Data spectacles: Materialisations of personal data

As I discussed in the previous chapter, creativity and playfulness can be important features of self-tracking practices, particularly those involving gamification. But these features may also be involved in creating personal data visualisations and other forms of sharing insights, such as giving talks, as part of self-tracking. An integral aspect of self-tracking for many participants is the opportunity it gives them to represent their personal data in various ways and to 'make sense' of these data via such representations. In the show and tell of the Quantified Self movement, whose ethos underpins the movement's 'sharing' mentality, finding compelling visual modes to demonstrate the patterns in a person's data is a central feature. The Quantified Self website is full of members' demonstrations of their data, including videos of their show-and-tell presentations and still images of their visualisations: over 750 such presentations have been uploaded to the site thus far. Numbers, graphs and charts are common ways of representing personal data, but more qualitative visualisations are also employed, for instance through the use of word clouds, colours that stand for moods, and images from photographs and videos.

Visual representations of data can be highly attractive, whether they are digitally generated or produced through time-honoured methods such as drawing, painting, sculpting and other forms of artistic expression. The American designer Nicholas Felton is well known for the glossy books he publishes each year, which detail his self-tracked data in attractive graphical representations (see Feltron.com, 2015). The notion that data can be beautiful and aesthetically pleasing when presented in appropriate formats pervades data science in general: Melissa Gregg (2015) refers to this phenomenon as the 'data spectacle'. The aesthetic elements of data visualisations involve affective responses that may contain both pleasure and anxiety. Indeed McCosker and Wilken (2014) identify the tendency, in data visualisation circles, towards sublimity and the fetishising of 'beautiful data' as part of exerting mastery over the seemingly unlimited and thus over-

whelming amounts of big digital data sets. Extending this logic, the physical materialisation of digital data in the form of a 2D or 3D data materialisation may offer a solution to the anxieties raised by big data. When it is one's personal data, drawn from one's own flesh, that are being manifested in a material digital data object, this phenomenon may provoke a sense of mastery over what is probably experienced as a continually data-emitting subjectivity. The liquidity, flows and force of personal digital data become frozen in time and space, offering an opportunity to make sense of one's data.

Potent emotional responses can be generated by self-trackers to their own data visualisations and materialisations. In their analysis of interview data from Finnish people who use self-monitoring devices for physical activity and heart-rate tracking, Ruckenstein and Pantzar observe that, when participants were shown the graphs produced from their heart rates, new kinds of affective ties were generated between users and their personal data (Pantzar and Ruckenstein, 2015; Ruckenstein, 2014). The two authors suggest that visual representations of personal data are vital if participants are to respond to the data with high levels of engagement and interest. When a specific part of the body is being closely monitored and its data are visualised and displayed to the owner, this bodily part may become invested with new significance. Similarly, numbers can acquire new significance and emotional meaning because they are measuring elements of one's own body.

For many participants in this study, being able to see from the graphs how many steps they had taken, or how their heart rate had responded to exercise, or how well they had slept was motivating and pleasurable. The well-rested body, as demonstrated by an undisturbed night's rest evidenced by heart-rate data, was viewed as an achievement, an accomplishment of the body – as was the tired body that resulted from a highly active day. Activities such as housework gained new value because they contributed positively to exercise and heart-rate data, while stress-alleviating activities, as demonstrated via graphs, were also valued for their contribution to rest and recovery (which resulted in a lowered heart rate). These embodied feelings gained additional value from the

data visualisations that 'proved' and supported them, thus engendering pleasurable emotions such as satisfaction and a sense of accomplishment.

Ruckenstein and Pantzar found that the participants in their study viewed the data visualisations as more credible and accurate than the 'subjective' assessments of their bodily sensations; indeed they expressed the desire for more data about their bodies to add to those already collected, so as to gain further insights. Several participants commented that the visualisations revealed aspects of their lives that they may have suspected (such as the stressful nature of their work), but the data served to prove these impressions, while others found that the data demonstrated findings that they had not anticipated (they were more physically active than they thought). A new kind of value was therefore given to some everyday activities and interactions.

