

The Quantified Self

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Introduction

The quantified self is a unique cultural phenomenon that is enormously popular within contemporary society in which technology is used both to collect and analyse vast amounts of personal data, with the purpose of enabling a previously unachievable level of nuanced self-tracking. Many different domains of people's lives are tracked in this way, from sleep, weight, and calorie intake to blood sugar and even mood. Rapid technological progress in the last decade has facilitated the growth of self-tracking (Swan, 2013), as devices such as smartphones and smartwatches are paired with specialised apps, making the process of self-tracking easy and enjoyable. The remit of the Quantified Self has extended far beyond its original technologically astute and data obsessive adopters. It is now a mainstream phenomenon, with over a third of internet-connected people using a device or app to self-track (Comstock, 2016).

Throughout this paper, I will use the terms 'self-tracking' and 'the quantified self' interchangeably as they both represent the action of recording the data of an aspect of your life. The term 'Quantified Self' was coined by *Wired* magazine editors, Gary Wolf and Kevin Kelly, to describe the practice of gaining 'self-knowledge through numbers' (Kraft, 2017) that they had witnessed in themselves and the surrounding technology community in southern California. The Quantified Self remains as an identifying community with an active online presence – a website that hosts blog posts and schedules meetups. When referring to this original movement, I will capitalise the phrase to be 'Quantified Self'. It is important to note that the term 'the quantified self', when used to describe the broad practice of digital self-tracking, is an imprecise term as it limits digital self-tracking to only quantifiable metrics. This is inaccurate as digital self-tracking frequently incorporates qualitative data and responses, which must be considered despite the limited term of 'quantified self'.

There are numerous reasons that motivate individuals to self-track, some of which you may have experienced yourself or know someone that has. Gimpel et al (2013) conducted a study of 150 participants which provides a useful identifying framework. It found five leading motivations: self-healing (becoming healthier), self-discipline, self-design (optimising yourself by taking control), self-association (associating with a movement and/or community), and self-entertainment. Of the five, the highest

adherence was to self-healing and self-design. The emphasis on health and fitness correlates with the figures found in research in 2016, which found over 160,000 tracking apps in Apple and Android app-stores, the vast majority of which are for tracking health-related factors (Koester, 2018). Self-design is also a very notable motivator for self-trackers, displayed by those with chronic illnesses who use data to self-analyse and experiment in an attempt to wrest control over their body, which is dysfunctional. Gimpel's study also noted that, anecdotally, many self-tracking participants displayed "a certain rebellion against the healthcare system." This potential exertion of medical autonomy by those feeling unfulfilled or inadequately cared for by the existing healthcare infrastructure is an important inference, and the implications of self-tracking as a supplement, or even replacement, of traditional forms of healthcare, will be explored in this article.

Tracking for health is not limited to the physical quantifiers, as there are numerous apps and devices for the purpose of tracking psychological wellbeing, such as sleep, energy levels, and mood (Koester, 2018). This expansion into the 'qualified self' shows how self-tracking has already developed into a more holistic practice whereby individuals can gain detailed insights about their habits, emotional state and behaviours, and adjust their practices based on these emotional metrics.

Part 1. The current state of self-tracking

People actively tracking and monitoring aspects of their personal life is an extremely old and established practice, with the present notion of the quantified self-being a contemporary formalisation of it. The current ability of people today with access to modern technology to easily generate huge personal datasets has many subjective benefits to the individual, which varies depending on the intention of the user. Those who actively self-track – monitoring their data and adjusting their inputs and outputs accordingly – effectively conduct $n=1$ experiments, whereby they are the single patient in an experimental trial. Due to the small sample size of only one, the lack of randomisation of studies, and the difficulty in controlling environmental and hereditary variables, self-research in isolation is lacking in scientific soundness (Swan). Despite this, self-research and experimentation can still provide personally relevant outcomes and outline implementable solutions for the subject.

