2016 - Peer Reviewed Journal Article

Version:

This is an Accepted Manuscript of a work that was published by Taylor & Francis in *Economy and Society* on 15 Apr 2016 which has been published at https://doi.org/10.1080/03085147.2016.1143726

Changes resulting from the publishing process may not be reflected in this document.

The Diverse Domains of Quantified Selves: Self-Tracking Modes and Dataveillance

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Abstract

The concept of self-tracking has recently begun to emerge in discussions of ways in which people can record specific features of their lives, often using digital technologies, to monitor, evaluate and optimise themselves. There is evidence that the personal data that are generated by the digital surveillance of individuals (dataveillance) are now used by a range of actors and agencies in diverse contexts. This article examines the 'function creep' of self-tracking by outlining five modes that have emerged: private, communal, pushed, imposed and exploited. The analysis draws upon theoretical perspectives on concepts of selfhood, citizenship, dataveillance and the global digital data economy in discussing the wider sociocultural implications of the emergence and development of these modes of self-tracking.

Introduction

Notions of selfhood, embodiment and social relations have increasingly become developed via digital technologies. Many social and commercial interactions now take place online, most homes, educational settings, healthcare institutions, security and policing enterprises and workplaces have become digitised to a greater or lesser degree. Physical spaces have become embedded with sensors that can detect humans' movements and other activities. The digital data that are continually generated by individuals when they use digital technologies have become invested with value and status. A global knowledge economy has developed that relies in part on the generation and use of the data that are collected by digital technologies. What is constituted as knowledge and the ways in which knowledges are used for commercial, research, managerial, security and governmental purposes have become intertwined with digital forms of data generation. Indeed, it has been contended by some theorists that power

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now operates principally via digital modes of communication. In this context, the software, hardware devices, the digital data that they generate and the algorithms that make sense of these data have become key actors in constituting and exploiting knowledges (Amoore & Piotukh, 2015; Kitchin, 2014; Lash, 2007; Thrift, 2005).

The concept of 'self-tracking' has recently begun to emerge in discussions of ways in which people can monitor and record specific features of their lives. Self-tracking is also referred to as lifelogging, personal analytics and personal informatics. In recent years, 'the quantified self' has become a popular term to describe self-tracking in the wake of the establishment of the Quantified Self website and movement, involving online interactions and face-to-face meetings and conferences . Once the data are collected, self-tracking practices typically incorporate organisation, analysis, interpretation and representation of the data (such as producing statistics or graphs and other data visualisations) to make sense of them, and efforts to determine how these data can offer insights for the user's life. With the advent of mobile and wearable digital devices and associated software, such details can be more readily collected, analysed, searched, aggregated, visualised and compared with others' data than ever before. It is on the new digitised strategies for self-tracking that I focus here. I contend that these technologies are raising new issues concerning the use of people's personal information about their lives and bodies. These include the ways in which this information is purposed and repurposed as part of the global digital knowledge economy, data privacy and security issues and the implications for concepts of selfhood and citizenship.

Digitised self-tracking is a form of dataveillance, or the watching of people using technologies that generate data, increasingly in digitised formats (Raley, 2013; van Dijck, 2014). Digitised self-tracking technologies promote a culture of dataveillance and offer diverse methods by which it is undertaken. A distinction should be made between the type of dataveillance of the self that is undertaken for self-tracking purposes and other forms using monitoring technologies. Many dataveillance activities monitor people in ways of which they may be unaware: closed-circuit television (CCTV) camera and sensor-monitoring of people's movements in public spaces, national security agencies' and policing bodies' surveillance of communication metadata and internet companies' commercial data-harvesting activities, for example. Other forms may be more obvious to those who are the subjects of dataveillance – such as biometric screening at airports. The subjects of these types of dataveillance do not usually have access to the information that is collected on them.

In contrast, self-tracking involves the data subjects themselves being confronted with their own personal information, and in many cases, being invited to engage with this information in some manner as part of optimising and improving their lives. They are therefore engaging in self-surveillance. As part of self-tracking, they may also participate in social surveillance (observing other people's data and sharing their own in social media platforms) (Marwick, 2012). Social surveillance is itself an element of 'sousveillance', or 'watching from below' (Mann & Ferenbok, 2013), which differs from classic surveillance, or 'watching from above'. The use of digital self-tracking technologies blurs the spatial boundaries between public and private surveillance, bringing public surveillance into the domestic sphere but also often extending private surveillance out into public domains.

Self-tracking at first glance appears to be a highly specialised subculture, confined to the chronically ill, obsessives, narcissists or computer geeks, or simply people who are already interested in optimising their health, physical fitness and productivity. These are certainly the

meanings that tends to be portrayed in popular representations of quantifying the self (Lupton, 2013c). As I will demonstrate, however, this form of dataveillance is becoming used in situations where the choice to participate may be limited. The concept and practices of self-tracking are now dispersing rapidly into multiple social domains, displaying evidence of 'function creep'. Increasingly, the collection and analysis of personal data via self-tracking practices are advocated and implemented in many social contexts and institutions, including the workplace, education, medicine and public health, insurance, marketing and commerce, energy sustainability initiatives, the military, citizen science and urban planning and management.