Artistic and design interventions

Artists and designers have experimented with various ways of materialising personal data beyond the standard graph or list of numbers. An exhibition of artistic responses to lifelogging held at Chicago's Elmhurst Art Museum in 2014 (Elmhurst Art Museum, 2014) included people who used photographic or painted self-portraits, the market and sentimental value of objects they owned or things they carried while travelling and translated longitude and latitude data of their daily spatial location into kinetic sculptures or weather data into woven sculptures and musical scores. Data artist Laurie Frick has developed her FRICKbits Data Art app, the purpose of which is to encourage self-trackers to '[t]ake back your data and turn it into art' and to 'make the ultimate data-selfie' (Frick, 2015). She has used various materials for portraying the personal information she has collected on herself, including her 'Floating Data' project. This project involved Frick's use of laser cut anodised aluminium panels to display the details of her walking data, which she describes as a 'human data portrait' (Floating Data, 2015). Audiences can view, touch and walk past these panels.

One example of using analogue drawing techniques to represent personal data is the 'Dear Data' data drawing project conducted by Giorgia Lupi and Stefanie Posavec (Dear Data, 2015). For a one-year period these women, living in cities on different continents (Europe and North America), engaged in tracking information about themselves each week and then drawing and writing about their data on a large postcard, which they would send to each other. Their weekly self-tracking topics were quirky, including such features as 'a week of clocks', 'a week of mirrors' and 'a week of complaints'. On the blog they put together to describe and represent the project, they observe that this data collection and visualisation practice 'became a sort of performance and ritual in our lives, affecting our days and weeks, and inherently changing our behaviour' (Dear Data, 2015).

A range of creative expressions of and challenges to personal data has been exhibited or displayed on artists' websites. For some artists, their collection, interpretation and display of personal data are a response to the imperative that impels other self-trackers. However, their impulse, in contrast to that of many self-trackers, is not necessarily to collect and display 'truthful' data, but rather to reflect on the practice and its implications for concepts of the self and the body. In 2002 British designer and researcher Lucy Kimbell created a performance art piece entitled 'LIX Index' that involved her uploading 50 pieces of her personal data into a database (LIX Index, 2002; see also LIX Index, 2014). These pieces included such elements as her bank balance, hours spent outdoors, the air temperature where she lives, conversations with friends and family, tweets, orgasms, physical activity and intellectual stimulation. She produced a weekly index from these disparate sources of data, the LIX Index (an example of commensuration that I discussed in Chapter 4). Kimbell's blog discusses the difficulties and surprises involved in making and engaging with her index. Her first iteration of the LIX Index lasted a year. She then started again in 2012 for some months, but apparently grew tired very quickly of doing it. On her blog, which recounts her more recent experiences of creating the LIX Index, Kimbell discusses the tedium of collecting and uploading her personal information and her attitude that such an enterprise represents a 'neurotic data gathering' (LIX

Index, 2015). Her work questions the purpose of collecting such personal information and the criteria that are used to evaluate its worth and that of the self-tracker, as well as exposing the messiness involved in self-tracking.

In addition to artistic interventions, practitioners in the field of critical making have developed some responses to the collection and use of personal information in the digital data economy. 'Critical making' is a phrase that is used to denote the unification of creative and engineering practices with critical social theory. The making of material objects and representational (art) works can provide a means of engaging with social issues by bringing together theoretical concepts and the design and engineering of material artefacts. This is seen as a form of intervention into dominant knowledge systems. It includes approaches such as participatory design, critical technical practice, critical or reflexive design and tactical media. Some writers also use the descriptions 'design fiction' or 'speculative design' to denote ways of imagining alternatives to technologies and technological practices (Dunne and Raby, 2013; Galloway, 2013).

As Oron Catts and Ionat Zurr, both practitioners of design fiction, put it, some creative efforts 'offer glimpses of the possible and the contestable; works that are neither utopic or [*sic*] dystopic but rather ambiguous and messy' (quoted in Turney, 2015). The idea is not to present concepts that are feasible or practical, but to 'invite new kinds of conversations about technological futures' (Turney, 2015). Inviting these new kinds of conversations might seek to reincorporate (in both senses of the word) the sensory knowledge of the self. As I have contended in this book, the knowledges that are generated about bodies and selves by conventional digitised self-tracking devices may appear to be clean and uncontaminated in their sheer digitisation. Yet numbers and graphs as a source of knowledge serve to represent bodies and selves in very limited, impoverished ways. Compare these flat forms of data materialisations with the complexities of the affective embodied knowledge that constitutes a response to a scent, a taste, a sound or the touch of skin.