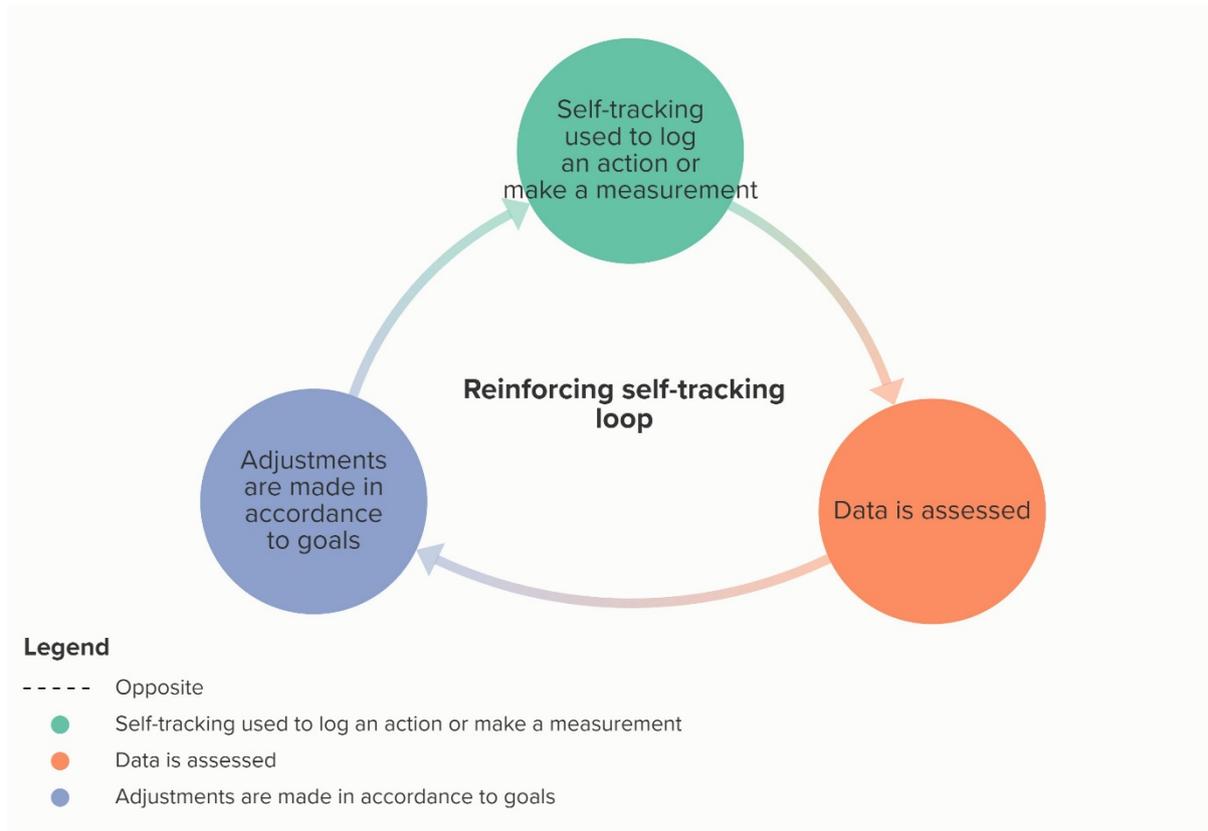


Figure 1: A causal loop diagram showing the basic tenants of self-tracking

One of the most pertinent examples of how self-tracking can be beneficial for the individual is shown by those who track in order to manage a chronic illness, such as type 1 diabetes. Described as being “somewhat unique among chronic conditions in that it’s very data-intensive” (Konstantina), type 1 diabetics use modern technology to regularly track and log their blood glucose levels. Results from a clinical study conducted by Huygens et al (2017) found that the willingness to self-monitor for those with chronic illnesses varied greatly between disease types, with diabetic patients being the most willing to self-monitor. A method of tracking diabetes is continuous glucose monitors (CGMs), which require the insertion of temporary sensors to provide ongoing data collection and can be synced with smartphone apps and smartwatches, providing an intuitive data management system. The behavioural change that has been established due to this improvement in self-tracking technology for diabetics is overwhelmingly positive. This is shown by clinical research on CGM users, as substantial improvements in HbA1c and a reduction in hypoglycaemic events were found which in turn led to a consistently higher reported quality of life. Other chronic illnesses, such as COPD and heart failure, respond positively to self-tracking methods, displayed by the decrease in hospital admission rates for those who regularly self-tracked (McBain et al, 2015). This has the twofold effect of improving patients’ quality

of life in addition to reducing the financial and logistical strain on the healthcare system itself.