As yet, there has been no sustained examination of the spreading out of self-tracking cultures and practices from the purely personal into multiple social domains. This article examines these issues, focusing on a typology I have developed of the five distinctive modes of self-tracking that have emerged in recent times. These are private, pushed, communal, imposed and exploited self-tracking. These categories are for heuristic purposes; a means to distinguish and elaborate on the ways in which self-tracking has become diversified. There are, of course, intersections and recursive relationships between each of these self-tracking modes. However there are also observable differences related to the extent to which the self-tracking is taken up voluntarily and the purposes to which the data thus created are put that are useful to explore as part of outlining the spread of the ethos of self-tracking. What I call 'private self-tracking' is undertaken for voluntary and personal reasons that are self-initiated. 'Pushed self-tracking' involves encouragement for people to monitor themselves from other agencies while the mode of 'communal self-tracking' relies on people sharing their personal information with others. 'Imposed self-tracking' involves moving from encouragement to requiring people to collect or engage with data about themselves in situations in which they have little choice. The 'exploited self-tracking' mode represents the use of personal data by other actors and agencies for their own purposes, either overtly or covertly.

Technologies of self-tracking

Monitoring features of one's life and reflecting upon them are not new strategies of selfhood. Traditional self-tracking practices have included ages-old strategies such as journaling and diary-keeping. However the recent focus on monitoring the self in both popular forums and the academic literature centres on using digital technologies. Mobile digital devices connected to the internet, devices and environments that are fitted with digital sensors and the possibilities for data archiving and sharing that are afforded by computing cloud technologies have contributed to the ever-more detailed measurement and monitoring of people's activities, bodies and behaviours in real time. People who engage in self-tracking may use devices that they carry or wear on their bodies, software for their mobile or desktop computers or generate data from 'smart' objects with which they interact.

Self-tracking for self-knowledge and self-optimisation using digital technologies began to gather momentum with experiments by North American computing engineers Gordon Bell, Steve Mann and others with lifelogging and early versions of wearable digital technologies from the 1970s onwards (Mann, 2013; "MyLifeBits," 2015). Digitised self-tracking gained greater public attention with the establishment of the Quantified Self movement in 2007 by two *Wired* magazine editors, Gary Wolf and Kevin Kelly. Wolf and Kelly had noticed that several of

their friends and colleagues had begun to engage in digitised self-tracking. They began to host meetings and went on to establish the official website (("Quantified Self," 2015) and its associated Quantified Self Labs, a collaboration of users and tool makers who are interested in working together to share expertise and experiences of self-tracking. Reference to the quantified self (either as a concept on its own or directly referring to this movement and website) has grown since the early years of the Quantified Self and has now firmly entered the cultural lexicon (Lupton, 2013c).

Digitised self-tracking has attracted a high level of attention from developers and entrepreneurs seeking to capitalise on the practice. The technologies themselves are viewed as a major source of potential revenue for digital developers and entrepreneurs, who are taking a keen interest in how best to produce technologies to market to self-trackers, and often attend Quantified Self meetups and conferences (Boesel, 2013; Nafus & Sherman, 2014). Tens of thousands of self-tracking apps are available for downloading to smartphones and iPod devices. Smartphones themselves include in-built sensors such as GPS, gyroscopes and accelerometers that can be employed for self-tracking and iPod Nanos come already equipped with fitness tracking apps such as Nike+ and a pedometer. The new Apple Watch incorporates even more sophisticated biometric monitoring sensors and includes two physical activity apps for self-monitoring. The Quantified Self website ("Quantified Self guide to self-tracking tools," 2015) lists over 500 self-tracking tools, including in addition to geolocation, health, fitness, weight, sleep, diet and mood or feeling tracking apps, services and devices that are able to record social interactions, emails, networks and social media status updates and comments. Other listed tools also allow users to track their meditation practices, television watching, computer use and driving habits, financial expenses, time use, beneficial habits and work productivity, and to monitor local environmental conditions, progress towards learning or the achievement of personal goals.

A number of 'smart' objects provide capacities for self-monitoring. Cars can now monitor driving habits and drowsiness, alerting drivers if they are at risk of falling asleep at the wheel. Mattresses can monitor sleep patterns and body temperature; chairs can sense physical movements, and 'smart' shoes and clothing can record activity and other physical data. 'Smart' homes use sensors to monitor their inhabitants' movements and 'smart meters' to track their domestic energy use. The term 'smart cities' is now often used to encapsulate the intersections of data from smart objects that are both sited in public spaces and used for personal reasons in the private domain, while 'smart schools' employ predictive learning analytics to create data profiles on individual learners as part of working towards educational objectives. The discourses and practices contributing to all of these 'smart' initiatives continually emphasise the importance not only of generating personal data about individuals but returning these data to that people can reflect – and importantly – act on this information. As the Internet of Things develops, some of these smart objects can now exchange data with each other, so that, for example, users' smart home thermostat system can now read the sleep data from their wearable device to ensure that the heating switches on as soon as users begin to wake in the morning. As this suggests, the concept of 'self'-tracking may be extended well beyond the envelope of the individual human body.

