from one form of life to another' (Ingold and Hallam, 2014: 2). They emphasise that growing things need not be only living things, using the examples of minerals deposits and crystals. Growth, indeed, is 'the fundamental condition of beings and things in a world that is always surpassing itself' (Ingold and Hallam, 2014: 3).

The anthropology of material culture has also included some reflections on the decay and degradation of artefacts and the potentials that this process creates. In her empirical scholarship, Hallam (2010; 2016) has focused predominantly on how dead bodies or other human remains (such as bones) have been portrayed and used in the context of museum anatomical displays, as artefacts for leaning. She examines their contributions to fields of knowledge, and how these displays are creatively made. As she notes, anatomical displays of human bodies 'cut across the categories of the organic and artefactual' (Hallam, 2016: 8). Hallam (2010,2016) uses the term 'articulation' to describe the ways in which various actors seek to make sense of parts of human bodies they are working with. For example, articulation refers both to how bones from a specific skeleton can be fitted together and how bones can be used and inserted into a range of diverse narratives and social relations, depending on the context. Bones, she argues, are relational entities. They have different meanings based on the historical, political and physical settings in which they are located, and the intentions of the human actors working to make sense of them: whether these are archaeologists, biologists, artists, historians, relatives or many other potential actors.

As Hallam (2010, 2016) points out, bones have been used in a multitude of ways as decorative, artistic or religious artefacts. While commonly thought of as 'dead', therefore, human bones are very much alive, in terms of their changing meanings and uses and the capacity they possess to arouse affect and action. They can be moved into very different contexts and take on different agential capacities. Thus, for example, human bones can be exhumed, reburied, turned into powder, brought into an art or museum exhibition: each time developing new meanings. The material properties of human bones facilitate many forms of display for mourning, commemorative, political, religious, symbolic, historical, heritage, decorative and artistic purposes.

There are several related themes that emerge in all these scholars' work. All adopt a more-than-human approach, which demands that the human subject is always considered permeable and open to the material world rather than closed-off and contained. Hallam's concept of articulation draws attention to the work involved in bringing human remains together, the multifarious ways in which this may be achieved and the consequent vitality of the meanings and capacities these remains can take on. Ingold and Hallam (2014) point out that an inevitable part of growth is decomposition and decay. Out of this rotting of matter springs new matter, continuing the growth cycle. So too, in taking up vital materialism, Frost argues for a concept

of humans as 'biocultural creatures' which are 'constantly composing, decomposing, and recomposing in response to their engagement with their habitats' (2016: 149). This notion of composition, and re/decomposition builds on Haraway's 'we are all compost' metaphor (Franklin and Haraway, 2017), usefully emphasising the dynamic nature of these processes.

Here again, vitality and agential capacities can be considered key to the ways in which humans respond to the elements of the environments with which they form assemblages. According to Frost (2016: 153), the 'cultural' dimension of biocultural creatures is representational, political and social but also biological, temporal and spatial. Together these dimensions work to compose and de/recompose humans, providing the conditions in which they live, move and grow (or are 'cultured', as Frost puts it). Humans, in turn, make and remake their habits through their continued presence in them and through intentional and unintentional adjustments they make to them. De/recomposition takes place in different ways and timescales for humans, from the micro-level of the cells to the macro-level of movement of the body through space. There are constraints on how humans respond to their environments that delimit what they can and cannot do and in what transformations they participate (Frost, 2016).

To summarise, the following themes are evident in the work of the sociomaterial perspectives I have discussed thus far:

- an approach that recognises that humans and nonhumans are entangled in hybrid, unstable and generative ways;
- the importance of considering the distributed agency and vital capacities ('thing-power') of human–nonhuman assemblages;
- an emphasis on the embodied, sensory and otherwise material nature of meaning, knowing, growing, perceiving and making as part of human embodiment;
- the changing meanings of artefacts as they move into different assemblages and the work required to articulate these assemblages; and
- the importance of identifying and tracing the ways in which humans and nonhumans are intermeshed, the enactments and practices that are involved, and the effects of these on human lives.