As a type 1 diabetic, I have personal experience of the individual benefits that self-tracking can have on my management of the condition, especially in the context of information exchange via the internet. Gathering data of my blood sugar in relation to factors such as exercise, food intake, and timings of meals allows for me note down values which I would like to adjust. Much like with other forms of self-tracking, this requires a period of self-experimentation where lifestyle factors are adjusted accordingly in order to discern how and why certain readings appear. This process has been made faster and more constructive by the use of online forums, such as on the website Reddit or Diabetes.co.uk, where questions can be posed to other type 1 diabetics complete with necessary information and figures that are specific to me. In contrast with the process of booking an appointment with an endocrinologist, this process is far more convenient and allows for the 'fine-tuning' of the multitude of variables that must be considered when living with this disease. This is an example of what Briggs (2017) would describe as the empowering effect of the quantified self, as instead of being confined to the rigid and removed world of the public health sector, patients are able to take ownership of their condition by treating it with precise and personalised methods. Briggs himself used self-tracking methods to discover which foods were causing allergic reactions after appointments with doctors failed to provide answers. Using an app called *mySymptoms*, Briggs conducted personal trials and eventually produced a list of his findings that he shared with his doctor, who promptly identified the underlying condition. Traditional healthcare practices are not necessarily being replaced by quantified self-techniques, instead, in many cases, they are being supplemented by them.

The 'Quantified Us'

Despite the clear importance of individual discovery and improvement, digital self-tracking is becoming a socialised phenomenon as social media platforms allow for users to share data, methods, and results. Ajana (2017) explains the reasons for this: as a source of encouragement and acknowledgement, which are effective motivators for people to continue to self-track; to enhance expertise via the 'wisdom of the crowd'; and to appeal to the human desire to be part of a community and create social bonds. Though the Quantified Self are well known for hosting meetups where members give presentations to share their findings and experiences, even more casual groups of self-

trackers utilise socialisation to contribute to their personal goals. For example, the cycling and running tracking app Strava encourages competition between users, creating an incentive for people to consistently engage in activity to improve their distances and times. This informs what Jordan and Pfarr (2014) term as the 'Quantified Us', which is the crowd-sourced health collaborations between people with similar health goals, conditions, and environmental factors. Lomborg and Fransden (2016) conducted a study of 12 people, with varying levels of exercise experience, to use a sample of self-tracking apps. They found that self-tracking was not just meaningful in a utilitarian sense, but also as a source of joy and pleasure for the individual. These findings were achieved as part of their conceptualisation that self-tracking is a social and cultural practice that is "fundamentally communicative". The rise of the 'Quantified Us' proves an insightful rebuke of the common criticism that self-tracking is a purely inward and self-serving practice (Lupton, 2016); instead, it is an effective example of digitally-transmitted social learning.

Despite the benefits that self-tracking has for individual goals and fostering social ties, there is evidence to suggest that the quantitative focus of much of digital self-tracking is limited and even detrimental. Ayobi et al compared digital self-tracking with 'bullet' journaling, an analogue and highly customisable approach to logging and reflecting on everyday life which also has a large online community on social media who share and discuss their methods. Their research found that the design of automated technology, such as wearable devices, lacked flexibility and often failed to meet people's practical goals and emotional needs. Swan's research (2013) supports this assertion, as she outlined how people are generally more suited to thinking in narratives than in statistics, thus an effective self-tracking device and process would include dimensions of both a quantitative and qualitative nature. Highlighting the idiosyncratic and fluctuating nature of the illnesses which people manage with digital self-tracking, Ayobi et al suggest that these technologies should draw inspiration from the flexibility that bullet journaling provides. Bullet journaling also provides another example of how the digital ecosphere fosters social learning. Rather than being replaced by digital technologies, bullet journaling has been digitally supported and enhanced by the platforms offered from social media, such as Instagram and Pinterest. Even if the tracking method itself is physical and analogue, it can be digitally disseminated for the benefit of both the producer and the wider self-tracking community.

On the other hand, Swan (2013) views the entire process of self-tracking as having significant quantified and qualitative elements, as objective metric data informs the subjective experience that the user responds with. Data produced by tracking devices mediates the experience of reality for the user due to formerly invisible bodily and mental details become coherent information that can be engaged and interacted with. A feedback loop is therefore created. Additionally, Ayobi's critique of self-tracking being too rigid in comparison to bullet journaling is also contended by Lomborg and Fransden (2016), who found that their participants found the apps scalable to their individual and social needs. Though it is indisputable that physical analogue journaling is a more variable and adaptable approach to tracking than pre-made applications, however, digital self-tracking is not wholly quantified and is adaptable, especially regarding the social and communicative aspect of the practice.

Summary

At present, the quantified self is an established practice for the management and improvement of everyday life for many, especially those with specific health-related goals or with a chronic illness. It has been shown to be an effective technique for helping an individual make adjustments in their life by providing vast quantities of data, but also by providing a network of others who have similar objectives. These networks can also provide fulfilment in and of itself due to the fundamental human needs of social recognition and communication being met. Though valid critique has arisen on the rigidity that digital tracking offers in relation to analogue, it is important not to overstate this as many have found digital self-tracking to be adaptable to their lives. However, the prominence of digital self-tracking has led to the emergence of new problems. This includes the confluence of self-tracking with other sectors which may lead to negative consequences for the individual and society as a whole. I will explore these risks in the second part of this article.