Some design and artistic work is attempting to bring these elements of corporeal sensation into data practices and materialisations related to self-tracking. Examples of this type of

work were included in the 2014 'Grow Your Own: Life after Nature' exhibition at Trinity College Dublin (Trinity College Dublin Science Gallery, 2015). This exhibition was directed at displayed design work and aimed to invite people to consider the implications of synthetic biology – a scientific experimental process that concerns genetic engineering. The projects presented 'living machines' that resulted from collaborations between engineers, scientists, designers, artists and biohackers. It asked such questions as 'how might designed life merge into our own? Where is the boundary between our things and our selves; the designed products that we consume, and our own bodies and identities?' (Trinity College Dublin Science Gallery, 2015). Such questions, as I have argued in this book, are also central to understanding self-tracking cultures and practices.

One of the projects on display is the 'self-made' human cheese project by Christina Agapakis and Sissel Tolaas. This project involved using human microbiota (in other words, bacteria that live in the human body) taken from the skin of several people to culture cheeses, each of which had developed from the specific microflora of these people. The exhibition displayed these cheeses to the public and invited its members to smell the individual microbial projects. Just as each human body has a unique microbial collection, so too the cheese that is made from each person's microbes emits a unique odour. This project therefore highlights the intersections between individual features of people's bodies – features of which they may not be overtly aware – and how these data – in this case, their unique skin microbial collection – may be converted into another material form and identified by others via the sense of smell (Agapakis and Tolaas, 2014).

In another exhibition, by Heather Dewey-Hagborg and entitled 'Stranger Visions', the artist created portrait sculptures from the analysis of human genetic material that she collected from public places: specifically, DNA (desoxyribonucleic acid) that had been left on cigarette butts discarded in the streets of Dublin. She used elements of the genomic profile that was created from this DNA – namely elements related to physical traits – to print out a 3D model of the person's face, in an attempt to imagine his or her appearance. Dewey-Hagborg's intention was to provoke audiences into

contemplating the possibility that people's DNA could be taken from detritus that they had unknowingly left behind and their identity inspected (Dewey-Hagborg, 2012–13). In her work, Dewey-Hagborg displays a collection of her own bodily products, which she has gathered over a 24-hour period (A Day in the Life, 2014). These include hair left in her brush, used tissues and nail clippings. These ephemera are used to stimulate reflection on the ways in which such objects can be analysed for DNA (by oneself or others), as a form of self-tracking or as a mode of surveillance exerted by others. As Dewey-Hagborg's work suggests, as material objects become invested over time with the marks of our use, they too can become data: repositories of information and sources of inspiration for reflection about ourselves and our lives.

Designers are beginning to use 3D printing technologies as a way of rendering people's digital data into three-dimensional forms that can be touched. Rohit Khot and colleagues (Khot, Hjorth, and Mueller, 2014), for example, have investigated the use of 3D printing to produce material artefacts that represent an individual's heart rate during physical exertion. The idea of such artefacts is to encourage people to achieve greater awareness of their personal data and to engage in self-reflection upon being confronted with the material representation of these data. Previously this kind of stimulus through objects has been confined to artwork installations, scientific experiments and education rather than extending over people's interpretations of the meanings of data (Stusak, Tabard, Sauka, Khot, and Butz, 2014). Khot, Hjorth and Mueller (2014) argue that, as any given physical activity is a material, embodied practice, material representations of the data related to this activity – representations that can be handled and touched – help people to make sense of their data. They characterise this approach as employing a 'physical–digital–physical' mode of interaction, 'where physical energy is first invested in generating data such as heart rate, which is then converted back to a material form, re-entering the physical world' (Khot, Hjorth et al., 2014: 2).

Khot, Hjorth and Mueller tested their system, entitled SweatAtoms, via six households that used five different material manifestations of their physical activity. These artefacts

included a 3D graph of heart-rate data, a flower shape where the length and width of the petals represented heart-rate duration and intensity, a frog shape that changed in size according to the amount of physical activity carried out during one day, a die representing the six zones of heart-beat data, and a ring displaying the number of active hours in a day. The participants were supplied with a digital heart-rate monitor, an iPod Touch endowed with an app for collecting the data, and a 3D printer for their homes to print out the artefacts from their data. The researchers found that viewing and handling the objects helped people gain a sense of their bodily data and illustrated different levels of engagement with these data. They concluded from their investigations: 'we envision people crafting their world with moments from their lives, using data that was [*sic*] previously only seen in digital form but now re-entering their physical world in an embodied material form' (Khot, Hjorth et al., 2014: 9). They found that the emotional connections that people had with their personal data were strengthened by the ability to handle these objects.