All these approaches use organic metaphors and concepts to think through the nature of human–nonhuman assemblages. These metaphors and concepts draw attention to the vibrancy, hybrid and emergent nature of these assemblages. They can contribute to new ways of conceptualising human–data assemblages and how people incorporate data into their bodies and lives, as the next section demonstrates.

How do personal digital data come to matter?

The concept of the human–data assemblage works to highlight the distributed and dynamic nature of subjectivity and embodiment that sociomaterial perspectives emphasise. The onto-epistemological problem posed by human–data assemblages requires humans to interpret what aspects of themselves these assemblages differentiate. Data and humans can potentially learn from each other and co-evolve. But humans may find themselves asking to what extent their data speak for them, and to what extent their data are different from other elements of embodiment and selfhood. Making sense of personal data requires developing practices that can manage and interpret lively data to make them useful and knowable.

The *sine qua non* of digital devices and software designed for generating personalised data about their users is making the information they produce intelligible to the users: making themselves known at the same time as they generate knowledge about users. From the sociomaterialist perspective, data about humans and humans are always part of each other and emerge together. Just as it can be claimed that authors and books write each other (Barad, 2007: x): it can also be asserted that people and their data make each other. The idea that personal data assemblages co-evolve with and are companion species to humans also acknowledges this (Lupton, 2016a). To the metaphor of lively data assemblages, Ingold's theorising of becoming, growing and learning can readily be incorporated. Ideas about the vitality of things drawn from Bennett can contribute to the concept of lively data and its implications for human embodiment.

The notion, from Barad, of matter and how it comes to matter, directs us to think about digital data as a form of matter and to focus attention on the ways in which they affect human lives. The value of personal data for people's lives, and the ways they make sense of the data, involve complex interactions between embodied sensory knowledge and information that is generated from digital devices and online interactions. Knowing, as Barad (2003) puts it, is one body making itself intelligible to another body. These human–data assemblages are configured within broader networks and environments which again are mutually articulated and co-constitutive. People can make decisions from the constantly changing choices available about what words they use to describe phenomena and what material practices they engage in to generate or interact with phenomena.

Hallam's discussions of the lively capacities of human bones also have much to offer an ontology of digital data about humans. Like human bones, digital

data only make sense in the contexts in which they are located. Like human bones, they have infinite capacities for taking on new meaning. It is this very vitality on which the claims of self-tracking enthusiasts often rest, in terms of its imputed power to change and optimise human bodies and lives (Lupton, 2016b). However, the vitality of human data also presents a great challenge to growing and learning with them. The tools used to digitally generate and materialise personal data are by necessity reductive and normative, as well as generative. If the metaphor of lively data is employed, we can begin to think about conceptualising what happens when these data are not found to be useful, insightful or otherwise valuable for the people who are engaging with them. The data are frozen in a state of materialisation for a time, inviting recognition (Lupton, 2017b). Barad (2003: 828) uses the alternative term 'the congealing of agency' to describe the doing and making of matter. If they remain inert (are not enlivened by further movements and uses), it is interesting to examine why this is the case. Personal data can have agentive capacities that shape people's embodied responses and actions, their sense of selfhood and their relationships with other people and with other things. In other words, they have the 'thing-power' that Bennett describes (Lupton, 2018a).

The potential for digital data to decompose (and then potentially recomposed) also requires consideration in the context of lively data and data sense. 'Broken world thinking' (Houston et al., 2016; Jackson and Kang, 2014) directs attention to the inherent instability of digital technologies and infrastructures, and the resultant need for continual repair. The terms 'degradation' and 'decay' are employed to describe these processes, which call for constant fixing, improvising and reinvention – act of repair – that in turn can create new possibilities for use. The broken world thinking literature has tended to focus on digital infrastructures and devices than specifically on digital data (Tanweer et al., 2016). Taking up this notion of decay and decomposition of sociotechnical objects and introducing further perspectives from feminist and vital materialism and the anthropology of material culture offers some novel ways of conceptualising personal data. There are resonances here with Haraway's idea of humans as compost, Frost's concepts of composition and re/decomposition of human–nonhuman assemblages, and Ingold and Hallam's writings on making and growing.