Modes of self-tracking

Private self-tracking

A major feature and attraction of self-tracking for many practitioners is using the information they collect on themselves to achieve self-awareness and optimise or improve their lives. The data and the knowledge contained therein are represented as enabling self-tracking practitioners to achieve better health, higher quality sleep, greater control over mood swings, improved management of chronic conditions, less stress, increased work productivity, better relationships with others and so on. In many cases, this is all self-initiated and voluntary, as part of the quest for self-knowledge and self-optimisation and as an often pleasurable and playful mode of selfhood.

Private self-tracking, as espoused in the Quantified Self's goal of 'self knowledge [sic] through numbers', is undertaken for purely personal reasons and the data are kept private or shared only with limited and selected others. Portrayals of self-tracking in the popular media often focus on this mode, with regular references to the 'narcissism' or 'self-experimentation' that self-tracking supposedly involves (Lupton, 2013c). The private self-tracking mode is often articulated in accounts that seek to define the self-tracking phenomenon. According to the Quantified Self Institute, a research body that is part of the Hanze University of Applied Sciences in the Netherlands and associated with the Quantified Self founders, self-tracking 'is a functionally "selfish" activity, which is a result of a personal motivation. "Me and my data", that is the point of the Quantified Self' (de Groot, 2014).

Research investigating the motives of self-trackers has demonstrated that they often involved for private and personal reasons. Many self-trackers have specific goals that they wish to achieve via monitoring efforts while others simply wish to document aspects of their lives (Epstein, Ping, Fogarty, & Munson, 2015; Nafus & Sherman, 2014; Rooksby, Rost, Morrison, & Chalmers, 2014). One study of American self-trackers (I. Li, Dey, & Forlizzi, 2011) found that the reasons the participants gave for engaging in self-monitoring were related to curiosity about what their data would reveal, an interest in quantitative data and numbers in general as part of being a 'geek' or experimenting with new tools for self-tracking, acting on a suggestion from another person, and trigger events, such as suffering from sleep problems, wanting to lose weight or developing an illness. Another study analysed 52 videos of meet-up talks posted on the Quantified Self website (Choe, Lee, & Schraefel, 2015). The researchers found that members of the largest group of self-trackers were monitoring health-related factors such as physical activity, food consumption, weight and mood. Another group was interested in tracking their work productivity and cognitive performance. A third group was identified, comprised of people who wanted to have new life experiences through self-tracking as part of experimenting. Indeed, the term 'self-experimentation' was frequently used across the speakers as relating to finding meaning knowledge about themselves that they could use for self-optimisation.

There is a strong emphasis on personal experience in the Quantified Self community. People who discuss their self-tracking practices in Quantified Self forums are encouraged to talk about 'What I did, how I did it and what I learned'. In this and other self-tracking circles, the concept of 'n=1' is often articulated, conveying the idea that collecting data is a personal enterprise that is limited to the individual. Not only do self-trackers make choices about what

data about themselves are important to collect, but they also make sense of and use data in highly specific and acculturated ways. They seek to make connections between diverse sets of data: how diet, meditation or caffeine affects their concentration, for example, or how their mood is influenced by exercise, sleep patterns or geographical location, or the specific interactions of all of these variables. Indeed, the very idiosyncrasy or uniqueness of many self-trackers' interests and consequent self-tracking data practices means that their data may not be interesting or valuable to others as it is not easily transferrable (Nafus & Sherman, 2014; Rooksby, et al., 2014).

Although digitised self-tracking as a phenomenon has been increasingly reported in the popular media, particularly in relation to the Quantified Self movement (Lupton, 2013c), using digital technologies to do so is still the practice of only a minority of people (Fox & Duggan, 2013). They are principally drawn from the ranks of younger, socioeconomically privileged and health-conscious and technologically-oriented people (I. Li, et al., 2011; Nielsen, 2014). A Nielsen market research survey in early 2014, for example, found that only one in six of the American adults used wearable devices (including digital fitness-tracking bands) in their daily lives. While women and men were equally likely to use them, owners of fitness bands, in particular, were more likely to have a high income (Nielsen, 2014). Many such individuals associate themselves with the 'geek' culture of the Quantified Self movement and associated website and meeting groups (Choe, et al., 2015; Nafus & Sherman, 2014; Ruckenstein & Pantzar, 2015).

Pushed self-tracking

Pushed self-tracking departs from the private self-tracking mode in that the initial incentive for engaging in dataveillance of the self comes from another actor or agency. Self-monitoring may be taken up more or less voluntarily, but in response to external encouragement or advocating rather than as a wholly self-generated and private initiative. In pushed self-tracking, those who are advocating others to engage in these practices are often interested in viewing or using participants' personal data for their own purposes. Self-trackers may not be provided with the opportunity to choose whether to share their information with others.

In a growing number of forums, self-tracking is advocated as a means for achieving behavioural change in target groups to achieve better health or other outcomes. This approach is referred to in computing science research as 'persuasive computing', or using digital technologies to 'nudge' people into behaviour change (Purpura, Schwanda, Williams, Stubler, & Sengers, 2011). Advocates for pushed self-tracking are particularly evident in the patient self-care, health promotion and preventive medicine literature. Arguments for persuading people to self-track such bodily features as their body weight and physical activity level, and in the case of patients with chronic illnesses, such aspects as blood glucose level and blood pressure are becoming increasingly common in this literature. In this context, the personal data generated from self-tracking are represented as pedagogical and motivational, a means of encouraging self-reflection or emotional responses such as fear, guilt or shame that will then lead to the advocated behaviour changes. Self-monitoring is otherwise presented as a form of self-care that allows people with chronic conditions to reduce their interactions with healthcare providers and become 'digitally engaged' (Lupton, 2013a, 2014b).