With other collaborators (Stusak et al., 2014) Khot has explored the idea of 'activity sculptures' – 3D printed sculptures made from physical activity data (running) extracted from popular apps. The data included the duration of a run, the distance covered, the average speed and the calories burned. The sculptures include a figure, a necklace, a lamp and a jar. Each individual piece represents a specific run by a participant in the study. The approach these designers adopt contends that encouraging people to engage with their data should be playful and emotionally appealing. These researchers recruited 14 participants with varying levels of running experience (some had none at all) and engaged them in the sculptures that were made from their running data over a three-week period. The sculptures were produced off-site and then given to the participants as if they were rewards. They were designed to be modular, so that separate pieces were given after each run to be formed together; the purpose was to make the sculpture into a further incentive for participants to continue to engage in their runs.

Here again, participants exhibited some interesting responses to the sculptures that were based on their activity

data. Several found the pieces decorative and evocative, and also as clearly representing variations in their running activities. Some enjoyed fitting the various pieces together, comparing them with other participants' pieces or displaying or wearing them. The researchers noted that such factors as curiosity, playfulness and aesthetics began to influence the ways in which the participants planned their runs, as they tried to control the shape of the pieces they would receive from each run or experimented with how certain aspects of their runs might influence the shape or size of the pieces that eventuated.

Khot is now working on using food 3D printing technologies to render bodily data into edible objects that can be consumed. He and colleagues (Khot, Lee, Munz, Aggarwal, and Mueller, 2014) have experimented with a system they call 'TastyBeats', which creates a unique, personalised drink by using heart-beat data from an individual engaged in physical activity. The height of the jet of the drink fountain used and the flavours that are produced for the drink are influenced by the heart rate of the individuals who contribute their data. The proposed system may be used to construct personalised energy drinks that can customise the contents on the basis of the physical activity data of each user. In this concept such aspects as the colour and flavour of the fluid produced by the drink fountain as well as the intensity of the liquid flow in the fountain act to represent the physical data in sensory ways. Khot and collaborators Ryan Pennings and Floyd Mueller from the RMIT Exertion Games Lab are also working on a project named 'Edi-Pulse' (originally 'Sweet-Hearts'), which transforms self-tracked heart-rate data into 3D chocolate materialisations. The idea is to reward people for engaging in physical activity with a chocolate that represents the level of exertion to which they have engaged in it. The energy expended in exercise is converted into food energy, which then acts to create more energy in the body (Millsaps, 2014).

Another design researcher, Stephen Barrass, has used a different technique, acoustic sonification, to render personal self-tracked data into objects, or 'as a medium for telling stories about numbers' (Barrass, 2014: 1). He used his own data from a year of blood-pressure monitoring to produce a

version of a Tibetan singing bowl – what he calls the Hypertension Singing Bowl. The bowl was fabricated from stainless steel by using 3D printing. The act of rubbing the inside of the bowl with a special stick produces a musical sound. Barrass' personal bodily data are therefore configured into an object that both is visual and tactile and can produce a unique sound. Each set of data produces a bowl that is slightly different in its proportions, and therefore in its acoustic properties. Barrass argues that not only can people see and hear this physical manifestation of their blood-pressure readings, they can also use the sound as a reflective stimulus that helps them calm their bodies and therefore reduce high blood pressure. This data object can therefore act as both a representation of personal data and an intervention in the type of data that are subsequently generated.