Part 2. The Future

As the quantified self becomes more embedded in our modern society, there is concern about the way in which this digitised practice alters the way we think about our bodies and our relation to healthcare. Ajana (2017) argues that the quantified self is making the body more susceptible to management techniques that echo the principles of neoliberalism, specifically the idea of the body being treated as a 'project' that is to be constantly worked on, improved, and invested in. The impact of the potentially unlimited scope of self-tracking is described by the blog 'The Unquantified

Self'. A self-confessed tracking 'addict', the blogger decided to completely abstain from tracking due to the negative consequences it was having on her, especially regarding her mental wellbeing. Instead of feeling empowered by the data, it led to her leading a more limited, dulled life and became a source of guilt when targets weren't met. This process of militant self-tracking spiralling until a breaking point is echoed by the Bateson's (1971) systems-theoretic study of alcohol addiction. Bateson describes a positive feedback loop, known in psychotherapy as the 'therapeutic double-blind', that seeks to verify what the cause of discomfort is by increasing the discomfort to a threshold level at which change would become possible. The blogger 'The Unquantified Self' enacted this process, visualised in Figure 2, eventually leading to a threshold and for the primary action of self-tracking to be significantly curtailed. Even at a more casual level of use, the increased responsibility bestowed upon the individual in their health management can construe health as an uninhibited choice. This is potentially damaging as those who do not or cannot 'choose' health can be blamed and stigmatised as a 'burden' on the public healthcare system, despite the fact that they may not have the socio-economic capabilities to access the resources needed for active fitness management.

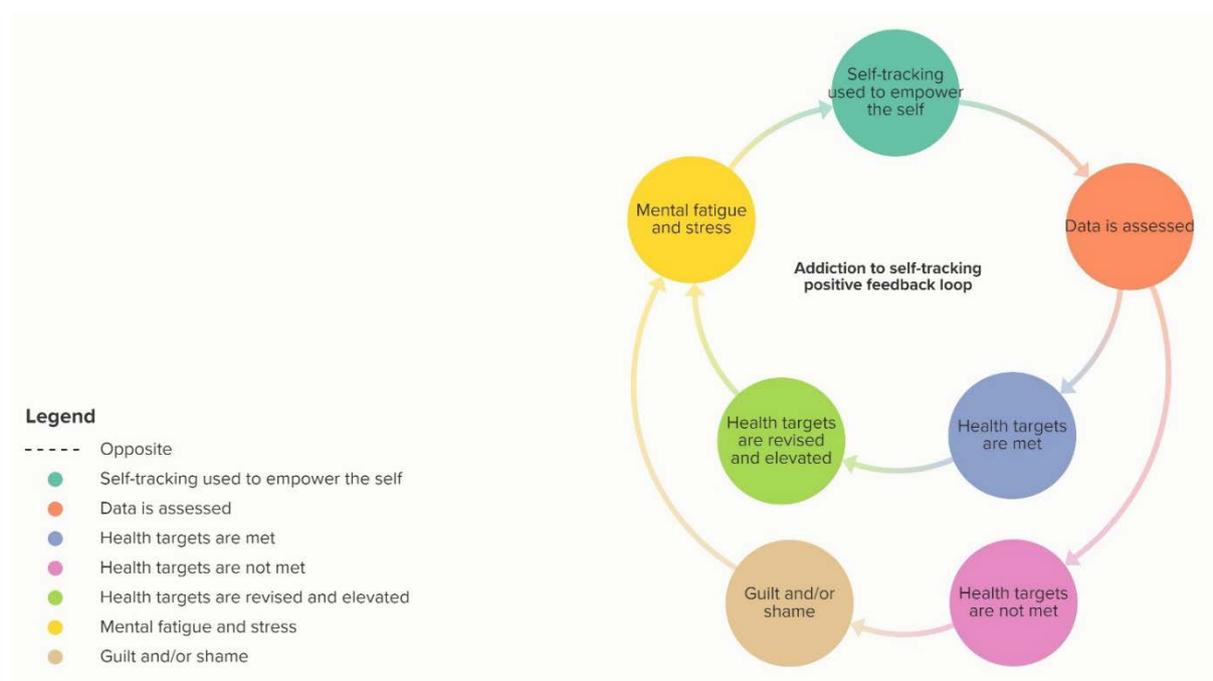


Figure 2: Addiction to self-tracking positive feedback loop

This neoliberal ethos that is purveyed by overuse of digital self-tracking is also contributing to a shift in notions of healthcare. Rising costs, ageing populations, and an increase in diagnosed chronic diseases have put western public healthcare under