Pushed self-tracking is becoming a feature of children's lives. In many school settings, software is employed to monitor individual children's learning, and data analytics is used to track their progress, compare them with other students and to predict their future learning (Selwyn, 2014; Williamson, 2014b). Parents may purchase gaming consoles such as Wii Fit or wearable devices for their children that include gamification elements to nudge them into engaging in physical activity. These 'exergaming' technologies are also becoming used in schools as part of physical education and health curricula (Lupton, 2015a; Williamson, 2014a). Children are expected to review their data and make changes if they are defined as deficient or lagging behind compared with the norms established by these types of software.

The workplace has become a key site of pushed self-tracking, where financial incentives or the importance of contributing to 'team spirit' and productivity may be offered for participating (Moore & Robinson, 2015; Rosenblat, Kneese, & boyd, 2014). Many employers are turning to the use of digital self-tracking technologies ('digital wellness tools') as part of workplace health promotion programs or 'wellness programs'. Various software packages are now offered to enable employers to monitor their employees' health and fitness and even their sleep patterns as well as their work habits in the name of good health and worker productivity. These programs are found particularly in the US, where employers pay for health insurance coverage for their employees, and it is therefore in their financial interests to promote good health among their workers. Wearable technology manufacturers such as Fitbit are brokering deals with employers and insurance companies to sell their fitness and activity trackers and data analytics software as part of these wellness programs (Olson, 2014). Mobile apps and software programs that remind employees to get up from their desks and take exercise breaks and to help them manage stress and sleep better are becoming more often used in the workplace (Zamosky, 2014).

Insurance companies are beginning to develop other ways of incorporating self-tracking data into the calculation of risks and resultant premiums offered to customers. Motor vehicle insurers led the way with their telematic devices attached to car engines to monitor driving practices as part of 'usage-based' insurance that calculates customised premiums using these data as well as demographic information (NAIC, 2014). Health and life insurance companies in the US and elsewhere are also directly offering consumers the opportunity to use self-tracking devices for health and fitness. For example, Wellness & Prevention (a health insurance subsidiary of the Johnson & Johnson company) has developed a proprietary app, Track Your Health, that is offered solely to their customers. Track Your Health incorporates data from several third party apps and uploads these data to the company's platform. Customers can also enter their data manually into the platform or use data collected by their smartphone on their physical activity. They can then view their data to monitor their progress towards health- or fitness-related goals (Comstock, 2014).

Communal self-tracking

Although self-tracking, in its very name and focus on the 'self' may appear to be an individualistic practice, many self-trackers view themselves as part of a community of trackers (Nafus & Sherman, 2014; Rooksby, et al., 2014). They use social media, platforms designed for comparing and sharing personal data and sites such as the Quantified Self website to engage with and learn from other self-trackers. Some attend meet-ups or conferences to engage face-

to-face with other self-trackers and share their data and evaluations of the value of different techniques and devices for self-tracking. This drive towards 'sharing your numbers' fits into the wider discourse of content creation and sharing personal details and experiences with others underpinning many activities on social media platforms (Banning, 2015; John, 2013). However, the focus on personal motivation and individual benefit is often still apparent in these discussions of the communal nature of self-tracking.

While there is constant reference to the 'Quantified Self community' among members of the Quantified Self movement, this community largely refers to sharing personal data with each other or learning from others' data or self-tracking or data visualisation methods so that one's own data practices may be improved. Several commentators have begun to refer to 'the quantified us' as a way of articulating how the small data produced by self-trackers may be usefully incorporated into large data sets to 'get more meaning out of our data' (Ramirez, 2013). As this suggests, the concept of quantified us still focuses firmly on the individual's agenda. The idea is to draw on others' pooled data to further one's own interests and goals.

Indeed, some self-tracking technologies are specifically directed towards gamification and competitiveness as a means of motivating people to continue. In endeavours such as fitness and weight-loss tracking, corporate wellness programs and digitised educational initiatives for children, users are given badges and other rewards and are encouraged to compare their data with others and attempt to perform better, or else to encourage others and receive support from them (Whitson, 2013). For example, the Mathletics educational platform for children encourages participants to compete against others globally in the effort to make mathematics fun. Children earn points, items of clothing for their avatars, win certificates for participation and completing challenges and can compare their progress with others in their class or across the entire user population, including the use of a world league table that lists and ranks the highest achievers.