The importance of context

I have remarked above on the value that is given to metricisation in accounts of the quantified self and other self-tracking practices. However, in recent years there has been evidence of a growing cynicism in some popular outlets concerning the value of the data gained from metrics. As expressed in an article for *The Huffington Post*, it can be difficult to discern the meaning and value of one's data. The author further notes that simply 'knowing your number' may not be enough to change a person's behaviour:

> We can visualize the data we collect from countless gadgets, but will we understand what the data means [*sic*]? Even if you know your retirement 'number' does that knowledge empower you or unnerve you? How does the data [*sic*] vary under a variety of conditions and factors? For example, does a rapid heart rate indicate an underlying disease or did you forget that before you downloaded the data you ran up the stairs to access the web as fast as you could to use that new supercool health visualization app? (Coughlin, 2014)

From this perspective, numbers alone tell us nothing. It is the contexts in which numbers (or any other forms of data

about the self) are created that are important. As two designers put it:

> context humanizes the numbers and places them back into our lives in meaningful ways. For example, a fitness tracker can tell us that our physical activity is down from the previous month. But it cannot tell us that the inactivity is due to a sprained ankle. Given that context, those declining numbers might tell a different story: that we are recovering steadily rather than slacking off. Even in that simple scenario, it is clear that a small bit of context can frame data in a much more insightful way. (Boam and Webb, 2014)

An example of the importance of context in relation to personal data is given by a man who identifies himself on his blog only as 'Morris' (Morris, 2014). Morris uses a Narrative mini-camera clipped to his clothes to take photos automatically throughout the day. In a blog post he reflects on what he does with the digitised images that are stored in his Narrative folder. After six months of use, Morris has over 200,000 images in his folder. He bought the camera to get assistance in his daily journaling, where he writes down everything that has happened to him that day. The images taken by the camera serve as an aide-memoire, reminding him of 'what I have done and what I have left to do'. The photos also serve to make him more aware 'of how many people I see every day but do not interact with'. Morris remarks that reviewing his images

> has given me another feeling of community that I did not quite realize. There are so many other people out there, in the street, in the metro, that pass through the same environments and that are mostly like me in the end. I recognize some of them now in the street, in the metro, and I feel more of a sensation of community, closeness. (Morris, 2014)

Morris observes that, if he had not photographed these people regularly and reviewed the photos at the end of each day, he would not have recognised them again. This would have led to his feeling more anonymous as he walked through those public spaces, 'possibly more an independent object in a colder world' (Morris, 2014).

These types of observations go well beyond reacting to 'counting' or 'numbers'. They are affective responses to everyday interactions, responses based on the interpretation of the content of images. Indeed, as I remarked in Chapter 3, people respond emotionally to the data they generate from self-tracking, and their emotions may be highly evident in how they display or talk about their data. The intimacy of revealing one's personal details to others is part of the context in which they are gathered and displayed. The format of the 'show and tell' on the Quantified Self website is directed at asking people to explain the following aspects of their self-tracking practices: 'What did you do? How did you do it? What did you learn?' (2014 QS Europe Conference, 2014). These talks open a window on often very private aspects of people's lives: how they are dealing with grief at the loss of a family member, coping with a chronic illness or attempting to give up smoking or lose weight, how long they sit in front of their computer, at what times they go to bed and wake up, how parenthood had changed their lives, what their dreams and their moods are. Therefore, for those who choose to share their data, whether during a show and tell at a meeting or online, there is a strong confessional dimension: 'These are my data; this is what these data reveal about me.'

Sharing one's data has implications not only for how users view and understand their own bodies but for how other members of the quantified-self community view and respond to them. The practice of quantifying the self, in this context, is not merely about monitoring and measuring oneself. It is also, and centrally, about communicating dimensions of the self by using visual or other material based on one's data, about seeking to help others see and understand patterns in the data and perhaps make connections to their own data in productive ways. Selecting when and to whom to reveal these details of their personal lives and the extent to which they themselves wish to be reminded of them can be significant choices for self-trackers.

An important aspect of the troves of personal data that are collected about people as part of self-tracking is the extent to which they constantly remind them of events and times of their lives. For some, these may be painful memories, which

they would rather forget (Allen, 2008; Sellen and Whittaker, 2010). This dimension of self-tracking is articulated in a blog post by Rachel Metz, who writes:

> there were some moments captured by my life-logging cameras that I'd rather not relive, like one particularly stressful Saturday night I spent at the wood shop helping my fiancé, Noah, finish up a project. The Narrative Clip's camera captured hours of exhaustion and irritation as we fumbled to glue little pieces of wood into small slots cut out of a giant map. I had pretty much forgotten about that miserable night until I glanced back at a set of images that show Noah in the corner of the frame with a sad look on his face. Every time I look at it, I wince. (Metz, 2014)

Self-trackers may not be able to control the extent to which they come face to face with personal details that they would rather forget. The concept of 'inadvertent algorithmic cruelty' was introduced in a blog post by Eric Meyer (2014), who wrote movingly about how Facebook's 'Your Year in Review' – a function that is offered to users – distressed him. That year his young daughter Rebecca had died. Meyer avoided participating in that function (which is optional), but was still given continual reminders by Facebook, and some messages used images of his dead daughter. He was unable to avoid these constant reminders of his loss.