spiralling pressure. European institutions and governments have shown widespread support for the introduction of digital health tools to facilitate personalised health care (PHC), which is preventative and tailored to the specific needs of individuals. However, Dickenson (2013) contends that economic and political factors shaped by neoliberalism, rather than scientific plausibility, is the main driver towards PHC. For example, the market for self-tracking technology has become vast, with wearable self-tracking technology alone said to have had a global market value of nearly \$20 billion in 2019. By transitioning healthcare from a public service to a private endeavour, the shift towards digital self-tracking has led to the growth of a very profitable new market. Although far more affordable now than a decade ago, many self-tracking devices are still expensive or require a certain amount of time or technical knowledge to be able to constructively analyse the data provided. However, though influenced by neoliberal ideology, there is a promising potential for the constructive combination of both individual tracking and public healthcare. As stated prior, McBain (2015) has displayed how, for those with chronic illnesses, self-tracking reduces hospital admission rates and provides more data for the clinician to analyse when the patient does go to the hospital. Furthermore, public healthcare services like the NHS are producing their own apps which will streamline the flow of information between a patient's biometrics and their doctor.

Big Data, gamification, and surveillance

Possibly the most pressing and perilous way which the quantified self can change our future is regarding its impact on surveillance, which lies at the nexus of two other factors that shape and invigorate self-tracking: Big Data and gamification.

To begin, Big Data is the concept of extremely large, conglomerated data sets that, when analysed computationally, have the potential to reveal insightful patterns and trends. Institutions with the necessary capabilities to utilise these Big Data sets are confined to powerful public and private entities. Swan (2013) provides illumination on how Big Data could provide exciting opportunities for the public healthcare system, for instance by early-warning signals to be more readily produced and to "articulate new tiers of health norms with much greater granularity". The ecosystem of Big Data is actively grown by the process of digital self-tracking due to the production of, as termed by Lupton (2016), biocapital. Self-tracking renders bodily attributes and dispositions into data, which itself generates value due to the

biomedical knowledge that they can provide, thereby creating biocapital. Though generated by the user, the personal data becomes the property of the developers, a public or private entity, who can then use the data for their own means or sell it. Much of this data is used for marketing purposes, wherein individuals can be targeted with personalised advertisements and promotions. Biocapital for this purpose is not only generated on self-tracking apps, but in other manners such as customer royalty programmes, wherein consumers allow their individual purchasing habits to be logged in return for deals and promotions, usually in exchange for digital 'points' which are earned.

The earning of 'points' in royalty programmes are an example of the gamification of self-tracking, which can be viewed as another method for biocapital to be produced for Big Data. Gamification is the utilisation of game mechanics, such as digital rewards or encouraged competition, into non-games spaces (Whitson, 2013) and is a rapidly expanding phenomenon. It is an incredibly effective motivating tool for self-tracking apps and devices, such as the cycling and running app Strava, which employs leader boards and badges as rewards and incentives for users to compete and log their data. Gamification provides a useful tool for encouraging behavioural changes as it can make solitary and tedious tasks more enjoyable and engaging. It also provides another example of the neoliberal ethos of free choice and the promise of reward, generating biocapital in a non-explicitly coercive manner. As with Big Data, gamification itself is not an intrinsically damaging concept, though they both contribute to the swelling quantity of data that can jeopardise privacy and facilitate the pervasive spread of surveillance.

Surveillant self-tracking is already being deployed in sectors such as education and healthcare. In the USA, where employers pay for their employees' health insurance coverage, there has been an increase in financial incentives for those who meet fitness guidelines (Lupton, 2016). Self-tracking devices are given to employees to provide data on whether these guidelines have been met, with wearable technology companies such as Fitbit brokering deals with employers and insurance companies to provide the quantified evidence for these 'wellness programmes'. Though not obligatory, there is a significant element of coercion to these programmes, as not taking part can diminish prospects of an increased salary or promotion. Furthermore, Google is in the process of purchasing Fitbit for \$1.6 billion (Harris, 2020) and is currently working with the large healthcare institution Ascension, giving Google access to the medical records of 50 million Americans. The alarming presence of a conglomerate private enterprise in

public healthcare is made starker when considering recent transgressions; In 2017, the Royal Free NHS Trust and Google's DeepMind division were found to have breached UK data protection law when 1.6 million people's medical data was used to develop a new medical system. Despite this, governmental deals with tech giants have only multiplied, leading to more reliance on trust that the companies do not break or circumnavigate the existing laws of data protection.