The scholarship of Ingold and Hallam on making and articulation emphasises the importance to artisans of their practices and the materials they work with 'feeling right'. Making and articulating materials in ways that feel right (or which meet affective and sensory judgements of what works) involves embodied learning and doing. The comparison with the capacities of human bones for meaning and repurposing is also apposite here. As Hallam (2010) points out, it is far from the case that bones, once interred, are inert and no longer meaningful. They can be disinterred and used for many other purposes. Like human bones, the processes of creating their meaning may be interrupted, broken, disrupted or lost. But this state of decay or deadness may not be permanent. So too, personal digital data may not be useful initially, but can become meaningful later. Like bones, they can be articulated with other data and take on more value. In the global digital data economy, the economic or research value of joining up disparate datasets about individuals to create detailed profiles of them has intensified. If we adopt Haraway's compost metaphor, even when digital data (or bones) have decayed, they may still possess potential vital capacities to grow new assemblages. Digital data can be 'cleaned' and made more useful or valuable, or they can be recomposed with other data sets, again generating new meaning. They may also reach a point where decomposition is so advanced that repair or recomposition cannot take place.

Like bones, our personal digital data are reliquaries of our humanity, testaments to our lived experiences and unique identity. These data are materialisations of selfhood that both represent elements of the self and also require attentive labour to generate value for those who make them. They possess biovalue, just as body parts, cells and tissues do (Lupton, 2016b). Personal data, in other words, can be viewed as a new type of human remains, one that is potentially open to a multitude of repurposing and reconfiguring, leading to many kinds of value for a diverse range of actors. Like human remains, they may also lose their potency and vibrancy, their capacity to affect and be affected.

Making and doing data

These theoretical explorations raise a series of key questions, namely: What data materialisations are deemed to be true and insightful? What are not? What aspects of bodies/selves are left out altogether in digitised practices and knowledges? What are the properties of the data encounter that work together to render data valuable or useless? What are the spatial, sensory and affective dimensions and entanglements of these encounters? How do these data come to matter – or not matter?

My empirical research on self-tracking as a set of emergent embodied and emplaced practices has found that the data generated were artefacts of both bodily knowledge and emotion, similarly produced through attentive labour. My research participants often described collecting and reviewing data about their bodies as generating agential capacities that are

suffused with affect. These data can motivate them, encourage them to move their bodies more, persist with weight-loss efforts or self-management of chronic conditions. The 'numbers' can make them feel good if they demonstrate that people are achieving goals set for themselves, or if the data demonstrate good health or higher levels of fitness. Positive feelings can be generated by the buzzes, flashing lights, badges and other notifications that communicate a goal has been achieved. Alternatively, however, biometric data can have demoralising effects, generating disappointment, frustration, guilt and anger. Notifications can be experienced as annoying or pestering, making unreasonable demands (see Lupton, 2018a, 2018b; Lupton and Maslen, 2018; Lupton et al., 2018; Sumartojo et al., 2016).

These metrics can tell us only limited details about our bodies. Just like a human bone in itself is meaningless, digital data by themselves mean nothing. They only make sense in the context in which people decide to collect their data and the social relationships and expectations, places and spaces in which they do so. Human data are articulated as part of sense-making, just as human bones are. The work of making and doing data involves people recognising the resonances and differences of the datafied forms of themselves that are data materialisations. Articulating one's personal data is a matter of connecting the metrics with the lived sensory experiences of one's body and the other elements that are important in data sense-making. Articulation is therefore a form of connection of joining disparate pieces of information together to make an assemblage, but the work of articulation is inevitably and invariably contextual. Choices about articulation are context-based, and the worlds in which articulated data assemblages move are also contextual, drawing their meaning from these contexts and contributing to them as well.