Some commentators seek to describe the concept of the 'qualified self' as a practice involving reflection and the interpretation of information, whether the latter is in the form of numbers or not. The qualified self involves the interpretation and assessment of any form of data – a reflexive engagement with this information that seeks to contextualise it in relation to other forms of data. The practice of self-tracking can therefore be regarded as a way of thinking information through as well as thinking *with* it, working to make connections between one kind or source and others. The validity or the quality of the information is interrogated: 'Where the *quantified* self gives us raw numbers, the *qualified* self completes our understanding of those numbers. The second half completes the first half' (Boam and Webb, 2014). Davis (2013) has similarly contended:

> This qualitative component is key in mediating between raw numbers and identity meanings. If self-quantifiers are seeking self-knowledge through numbers, then narratives and subjective interpretations are the mechanisms by which data morphs into selves. Self-quantifiers don't just use data to learn about themselves, but rather, use data to construct the stories that they tell themselves about themselves.

When self-tracking is viewed in this way, what is important for self-trackers is the range of the information that can be gathered about themselves, the specific types of information they choose to collect, and the process of making sense of this information. Davis refers to the 'stories that [self-trackers] tell about themselves'; but self-tracking is also about the stories that people tell others, or the types of selves that are presented to others. Indeed, as I asserted in Chapter 3, the very act of self-tracking, or positioning oneself as a self-tracker, is already a performance of a certain type of subject: the reflexive self-monitoring subject.

This distinction between the quantified and the qualified self works towards challenging the notion of 'the quantified self'. Indeed it may be contended that the essential feature of the quantified self, at least as it is described in the motto 'self knowledge by numbers', is self-knowledge, however it is produced. Here the word 'numbers' really comes to stand for 'information of any kind about oneself', and 'self-knowledge' means not only the accumulation of facts about oneself and the interpretation of these facts, but also a heightened recognition of the implications of confronting one's personal information and sharing it with others. Collecting and aggregating personal data therefore contribute to a range of practices that involve self-knowledge, self-expression and sometimes the unburdening of weighty emotions or private insights about the self. Self-tracking becomes performative, both for the insights that a self-tracker may achieve about her or his life and in terms of the aesthetics of the data that she or he may be able to curate and the decisions the self-tracker makes about which information to voluntarily share with others, which to keep private and which to try to ignore or avoid.

The discussion in this chapter has focused on personal data meanings and practices. The data produced by self-trackers

are generally represented as 'small' and human-made, wrought from the personalised decisions and individual objectives of the people who gather them. Yet, if these data are generated by digital devices, they are often aggregated into big data sets and become part of the digital data economy. This raises issues about data politics, security and privacy in terms of the ways in which people's personal details are accessed by other parties. These issues are the focus of the next chapter.

5

'Data's Capacity for Betrayal'

Personal Data Politics

In the previous chapter I discussed the ways in which self-trackers seek to make sense of, materialise and use their personal information. Beyond these reflexive data practices, some self-trackers confront the next level of data use: where and how their personal data are stored, how they are harvested by other actors, what these actors do with their data and how they can gain better access to them. This chapter addresses these political dimensions of personal data.