Another portrayal of communal self-tracking is that which is frequently championed in discourses on citizen science, volunteered geographical information, environmental activism, healthy cities and community development. These initiatives, sometimes referred to as 'citizen sensing' (Gabrys, 2014), are a form of crowdsourcing. They involve the use of data that individuals collect on their local environs, such as geographical features, air quality, traffic levels or crime rates. People may monitor their commuting, cycling or running routes or their health status as part of contributing to community efforts to generate large data sets. The concepts of the 'healthy city' and the 'smart city' are beginning to come together in some attempts to use the digitised sensing and monitoring technologies for health promoting purposes (Kamel Boulos & Al-Shorbaji, 2014). These data are used in various ways. Sometimes they are simply part of gathering collective data at the behest of local agencies, but they are also sometimes used in political efforts to challenge governmental policy and agitate for improved services or planning. The impetus may come from grassroots organisations or encouraged upon citizens as top-down initiatives from governmental organisations as part of community development.

Imposed self-tracking

Imposed self-tracking, while still in its nascent stages, is gradually becoming a feature in institutional settings. I noted above that employers are now encouraging or nudging their staff

members to engage in self-tracking, offering various incentives or simply appealing to workers' desire to improve their health or work productivity. In some work contexts, however, there is little choice offered to workers, and they may have scant opportunity to refuse to engage in dataveillance (Moore & Robinson, 2015; Rosenblat, Kneese, et al., 2014). One example is the productivity self-tracking devices that are becoming a feature of many workplaces as employers seek to identify the habits of staff members in the interests of collecting data that will assist in maximising worker efficiency or reduce costs. Some companies, including those in the banking, technology, pharmaceutical and healthcare industries, require their employees to wear badges equipped with radio frequency identification (RFID) chips and other sensors that can record sound, geo-location and physical movement to monitor such aspects of the wearers as tone of voice, posture and who they speak to and for how long (Lohr, 2014; Moore & Robinson, 2015).

Another example of imposed self-tracking is the use of digital self-tracking devices and apps in school-based health and physical education. Some physical education teachers require their students to wear such devices as heart-rate monitors to determine whether they are fully participating in set exercise activities and to compare their exertions with other students (Lupton, 2015a). In the world of academic work, software such as Web of Science and Google Scholar automatically collect publication and citation details on individual academics, thus generating various metrics about their performance. Academics have no option about whether or not they wish their publication and citation records to be publicly displayed on these platforms.

At its most coercive, imposed self-tracking is used in programs involving monitoring of location and drug use for probation and parole surveillance, drug addiction programs and family law and child custody monitoring. Digital cellular monitoring devices allow radio frequency monitoring of offenders who are serving at-home sentences. In some criminal justice systems, global positioning technologies are also used to track parolees' movements. Several self-tracking devices to monitor alcohol use are employed in programs for alcohol addiction and policing. The secure continuous remote alcohol monitoring device is used to provide alcohol testing (via the wearer's sweat) through the wearing of a bracelet or anklet. A number of such monitoring devices combine biometric tracking and surveillance technologies. For example, the Soberlink company has developed digital mobile alcohol breath-testing devices that combine alcohol-monitoring with facial recognition technologies for authenticating identity. They send text messages to clients to remind them to test their breath and send the data to designated contacts. These devices are marketed to criminal justice, family law and addiction treatment agencies.

Exploited self-tracking

As outlined in the Introduction, in the contemporary digital knowledge economy, personal data and big data sets have become invested with commercial and managerial value. Individuals' personal data (whether collected purely for their purposes or as part of pushed, communal or imposed self-tracking) are frequently repurposed for the financial benefit of others. The notion of personal data as commodities is now often articulated in commercial circles. Opportunities to practice dataveillance of individuals are viewed as valuable in informing companies about consumer habits and preferences. For example, market research

companies use self-tracking apps issued to their research subjects to gauge their habits and responses to brands, as well as harvesting data from social media interactions.

Self-tracking is also often marketed to consumers as a way for them to benefit personally, whether by sharing their information with others as a form of communal self-tracking or by earning points or rewards. Customer loyalty programs, in which consumers voluntarily sign up to have their individual purchasing habits logged by retailers in return for points or rewards is one example. Their data are used by the retailers to gather data about their customers, learn more about purchasing habits generally and to target the individual with promotions, special offers and advertising. The personal data that are uploaded by participants in these activities, therefore, are used by third parties for commercial gain.

Some retailers are beginning to use wearable devices as part of their customer rewards schemes. One example is the 'Balance Rewards for Healthy Choices' program offered by Walgreens, America's largest pharmacy retailing chain. As part of a customer loyalty program, people are offered the opportunity to 'earn points for your healthy choices' to save money on products and 'take advantage of great, exclusive offers for members'. They can do so by recording details of their physical activity, chronic disease management or progress towards a health-related goal such as losing weight or ceasing smoking and syncing the data collected by digital fitness trackers or uploading data to the Walgreens' platform or customised app (Walgreens, 2014).

Beyond these legal uses of personal data, cyber-criminals have identified the commercial value of this information. There are many privacy threats involved with uploading personal data from self-tracking devices or social media platforms to the computing cloud. These data may be hacked at the time of transmission or when archived (Barcena, Wueest, & Lau, 2014; Huckvale, Prieto, Tilney, Benghozi, & Car, 2015; J. Li, 2015). While they may originally be anonymised, some of these data may be readily de-identified by data experts. Several researchers have demonstrated, for example, how easy it can be to access information about people's use of smart meters in their homes which can potentially open them to theft and other criminal activities, or for the data to be used to make inferences about people's private activities (McKenna, Richardson, & Thomson, 2012) .