Experienced self-trackers know this, as they work to make sense of these data and incorporate them into their lives. They realise that they must improvise and provide context to the data – otherwise the information is meaningless. Far from passively expecting machines to generate the data that can then be meaningfully applied, self-trackers are agential, constantly engaging in the work of sense-making. While some elements of self-tracking may be automated, what can never be left to the machines is the process of learning from one's data and drawing it into one's mundane routines, practices and performances of identity. When people review their data, they actively relate them to the contexts in which they were generated. People consider such aspects as the time of day, the weather, how their bodies felt, whether they were lacking sleep, were hungry, feeling stressed, drank too much the night before, what place and space they were inhabiting or moving through when the information were generated.

Thus, for example, in our study of cycling self-trackers using digital monitoring of their bodies or their bicycles (Lupton et al., 2018; Pink et al., 2017b; Sumartojo et al., 2016), we found that the cyclists reviewed data about their rides bearing in mind such factors as the weather conditions (including how hot or windy it was during the ride), the traffic conditions, the behaviours of other road users, whether they were nursing an injury or getting over a cold and how accurate the GPS system was in the areas they were riding in. Each process of reviewing their data included consideration of some of these factors when people were deciding how valuable, important or accurate were the metrics and other data materialisations that their devices or apps delivered to them. Sometimes the data were considered to be useless, because they failed to register the correct location of the user, or they did not properly sync to an app or platform, or because the monitoring device was unable to register and take account of how tired the user was from a bad night's sleep. In other cases, the data were considered helpful and useful, based on factors such as the users' previous experiences of the ride and the data generated from previous rides and how well the data accorded with their bodily sensations and memories of the trip.

Researchers interested in the pedagogical dimensions of personal data have also begun to observe that people's responses to their personal data are always emplaced and embodied, building on their previous experiences and knowledges. In their study involving autoethnography and ethnographies of self-trackers, for example, Fors and Pink (2017) focused on how people learn with their data, including the ways in which data contribute to established routines of sensing and knowing bodies. Their research found that self-tracking data tends to understood in relation to what people already know and feel in and with their bodies. Fors and Pink noted that people engaging with their personal digital data often employ judgements of what feels right. These judgements are complex and dynamic, founded in personal histories but also in personal futures. Here again, the material, sensory and social contexts in which data can become meaningful or lose meaning are highlighted.

Diffractive analysis and becoming-with data

The effects of difference are a key focus of Barad's work. Barad (2007) critiques 'reflexive practice' as a mode of research, as this approach attempts to fix in time and place a specific understanding. Reflexive practice involves identifying a materialisation of what

is assumed to exist. In contrast, what Barad calls 'diffractive analysis' works to identify differences and alternative ways of being and doing, including how differences are made and what is excluded from decisions about what matters. From this perspective, what counts as 'truth' is always contingent, contextual and emergent. Analysis is directed at identifying these choices and the possibilities that they entail and close off. This may involve focusing attention on how humans and nonhumans differentiate themselves from other phenomena. Interactions with personal data may be viewed as one mode of such differentiation. The digital devices and software used for self-tracking work fundamentally to differentiate certain aspects of embodied practices and properties from others, using highly specific modes of measurement that tend to seek to quantify these practices and properties and render them more visible than other bodily attributes.

Lenz Taguchi (2012: 265) has taken up Barad's work to discuss the ways in which she engages with her research data. Lenz Taguchi emphasises that research data do not 'speak for themselves' (2012: 270). Researchers must work to turn these data into coherent narratives, which are always inevitably partial and selective. Adopting a diffractive approach, she refers to research as 'a becoming-with data', involving 'transcorporeal engagements' in which the researcher is sensitised to the different embodied ways in which she interacts with and makes sense of her data (see also Hultman and Lenz Taguchi, 2010). Lenz Taguchi discusses how diffractive analysis involves the researcher engaging in transcorporeality, acknowledging that the research data are entangled with the research/researcher inextricably. She asserts that: 'When reading diffractively, I want to read *with* the data, understanding it as a constitutive force, working with and upon me in the event of reading it... This is about the uncovering of a reality that already exists among the multitude of realities already being enacted in an event' (Lenz Taguchi, 2012: 274–275, emphasis in the original). This process involves making data intelligible and knowable: organising and ordering it in a particular way, sometimes involving affective responses to the vibrancy of data that cannot be easily described. The researcher's previous embodied and affective experiences contribute to her decisions about which data to select and how to configure data narratives so that they make sense to her and her audiences.