Self-tracking is becoming more widespread and implementable, making it of urgent importance to regard the resultant data with caution due to the top-down processes which utilise said data. Self-tracking is now shifting into self-surveillance, with varying degrees of conscious. Lupton (2016) contends that, under the guise of empowerment through self-knowledge, self-surveillance has increased exponentially despite the lack of ownership of the data produced. She argues that this extends the panoptic gaze in a Foucauldian sense, whereby intrusive power structures are maintained by subtle surveillance techniques that incorporate the user into the monitoring entity. Gamification only furthers and heightens this potential informational intrusion, as it encourages the production and sharing of personal data at a faster rate. Aside from 'wellness programmes', the use of self-tracked data to enforce discipline and conformation has been deployed in more overt manners. In 2014, Fitbit data was used in a Canadian court case to assess the relative fitness of a person making an injury claim, leading to self-tracking becoming a "witness against oneself" (Ajana). Due to the ambiguous and complex legal policies surrounding tracking companies and data, there is potential for self-trackers to become unknowingly culpable due to their tracked history. Dispersal into all of these social spheres indicates that self-tracking is experiencing a 'function creep': a technology that has developed for use beyond its original purpose, often resulting in an invasion of privacy. This is facilitated by much of the post-September 11th political discourse, which often portrays a binary between privacy and public interest (Ajana). The seeping of this mode of thought into legal and medical sectors provokes alarm due to the immense catalogue of personal data that is now attainable, rendering previously private details to become scrutinised and legally acted upon.

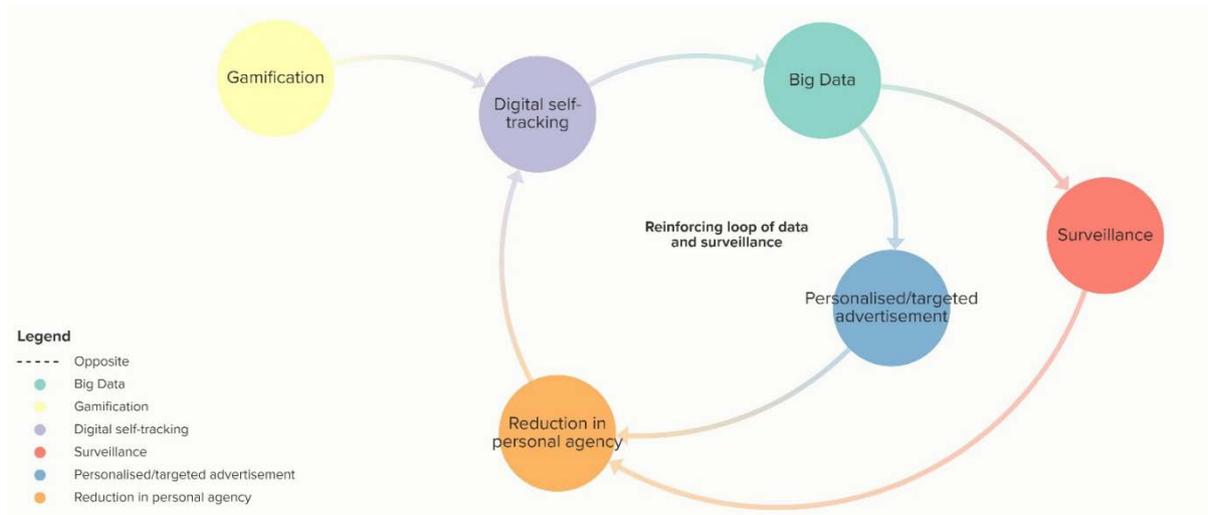


Figure 3: Reinforcing loop of data and surveillance

The diagram above shows how surveillance is contributed to by gamification, which encourages self-tracking, and Big Data, which itself is produced by the digital self-tracking that millions of people conduct on a regular basis. Big Data is pivotal as it provides the capital and basis for other uses of the extremely valuable resource that is digital data, namely advertisement and surveillance. Although more outwardly innocuous, personalised advertisement is an important element of the system due to the barriers which it erects for the digital citizen. Beyond the surface of marketing, this use of Big Data can alter what is suggested to individuals on their social media, which includes political content. As more information is constantly provided on what the individual views and responds positively to, in the form of likes, for instance, echo chambers can be produced wherein horizontal discourse and discussion is neutered. Combining with top-down surveillance, these two factors limit personal choice which in turn will push people towards digital self-tracking as a way of empowering themselves, viewing quantitative data as something in which they can control despite the capacity for this being significantly curtailed by barriers placed around them. To tackle this, there must be some measures taken to limit and regulate the connective nodes that Big Data has with surveillance and personalised advertisement. Although privacy-advocating NGOs are active, such as Med Confidential, there is still a lack of awareness and publication of both the threats that misused Big Data can have, as well as of the 'opt-out' policies that the NHS has regarding personal medical records being shared (Harris). Lobbying at a grassroots level is necessary to promote the advocacy of tighter and prudent regulation, which must be supported by the legal proceedings of government.