It has been estimated that health and medical information, in particular, is one of the most valuable commodities for hackers, as it can be used for identify theft, to make fraudulent health insurance claims or to access drugs and medical equipment or for blackmailing claims if these data are particularly sensitive (such as sexual identity or activity, for example) (Wicks & Chiauzzi, 2015). Various scandals involving data breaches and hacking into often very intimate personal information have received a high level of coverage in the news media since 2013. These include not only the Snowden revelations but also the celebrity nude photo hacking event and the Adult Friend Finder and Ashley Madison sex dating sites hacks, in which millions of users' sexually explicit details were released by the hackers onto the internet.

The intersections of self-tracking modes

There are intersections and blurring between the various modes of self-tracking that I have identified here. The private mode of self-tracking can merge with communal self-tracking when the focus is encouraging people to achieve community development or other collective

goals via self-tracking data. This representation of self-tracking portrays it as a civic duty in producing small data that is valuable not only or simply for personal use but also for others in one's community. Personal dataveillance is still a feature of this mode when it involves sharing data with other self-trackers, as in Quantified Self forums, but some versions of communal self-tracking incorporate notions of participatory democracy, citizenship and community. Indeed the concept of what I call 'self-tracking citizenship' involves a distribution of subjectivity that incorporates technologies and the data they gather as part of its ethos and practice (Gabrys, 2014). This dimension of self-tracking brings together the ideals of self-entrepreneurial citizens who are taking responsibility for managing and optimising their lives with sharing their personal data with others both to achieve their goals and enable others to do so .

The overlapping of self-tracking modes is apparent in platforms such as PatientsLikeMe and similar websites that have been established to promote the sharing of experiences between patients who have the same medical condition. The overt objective of these platforms is to provide a place where patients can talk to each other, exchange information and provide support, and some offer self-tracking tools for users to monitor their symptoms and therapies as well. Patients may choose to digitally track their symptoms, illness experiences and therapies (private self-tracking), but also share these data with other patients for mutual benefit (communal self-tracking). The data generated on these websites are also used by the developers and by third-parties such as medical researchers and pharmaceutical companies who are given access to the data, sometimes on payment of a fee. In some cases these third-party uses of the data may be viewed as benefiting the patient community; when new therapies are tested, for example. However, in other cases, only the developers and third-parties benefit by harvesting the patients' data for commercial gain (Lupton, 2014a). This is a form of exploited self-tracking, in which the 'little analytics' of people's volunteered personal information (Amoore & Piotukh, 2015) turns into commodified big data.

There is a fine line between pushed self-tracking and imposed self-tracking. While some elements of self-interest may still operate and a discourse of 'choice' may be employed, people may have little option of opting out. In the case of workplace wellness programs involving self-tracking of physical activity or body weight, for instance, employees may be given the option of wearing the devices and allowing employers to view their personal data. However failure to participate may lead to higher health insurance premiums enforced by an employer, as is happening in some workplaces in the US (Olson, 2014; Rosenblat, Wikelius, boyd, Gangadharan, & Yu, 2014). Workers issued with self-tracking devices for productivity monitoring may view this as an opportunity to improve their performance. Alternatively, they may feel subjected to invasive and coercive surveillance. Employees may lose their job or receive fewer opportunities for improved pay or promotion prospects if they refuse (Moore & Robinson, 2015; Rosenblat, Kneese, et al., 2014). In these contexts, the use of self-tracking devices becomes imposed upon the user where they otherwise might not have chosen to engage in dataveillance or to share their personal data with others.

Discussion

Self-tracking cultures have emerged in a sociocultural context in which various rationales, discourses, practices and technologies are converging. These include the following: concepts

of the self that value self-knowledge, self-awareness and self-entrepreneurialism; a moral and political environment in which taking responsibility for one's life as an individual rational actor is privileged and promoted; the development of audit culture; the ability of digital technologies to monitor an increasing array of aspects of human bodies, behaviours, habits and environments; the spread of surveillance technologies and diversification in their use; the metricisation and dataficiation of an increasing range of human and nonhuman phenomena; the emergence of the digital data knowledge economy, in which both small data and big data are valued for their insights and have become tradeable commodities; and the realisation on the part of government, managerial, security, commercial and criminal actors and agencies that the data derived from self-tracking can be mobilised for their own purposes. These elements are discussed below, grouped under two themes: 1) lively data and data practices, and 2) digital biocapital and data politics.

Lively data and data practices

Digital data about people may be conceptualised as 'lively' in several respects: they are information about human life itself; they have a vitality and social life of their own, circulating as they do between a multitude of sites and being continually repurposed; they have an impact on people's lives; and as important elements of the global knowledge economy, they contribute to livelihoods . This vitality of data has significant implications for how self-trackers use and share their data with others on social media and also for how they may lose control of their data as they enter the digital data economy.