While Lenz Taguchi is here discussing her approach to diffractively analysing research data, the same perspective can be adopted to understand how people who engage with the personal data generated by themselves or others. This diffractive process, I would argue, is what many people do when they are engaging with their personal digital data and making sense of it. Indeed, acknowledging the 'constitutive force' of their data is one reason why people may decide to take up digitised self-tracking and continue with it. They recognise these human–data assemblages offer them new insights into their bodies, habits and practices, insights that can, in turn, contribute to new forms of embodiment. These data both affect and are affected by the humans they make and remake.

Diffractive analysis draws attention to events and encounters of humans and nonhumans with each other that evoke transformation. People engaging with their personal data often adopt a diffractive approach as they work to make sense of the data. This is facilitated by their personal investments in the data they are reviewing. The data are meaningful because they are about and for them. The person engaging with their data is a performative agent (Hultman and Lenz Taguchi, 2010: 537) in an event with the data materialisations, just as they earlier were agential in co-creating the data with the device they used to do this.

Our research with people who engage in self-tracking has found that this perspective on personal data is often expressed by people when they are explaining why they generate these data about themselves and what the value of the data are – in other words, how the data 'come to matter' (Lupton, 2017c; Lupton et al., 2018; Lupton and Smith, 2018; Pink et al., 2017b; Sumartojo et al., 2016). Particularly when people become aware of the ruptures and disjunctions when they are engaging in data sense that they move towards a more diffractive position. They start to engage in the work of articulating and making sense of their data and to identify what goes wrong or why these data don't work to help them in the ways they expect. They may also find that their data practices and sense-making bring them to a point where they can see alternative values and uses for the data or other ways to generate them or alternative sources of information that work better for them and feel more comfortable. Sensory engagements other than the visual can be important in this process (Hultman and Lenz Taguchi, 2010; Lupton, 2018a; Lupton and Maslen, 2018; Pink et al., 2017a; Sumartojo et al., 2016).

In their research investigating people's encounters with data about their bodies generated by medical biometric machines, Gardner and Jenkins (2016) note the affective labour that is part of their sense-making. They filmed and interviewed the participants as they interacted with devices that tracked their heart rates and brain wave frequencies, seeking to identify the ways in which people negotiated the data generated about them. As part of their project, Gardner and Jenkins encouraged their participants to experiment with and challenge these monitoring devices and the data they

revealed about them. The participants were therefore able to intervene in and disrupt the 'truths' about their bodies the data supposedly engendered, rather than simply accepting them at face value. Playful experimentation worked for the participants to help them 're-embody' the visualisations of their biometric data. They learnt how to manipulate and alter the data by using their bodies differently. They drew on affective experiences to augment the data, configuring narratives into which the data could be inserted and made meaningful. The participants learnt that they were not passive actors in this encounter: they could change the data.

These empirical studies highlight the dynamic nature of the more-than-human world of human–data assemblages. They point to the sensory and embodied dimensions of the ways in which humans and technologies gather to make and do data. As performative agents, individuals are actively engaging their bodies and minds as they are 'becoming-with data' (Hultman and Lenz Taguchi, 2010: 538). These are forms of lively imaginings and interpretings, in which knowing and being cannot be separated (Barad, 2003).

Where to from here?