On a more practical and less sociological scale, the ubiquity of self-tracking also entails consequences for the security of those who use it. The Big Data ecosystem is extremely large and growing continuously. Information is analysed and distributed between the general public, healthcare institutions, third-party service providers and self-tracking companies and – though it is unfortunate – this web of data is liable to be leaked, sold, or misused by at least a small portion of the parties involved. An experiment conducted by cybersecurity company Symantec found that the vast majority of wearable tracking devices were liable to location tracking, while 20% of the scanned devices transmitting usernames and passwords that were not encrypted, and therefore insecure (Ajana, 2017). Much like the swelling of surveillance requires regulatory improvements in the law to keep up with the development of self-tracking technology, improved information security systems are also needed to protect the individual from their data being hacked and illegally exploited.

Summary

The discourse regarding self-tracking is evidently divisive. Proponents, such as the Quantified Self membered community and wearable tech companies, espouse the age-old maxim of “knowledge is power”. Self-knowledge, therefore, translates to greater power over your life and its direction. Social scientists make a more cautious appraisal, raising valid concerns regarding the encroachment of personal privacy and the erosion of social structures to name a few. Sharon (2016) seeks to move beyond this debate by offering a ‘practice theory’ framework, which views human’s main interactions with the world as being a physical activity, instead of the more representative approach taken by social scientists. She posits that self-trackers are misrepresented in unrealistic, extreme ways: as wholly rational consumers who make autonomous health choices or oblivious victims of economic and political agendas. Ruckenstein (2014) conducted a study which supports this more nuanced view of trackers. After studying the use of heart rate monitoring in everyday life, Ruckenstein found that the relationship between the tracker and their ‘data double’, the visualisation of a body using data, was both affective and purposeful. The personal and even emotive attachment that trackers have to their data, which is viewed as a reflection of their selves, is often overlooked in surveillance literature which views self-tracking in a broad and theoretical scale.

Despite this, there is an urgent need for regulatory improvements to stymie the potentially egregious misuse of data that is gathered by self-tracking. This has been

underlined by the warning that historian Yuval Harari (2020) has made at the Davos World Economic Forum if this 'AI Revolution' goes unchecked. Harari argues that as biological knowledge, computing power, and data are rapidly expanding, the ability to have intimate and detailed knowledge of entire populations becomes possible. Nations which cannot keep up with this technological development will become subservient data colonies, much like the non-industrialised world following the Industrial Revolution. As argued in this article, the impact of data is also felt on a more inward and individual level, with Harari highlighting that the current power of algorithms to dictate what we believe as true or spend money on could develop to effect more personal experiences such as who to marry or where to work. To not acknowledge and confront this potential threat would be erroneous due to how existential it is – the erosion of human agency.

References

Ajana, B. (2017). *Digital Health and the Biopolitics of the Quantified Self*. Digital Health, Volume 3, pp.1-18. [Online]. [Accessed 23 January 2020]. Available from: <https://journals.sagepub.com/doi/pdf/10.1177/2055207616689509>

Ayobi, A., Sonne, T., Marshall, P., and Cox, A.L. (2018). *Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals*. University of Bristol. [Online]. [Accessed 23 January 2020]. Available from: <https://uclic.ucl.ac.uk/content/1-people/0-amid-ayobi/flexible-and-mindful-self-tracking-design-implications-from-paper-bullet-journals.pdf>

Bateson, G., (1971). *The Cybernetics of "Self": A Theory of Alcoholism*. Interpersonal and Biological Processes, Volume 34, pp.440-456. [Online]. [Accessed 1 February 2020]. Available from: <http://ift-malta.com/wp-content/uploads/2012/07/The-cybernetics-of-self-A-theory-of-alcoholism.pdf>

Briggs, R. (2017). *The Quantified Self*. Research World, Volume 2017, pp. 9-12. [Online]. [Accessed 20 January 2020]. Available from: <https://onlinelibrary.wiley.com/doi/full/10.1002/rwm3.20533?sid=worldcat.org>