Exploited self-tracking

Several years ago, when digital technologies were beginning to be used for self-tracking, Dodge and Kitchin (Dodge and Kitchin, 2007; Kitchin and Dodge, 2011) raised some important questions about the data that are produced through lifelogging practices. Here are some of their questions: Who (other than the creator) should have access to the data archives that are preserved in a lifelog? Should other people, whose data may be included in an individual's data archives, have access to some or all of the data contained in those archives (for example, images of them or details about them?) To what extent could the material be sequestered for legal cases? To what extent would deletion of data or suspension of data

gathering from a lifelog be considered a sign of guilt if the lifelog were to be used in a legal case? Could other actors insert false information into a person's lifelog, thus creating false memories? What happens to lifelog data after the death of the creator? What are the inheritance rights? How much more valid than human memories are these data to be considered? How long will lifelogs remain an act of choice and free will – will their collection become mandatory and be imposed by (some) authorities? Should portions of a lifelog be available for erasing or modifying? What details should be preserved? Is there a need to forget misfortunes and errors? What happens if one's lifelog data are stolen and used by others? Who has control over a child's lifelog?

An important implication of automated digital recording of a greater amount of personal information is that such technologies lack the power to discriminate. They simply continue to record details, leaving no sign or mark of what is important, which details should be preserved and which could be relinquished (Kitchin and Dodge, 2011). Dodge and Kitchin (2007: 439) contend that lifelogs have the potential to fulfil a 'marketer's dream' – if that marketer is able to get access to the wealth of personal details in a lifelog, including the self-tracker's purchasing and consumption habits. The two authors envisage incidents in which third parties might use this information for social sorting, invasive profiling and disciplining. They raise the possibility of insurance companies and other commercial entities requiring access to lifelog data for the benefit of calculating risks and premiums or for the purpose of according preferential treatment to some customers – while others, who fit certain profiles, would be penalised. Dodge and Kitchin also identify the possibility that society would become more conservative once people are aware that their personal information can be accessed by others and used against them, thus making public forbidden, indiscreet or criminal behaviours.

Dodge and Kitchin were writing before the widespread use of cloud computing, the growth in the collection and use of personal data by internet companies such as Facebook, Amazon and Google and the spreading of self-tracking practices beyond the realm of the private and the consensual. The

uses of the personal data that people have generated through self-tracking – that is, the uses that Dodge and Kitchin envisaged several years ago – have largely eventuated as the two authors predicted.

I have referred throughout this book to the notion of 'lively data', as the feature involved in this notion participates in the digital data economy. As I have argued, one dimension of the vitality of digital data relates to the multiple ways in which different actors and agencies may use them for their own purposes. This multiplicity has major implications for how the information that people collect about themselves, as part of self-tracking endeavours, is used (or indeed misused) by others. The exploitation of people's personal information by second and third parties is a significant political issue, not simply because of the data privacy and security issues involved but also because of the ways in which people's personal information has become valuable for these parties. The collection of personal data is now not only a mode of consensual, individually driven imperatives for self-improvement, but also an element of (sometimes illegal) commercial profiteering, population monitoring and governance.

Indeed one might view the knowledges that are created through self-tracking practices as a new element of biopower or vitality expertise. The movement of self-tracking cultures into commercial, managerial and government domains combines the rationalities of biocapital with those of the digital data economy. Biocapital involves the derivation of value from biological entities such as human bodies (Rose, 2008), while the digital data economy positions digital data objects as valuable. Just as other forms of human life – such as human gametes, blood, tissues and cells – have become commodified and invested with monetary value, so too have the digital data assemblages that are configured on human bodies via self-tracking. Indeed the value attributed to personal digital data assemblages combines two kinds of value: one related to the digital data economy and one emerging from the capitalisation of the human body. Many self-tracking practices involve the rendering of bodily attributes and dispositions into digital data. They produce value in terms of the intimate biodigital knowledges that they generate from

individuals, and therefore self-tracking practices may be described as generating digital biocapital.

The creation of digital content – that is, prosumption on online platforms and apps – can be viewed as a form of work. Indeed some scholars have represented prosumption in general as free digital labour, in which people who generate these data do so for the commercial benefit of other actors and agencies. Their labour is exploited because, while they may benefit personally from their acts of prosumption (for example, by enjoying free access to platforms and apps and opportunities to interact with others, use the information provided there, or monitor their bodies and behaviours closely), others are profiting financially from this freely given content (Fuchs and Dyer-Witheford, 2013; Rey, 2012; Till, 2014). People are not offered financial compensation, nor do they receive it for providing their experiences. The value that prosumers derive is noncommercial, while the exchange value of the data they create is accumulated by the for-profit companies that provide the platforms for people to share their experiences or to trawl the web, harvest the data and render it into a form that is valuable for commercial entities.