In this essay, I have contended that personal data, like other forms of mediated representations of bodies and selves, are dynamic assemblages of humans and nonhumans that are constantly subject to change. I have sought to put forward a perspective on personal digital data that proposes new metaphors and concepts beyond the archetypal. This perspective on personal digital data about human bodies allows a different way of thinking about the labour of making and giving meaning to this information and the agentive capacities of personal digital data assemblages. They are not separate entities from people's bodies and selves, but rather are materialisations and extensions, alternative ways of knowing and enacting bodies and selves.

Ways of thinking about data sense may productively be expanded by acknowledging the thing-power of digital data assemblages and directing attention to the processes of growing, making, knowing, transforming, composing/decomposing/recomposing, articulating and incorporating that the work of data sense demands. This is a new vocabulary that moves well on from ideas of 'data literacy' that tend to be espoused in literatures on information sense-making. In broader terms, bringing organic/embodied metaphors and concepts into the discourse on digital data works towards a greater emphasis on the inextricable aspects of more-than-human worlds, and novel ways in which digital technologies and the data they generate are part of human embodiment and selfhood.

On the basis of these concepts, we can start to think about the ways in which these liminal human–nonhuman artefacts change over time and the social relations and material contexts in which they are generated and become objects for sense-making. We can consider how humans make and remake these digital data, and how these data make and remake humans, and where the congruences and frictions are, and how they are enacted. Drawing on Barad (2014), we can begin to explore the ways in which these correspondences are inevitably subject to rupture and how choices are made about which data are considered to be important or valuable (to resonate) and which are ignored or considered useless. Living with data is a mode of being and becoming. These data are not inscribed on bodies: they work with and through bodies.

In addition to using the perspectives I have suggested to understand data sense, there is the potential to engage in critical and political enactments. Data sense-making can lead to what has been described as 'data activism' (Milan and Velden, 2016), an approach that seeks to uncover the ways in which people's personal data are used to conduct surveillance on them without their knowledge or consent, invade their privacy, generate profits for large corporations or delimit their life opportunities (Andrejevic et al., 2015; Brunton and Nissenbaum, 2011; Kennedy and Moss, 2015; Zuboff, 2015). Bennett's and Coole's application of vital materialism to issues concerning political action emphasises the ethical sensibilities that may be generated by close attentiveness to the agential capacities of nonhumans. This includes identifying the 'circuits through which matter flows' (Coole, 2013: 463), including their social structural and political dimensions as well as the material affordances of technologies.

Both Bennett and Coole identify the political possibilities of such a perspective for critiquing modes of production and consumption contributing to environmental damage and related problems such as global warming and food and water insecurity. Bennett (2004: 349) discusses the importance of fostering a 'receptivity to thing-power' and a consonant awareness of its impact on ecology and implications for environmental sustainability. Coole (2013: 465) also emphasises the importance for such a project in devoting attention to 'concrete studies of everyday visceral experience that bring real material ballast to what otherwise remain abstract studies'. Coole (2013) further calls for research which identifies the disaggregated and calibrated dimensions of human flesh and how these are used to generate knowledge about humans that may be used in productive or disciplining ways, engendering different types of agential capacities. This approach, she argues, is a form of biopolitics, in seeking to understand the workings of power in, through and with human bodies.

While neither Coole nor Bennett makes direct reference to digital data about human bodies, this is clearly a prime potential object of attention for future work on this topic. In developing close studies of quotidian experiences of making, doing and living with digital data, an analysis founded on sociomaterial perspectives from the work of the scholars I have here discussed serves to highlight the material dimensions of human–data assemblages as they are made, grow, enacted, articulated and incorporated, and emphasises the intertwined nature of known, knower and knowing. Such an analysis can involve both a reflexive analysis, focusing on the shared tacit norms, assumptions and discourses that underpin practices, and a diffractive analysis that directs attention to what is different or resistant, and identifying new or alternative possibilities. Both approaches can work towards a better understanding of how and in what contexts data can assume importance and significance in people's lives; and in others, lose their vitality, value and potential for enacting change.

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