Comstock, J. (2016). *Survey: One in three people tracks health, fitness with an app or device*. Mobihealthnews [Online]. [Accessed 22 January 2020]. Available from: <https://www.mobihealthnews.com/content/survey-one-three-people-tracks-health-fitness-app-or-device>

Dickenson, D., (2013). *Me medicine vs. We medicine: reclaiming biotechnology for the common good*. New York: Columbia University Press

Gimpel et al. *Quantifying the Quantified Self: A Study on the Motivations of Patients to Track Their Own Health*. [Online]. [Accessed 18 January 2020]. Available from: <https://pdfs.semanticscholar.org/7ccb/e2e99078317a8657a2d362cdeb755b323cf4.pdf>

Huygens, W.J., et al., (2017). *Self-monitoring of health data by patients with a chronic disease: does disease controllability matter?* BMC Family Practice, Volume 18, pp.1-10. [Online]. [Accessed 19 January 2020]. Available from: <https://bmcfampract.biomedcentral.com/track/pdf/10.1186/s12875-017-0615-3>

Jordan, M., and Pfarr, N. (2014). *Forget the Quantified Self. We need to build the Quantified Us*. Wired. [Online]. [Accessed 19 January 2020]. Available from: <https://www.wired.com/2014/04/forget-the-quantified-self-we-need-to-build-the-quantified-us/>

Koester, M. (2018). *Why People Self-Track: Research on the Motivations Behind the Quantified Self and Self-Trackers*. Mark Koester. [Online]. [Accessed 21 January 2020]. Available from: <http://www.markwk.com/why-people-self-track.html>

Konstantina, V. (2017). *The Role of Data & the Quantified Self in Diabetes Management*. Medium. [Online]. [Accessed 22 January 2020]. Available from: <https://medium.com/the-data-nudge/data-diabetes-the-quantified-self-b308f12888f6>

Kraft, D. (2017). *Quantified self to quantified health: how tech helps doctors fill gaps in patient records*. Wired. [Online]. [Accessed 22 January 2020]. Available from: <https://www.wired.co.uk/article/hospital-prescribing-tech>

Lomborg, S., and Frandsen, K. (2016). *Self-tracking as communication*. Information, Communication, and Society, Volume 19, pp. 1015-1027. [Online]. [Accessed 24 January 2020]. Available from: https://curis.ku.dk/ws/files/172851886/Lomborg_Frandsen_2016_Self_tracking_as_communication_postprint_version.pdf

Lupton, D., (2016). *The diverse domains of quantified selves: selftracking modes and dataveillance*. Economy and Society, Volume 45, pp. 101-122. [Online]. [Accessed 23 January 2020]. Available from: <https://www.tandfonline.com/doi/pdf/10.1080/03085147.2016.1143726?needAccess=true>

McBain, H., Shipley, M., and Newman, S. (2015). *The impact of self-monitoring in chronic illness on healthcare utilisation: a systematic review of reviews*. BMC Health Services Research, Volume 15, pp. 1-10. [Online]. [Accessed 25 January 2020]. Available from:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4683734/pdf/12913_2015_Article_1221.pdf

Morris, J. (2020). *Will having longer, healthier lives be worth losing the most basic kinds of privacy?* The Guardian. [Online]. [Accessed 3 February 2020]. Available from: <https://www.theguardian.com/commentisfree/2020/feb/03/longer-healthier-lives-privacy-technology-healthcare>

Ruckenstein, M. (2014). *Visualized and interacted life: Personal analytics and engagements with data doubles*. Societies, Volume 4, pp. 68–84, [Online]. [Accessed 25 January 2020]. Available from: <https://www.mdpi.com/2075-4698/4/1/68>

Swan, M. (2013). *The Quantified Self: Fundamental Disruption in Big Data Science and Biological Discovery*. Big Data, Volume 1, pp. 85-99. [Online]. [Accessed 18 January 2020]. Available from: <https://www.liebertpub.com/doi/pdf/10.1089/big.2012.0002>

The Unquantified Self. (2013). *Why This Blog*. The Unquantified Self: Figuring out what really counts. [Online]. [Accessed 25 January 2020]. Available from: <https://unquantifiedself.wordpress.com/my-story/>

Whitson, J. (2013). *Gaming the Quantified Self*. Surveillance and Society, Volume 11, pp. 163-176. [Online]. [Accessed 26 January 2020]. Available from: <https://ojs.library.queensu.ca/index.php/surveillance-and-society/article/view/gaming>