The self-tracking phenomenon offers an exemplar of the ways in which digital technologies participate in the configuration of selfhood, embodiment and social relations and locate the individual within digitised networks and economies. Bodies and selves are increasingly digitised in a multitude of ways . Digital self-tracking devices and software recording personal information are one element of this process of digitisation. A feedback loop is established, in which personal data are produced from digital technologies that then are used by the individual to assess her or his activities and behaviour and modify them accordingly. Discourses on self-tracking therefore also reveal notions of the value of data and the importance of creating data that are about oneself. Self-tracking is portrayed as a means by which the hidden patterns in one's life that are otherwise indiscernible may be not only identified, but most importantly, acted upon (Lupton, 2012, 2013b, 2013c).

Unlike the 'passive' forms of personal data collection that are characteristic of many other forms of transactional user engagement with online technologies, self-tracking is an 'active' and purposeful data practice. Self-tracking may thus be further conceptualised as a data practice that produces data assemblages. A data assemblage is a complex sociotechnical system composed of many actors whose central concern is the production of data (Kitchin & Lauriault, 2014). It is via the configuration of data assemblages that detailed profiles of individuals emerge, flattening out the heterogeneity of information from which these profiles are assembled (Amoore & Piotukh, 2015). In the case of self-tracking, these data assemblages are configured via systems of thought, forms of knowledge, business or government models, human users, practices, devices and software, and also sometimes by networks of other users and agents other than the self-tracker who seek to make use of the data for their own purposes. Given the ways in which digital data are generated, stored, managed and used, once

they are digitised, the array of practices that began as personal and private tend to become inextricably imbricated within these networks and economies.

Shifting forms of selfhood are configured via these digital data assemblages, depending on the context in and purpose for which they are assembled. As the digital data produced by dataveillance of individuals are constantly generated and the combinations of data sets that may be brought together on individuals are numerous, personal data assemblages are never stable or contained. They represent a 'snap-shot' of a particular moment in time and a particular rationale of data practice. The data assemblages are always mutable, dynamic, responsive to new inputs and interpretations. They thus represent a type of selfhood that is distributed between different and constantly changing data sets. To gain meaning from these data sets, self-trackers or the third parties who seek to use their data must engage in sense-making that can interpret these data and gain some purchase on their mutating forms.

Self-tracking privileges practices of selfhood that conform to cultural expectations concerning the importance of self-awareness, reflection and taking responsibility for managing, governing oneself and improving one's life chances (Lupton, 2012, 2013b, 2013c). A Foucauldian perspective as articulated in the work of theorists on contemporary selfhood (Elliott, 2013; Rose, 1990) can readily be adopted to theorise the modes and ethics of selfhood that are demonstrated in self-tracking cultures. What might be described as 'the reflexive monitoring self' in the context of digitised tracking technologies is an aggregation of practices that combine regular and systemised information collection, interpretation and reflection as part of working towards the goal of becoming. Underpinning these efforts are the notion of an ethical incompleteness and a set of moral obligations concerning working on the self that are central to contemporary ideas about selfhood and citizenship (Foucault, 1988). The idealised reflexive monitoring subject as represented in popular forums and some of the academic literature focusing on the benefits of self-tracking is highly rational, motivated and data-centric. Underpinning this ideal is the belief that the self-knowledge that will eventuate will allow self-trackers to exert greater control over their destinies.

This concept of selfhood conforms to the imperatives of audit culture, which highlights the importance of collecting detailed information about individuals, groups and institutions and using these data for surveillance and improvement. The practices of 'datafication', or rendering phenomena into digital data assemblages (van Dijck, 2014) and metricisation, or using numbers to monitor, measure, normalise and manage elements of human life that may previously have been regarded as unquantifiable (Amoore & Piotukh, 2015; Day, Lury, & Wakeford, 2014; Pugliese, 2010) are central to both reflexive self-monitoring and institutional audit culture. The notion of accountability is also an important element of both. This notion suggests that people's activities and bodies should be monitored and that they will be called to account or expected to make improvements if they are found to be lacking. Both institutional audit culture and self-tracking cultures are directed at what Strathern (2000, p. 1) refers to as 'a common language of aspiration', incorporating the idea that close monitoring and accountability, including taking on these tasks for oneself, enhances productivity as well as wellbeing and happiness. Indeed, many elements of reflexive self-monitoring may be interpreted as practices of self-auditing.

Digital biocapital and data politics

Self-tracking cultures and practices, in their focus identifying and making sense of the characteristics of individual lives, may be viewed further as an element in contemporary biopolitical governance and economies. The movement of self-tracking cultures into commercial, managerial and government domains combines the rationalities of biocapital with those of the digital data economy. Just as other forms of human life 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 that is attributed to personal digital data assemblages combines two forms of value: that related to the digital data economy and that emerging from the capitalisation of the human body. Biocapital involves the derivation of value from biological entities such as human bodies (Rose, 2007; Sunder Rajan, 2012), while the digital data economy positions digital data objects as valuable. Many self-tracking practices involve the rendering of bodily attributes and dispositions into digital data (Lupton, 2012, 2013b). They produce value in terms of the intimate bio-digital knowledges that they generate on individuals. Therefore self-tracking practices may be described as generating digital biocapital.