The exploitation of prosumers' personal information frequently occurs when people use apps and other software for self-tracking. Many commercial companies are interested in the type of details about health, physical activities and consumption patterns that are revealed by the information collected by self-trackers on their bodies and lives (Till, 2014). For example, when people engage in user experience platforms such as PatientsLikeMe, they are encouraged to share the information they have collected about their bodies, medical conditions and treatments with other patients with the same condition. These data are valuable not only to other patients, for the insights they offer them, but also to the platform developers, who on-sell these data, and to other third parties, who use them for research into medical conditions, for clinical trials of new pharmaceuticals, or for purely commercial purposes – as do medical device manufacturers and pharmaceutical companies, for instance (Lupton, 2014).

The burgeoning business of data harvesting and data brokering involves a process whereby companies are scraping the

web for whatever they can find about people; in other words it involves the sale of the data that have been generated through the use of apps and other software. Data-harvesting and brokering companies use the information they can find online or have bought from developers in order to construct 'profiles' that provide detailed descriptions of the behaviours and health states of the people profiled. Drawing on this information, some companies create lists of people who have been sexually assaulted, diagnosed with a mental health condition or a sexually transmitted disease, designated as impulse buyers or credit risks, or accused of wrongdoing. These lists are sold to marketers, financial institutions and potential employers (Pasquale, 2014).

The advent of big data, together with the opportunity to mine them for personal information, has created new possibilities for social and economic discrimination against the disadvantaged and against minority social groups. Here one could mention the potential for predictive privacy harms, which covers cases where individuals are adversely affected by assumptions and predictions made about them on the basis of preexisting digital data sets (Crawford and Schultz, 2014; Robinson, Yu, and Rieke, 2014). Predictive algorithms that draw on personal digital data are used now in many social and economic domains. This new practice can affect people's access to healthcare, credit, insurance, social security, educational institutions and employment options and render them vulnerable to unfair targeting by policing and security agencies (Crawford and Schultz, 2014; Nuffield Council on Bioethics, 2015; Rosenblat, Kneese, and boyd, 2014). What is more, it can be difficult to challenge such assessments or to seek to have certain personal details removed from digital data sets, even if the data on which they are based are proven to be inaccurate.

Some employers have begun to use the algorithms of specially designed automated software for the purpose of selecting employees; they are also engaging in online searches through search engines or professional networking platforms such as LinkedIn in order to seek out information on job applicants (Rosenblat, Kneese et al., 2014). Now that diverse databases holding personal details on various aspects of people's lives can be joined together for analysis,

information on features such as a job applicant's health status or sexual orientation may become identifiable (Andrejevic, 2014). One recent study found that Google directs fewer higher-paid job advertisements to female than to male users in search of employment sites, in a clear case of algorithmic discrimination based on gender (Datta, Tschantz, and Datta, 2015).

Insurance and credit companies are scraping big data sets to develop customer profiles, with the result that disadvantaged groups suffer further disadvantage by being targeted for differential offers or excluded altogether because they are not viewed as profitable or as poor credit risks (Libert, 2014; Robinson et al., 2014). Data brokers in the United States use available personal data to calculate certain predictive 'health scores' on patients with the help of digital data; such scores include the Affordable Care Act (ACA) individual health risk score, which is used for assessing the risk factor for an individual who requires healthcare (Sarasohn-Kahn, 2014). Some American hospitals are purchasing from data-broking companies data on their patients' credit card transactions and information about them in public records and and in customer loyalty programs, in an attempt to use predictive algorithms for creating models that identify 'high-risk' patients. These patients will then be contacted by the hospital as part of an intervention program that seeks to prevent ill health and reduce healthcare admissions (Pettypiece and Robertson, 2014).

The legal implications of the use of personal data archives for evidence are just beginning to emerge. In 2014 the first known case where an individual's self-tracking data (collected by her Fitbit physical activity tracker) were used as legal evidence in a personal injury lawsuit received media attention. A Canadian fitness instructor sought to use her physical activity data, collected by her Fitbit, to demonstrate reduction in her activity after an injury. Her lawyers used the data analytics platform Vivametrica to compare this woman's physical activity data with those of the general population. Commentators on this case speculated that similar self-tracked personal data could be used in the future not only to support people's lawsuits, but also as evidence to prosecute them in litigation (Olson, 2014a).