The use and ownership of personal data by actors and agencies other than the individual who generates these data are beginning to have major implications for social discrimination and justice issues. The algorithms constructed by software coders bring digital data together in certain ways that result in 'algorithmic identities' configured on the behalf of users (Cheney-Lippold, 2011). These algorithmic identities can have material effects. Self-tracking data can be mobilised as surveillant technologies in ways that further entrench the social disadvantage of marginalised groups (Andrejevic, 2013; Crawford & Schultz, 2014; Rosenblat, Wikelius, et al., 2014). This use of personal data may take place without people having any control or even knowledge of how the data are analysed and employed. An 'algorithmic authority' is exerted, in which the decisions made by software coders play a dominant role in shaping individuals' life chances (Amoore & Piotukh, 2015; Cheney-Lippold, 2011).

Beyond the biopolitical dimension of self-tracking, it can also be theorised as a new kind of politics; namely data politics. The project of reflexive self-monitoring for many self-trackers involves reflection not only on the uses to which personal data can be put by oneself but on the validity of the data, whether the kinds of data they collect are appropriate for their purposes, how best to display or visualise their data and how best to share their data with others and convey the insights they garner from the data. Beyond these reflexive data practices, some self-trackers confront the next level of data use: where their personal data are algorithmically generated and stored, how they are harvested by other actors, what these actors do with their data and how one can gain access to one's personal data.

Some self-trackers engage with practices of data collection in critical and resistant ways, seeking to exert greater control over the ways in which their personal data are collected, archived and used. They are attempting to generate and control their own algorithmic identities as they practise dataveillance. These practices are in response to a growing awareness of the ways in which personal data are structured, archived and appropriated by commercial, criminal, government or surveillance agencies. This issue of 'controlling my data'

frequently comes up for discussion on the Quantified Self website and in their meetups and conferences.

Whether or not they engage in self-tracking, members of the public are gradually realising how the data that are collected on them when they use the internet or customer loyalty programs are becoming used for commercial purposes (Andrejevic, 2014; The Wellcome Trust, 2013). Research into people's attitudes towards the use of smart meters in their home has demonstrated suspicion on the part of many concerning the exploitation of their private information about energy use (McKenna, et al., 2012; Rodden, Fischer, Pantidi, Bachour, & Moran, 2013). Post-Snowden and the mass media coverage of the documents he released, members of the public have been apprised of the ways in which digital data are used by national security agencies for the mass surveillance of their own citizens, including not only those data derived from mobile phone and social media but also the personal data that are generated by the use of apps (Ball, 2014). Two surveys conducted by the Pew Research Center found that Americans were becoming concerned about the security and privacy of their personal data. Despite this concern, few respondents were engaging in practices to protect their data, such as using browsers that did not track their habits or virtual private networks, perhaps because they did not possess the knowledge to do so (Madden & Rainie, 2015; Pew Research Center, 2014). My research on people's personal data practices and understandings suggests that while they have vague ideas about how their personal data are used and exploited by others, they are less sure of the details and how to go about protecting their data (Lupton, 2015b; Michael & Lupton, 2015).

It is difficult for self-trackers to avoid the exploitation of their personal data by other actors or agencies. While a small minority of technically-proficient self-trackers are able to devise their own digital technologies for self-tracking, the vast majority must rely on the commercialised products that are available. In most cases the personal data that they generate using these technologies become the property of the developers. Many people express powerlessness in the face of the authority of the internet empires to collect, own and harvest their personal data (Andrejevic, 2014). The vitality of digital data and the many different ways in different actors and agencies may repurpose them cannot be predicted, and therefore, are not amenable to control.

Conclusion: towards a new mode of self-tracking

As humans increasingly become represented in popular discourse as 'nodes in the Internet of Things', generating and exchanging digital data with other sensor-equipped objects, self-tracking practices will become unavoidable for many people, whether they are taken up voluntarily or pushed or imposed upon them. The evidence outlined in this article suggests a gradually widening scope for the use of self-tracking that is likely to expand as a growing number of agencies and organisations realise the potential of the data produced by these practices.

I have described how self-tracking conforms to a conservative political agenda that represents citizens as automated/autonomous subjects, ideally engaging in self-responsibilised practices of dataveillance and life optimisation and emitting valuable 'data exhausts' for repurposing by other actors and agencies. As yet, there has been little discussion of the ways in which self-tracking may be used for resistant or strategic political interventions – as means

to challenge accepted norms and assumptions about selves and bodies rather than conforming to these norms and assumptions. Few commentators have drawn attention to how self-tracking highlights certain forms of information about specific kinds of individuals or social groups while it neglects or ignores others, and how idealised citizen-subjects are configured via dominant self-tracking cultures while those who fail to meet these ideals are stigmatised or disciplined.

Nascent moves towards a more political use of self-tracking are evident in some citizen sensing initiatives when they are used to expose or challenge assumptions about geographical areas, the social determinants of ill-health, the environment and living conditions in the effort to draw attention towards social inequalities, government neglect or environmental mismanagement. There is ample further scope for alternative approaches to self-tracking as a form of knowledge production that seek to identify, record and highlight details of socioeconomic disadvantage or social stigma rather than simply to perpetuate them, or to generate knowledge of others rather than serving the solipsism of self-knowledge. Resistant self-tracking efforts may work to make visible forms of power relations, injustice and inequalities hidden from view. It is here that a new mode of self-tracking may develop. The possibilities for a new form of data politics that takes up these more critical and challenging practices are intriguing.

Acknowledgements

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