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Quantifying the body: monitoring and measuring health in the age of mHealth technologies

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Mobile and wearable digital devices and related Web 2.0 apps and social media tools offer new ways of monitoring, measuring and representing the human body. They are capable of producing detailed biometric data that may be collected by individuals and then shared with others. Health promoters, like many medical and public health professionals, have been eager to seize the opportunities they perceive for using what have been dubbed ‘mHealth’ (‘mobile health’) technologies to promote the public’s health. These technologies are also increasingly used by lay people outside the professional sphere of health promotion as part of voluntary self-tracking strategies (referred to by some as the ‘quantified self’). In response to the overwhelmingly positive approach evident in the health promotion and self-tracking literature, this article adopts a critical sociological perspective to identify some of the social and cultural meanings of self-tracking practices via digital devices. Following an overview of the technologies currently available for such purposes, I move on to discuss how they may contribute to concepts of health, embodiment and identity. The discussion focuses particularly on how these technologies promote techno-utopian, enhancement and healthist discourses, and the privileging of the visual and metric in representing the body via these devices.

Keywords: mHealth; sociology of health; health promotion

Introduction

Over a period of only five years, mobile digital devices connected to the web, such as smartphones, tablet computers, iPods and wearable patches and bands, have emerged onto the market and become widely adopted. Mobile digital devices, which are now very small and portable, can be taken almost anywhere and are able to connect remotely to the Internet from most locations. Frequent statements are now made in the popular media and in the medical and public health literature about an imminent revolution in health care, preventive medicine and public health, driven by the use of such devices and their related apps and tools, otherwise referred to as ‘mHealth’ technologies. Many articles have recently appeared in the health promotional and preventive medicine literature, ruminating on the possibilities of being able to communicate with the public, monitor their behaviours and conduct health promotion interventions via the mobile devices that they carry with them or wear throughout their day (Donner 2012; Kratzke and Cox 2012; Chib 2013; Kaplan and Stone 2013).

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One specific aspect of mHealth that has received attention of late is that of using mobile and wearable digital devices to collect data on one's bodily functions and everyday activities (Kirwan et al. 2010; Cummiskey 2011; Swan 2012). Individuals' bodily movements and geographical location can be identified and recorded remotely using the GPS systems and accelerometers that are embedded within these technologies. Such body functions and indicators as blood glucose, body temperature, breathing rate, blood chemistry readings, body weight, blood pressure, heart rate, sleep patterns, cardiac output readings and even brain activity, can all be monitored using portable wearable and internal sensors, woven into clothing or laminated onto ultrathin skin interfaces and placed anywhere on the body. Ski goggles, headbands, wristbands, adhesive patches, sports shoes, bathroom weight scales, pyjamas, fitness clothing and even toothbrushes with tiny digital sensors implanted in them are now available for purchase as part of the project of producing biometric data. Several wearable devices can be worn on the body throughout the day and night to provide continual monitoring (see e.g. Ramirez 2013).

Many thousands of health-related apps for mobile digital devices have been developed for commercial use. The Apple App Store alone offers over 13,000 health-related apps (Strickland 2012). It has been estimated that in 2012, 44 million of these were downloaded worldwide (Raskin 2012). These apps provide a range of medical and health information, from assisting users in self-diagnosing illness, displaying detailed anatomical information about the human body and allowing users to monitor, log and graph such bodily functions as exercise habits, diet and drug consumption, mental health and moods, menstrual cycles and ovulation patterns, sleep patterns and hearing function and to record the incidence and severity of pain. To motivate users, some apps include built-in reward or docking systems so that points, badges or real money can be collected or paid, if various commitments (e.g. to regular exercise or weight loss goals) are either met or unmet. Data collected from many of these apps can be uploaded to related websites or social media platforms, such as Facebook or Twitter, and thus can be shared with many others.

Wearable or mobile devices designed for such monitoring activities include those developed by the iHealth company (iHealth 2013). It offers technologies that include digitalised scales for measuring body weight and bone density, blood pressure and heart rate monitors and glucose measuring devices that wirelessly connect with apps on iPhones, iPods and iPads to allow for measurement and monitoring of these body functions. The software incorporated with these devices provides a means for the user to keep a record of their measurements and to easily observe any variation over time. The data collected can be emailed to one's medical professional or uploaded to social media platforms to share with family members and friends. Other wearable digital self-tracking technologies on the market include the Nike+Fuelband, a wristband physical activity and calorie expenditure monitor, the Fitbit One, a small device that can be clipped onto clothing, placed into a wristband during sleep or carried in a pocket, which tracks physical activity, weight, calories used, water consumption, diet and sleep patterns, the Zeo Personal Sleep Coach, a digitised headband to monitor sleep and the Larklife wristband, which collects data on the user's physical activity, sleep and diet and incorporates reminders to users to move more, advice about how to improve their workout as well as suggestions for improving work productivity (Ramirez 2013).

The terms 'self-tracking' and 'the quantified self' are now often employed to describe the use of these technologies (Smarr 2012; Swan 2012). There is a growing movement in self-tracking as part of managing and improving one's life (Lupton 2013).

The activities of voluntary self-trackers in many ways coincide with the objectives of health promotion. While other aspects of one's everyday life (e.g. work outputs or social encounters) are often recorded as part of producing the quantified self, bodily functions represent a major target of self-tracking activities. Indeed, medical and public health professionals have begun to show awareness of the self-tracking movement and advocate for building upon it in their work (Swan 2012; Wiederhold 2012). According to Wiederhold, for example, 'we are on the leading edge of another revolution in health care, brought to you by the patient herself as she uses her phone for self-tracking' (2012, 235).

Although thus far there are little published data in the academic literature on how and why people are using self-tracking digital devices for health, research conducted by the US-based Pew Research Center (Fox and Duggan 2013) found that 21% of the USA adults surveyed reported monitoring a health indicator, such as body weight, diet, exercise patterns and bodily functions, such as blood pressure or a medical symptom, either for themselves or a family member, using a technological device, such as a medical device (8%), app or other tool on their mobile device (7%), computerised spreadsheet (5%) and website or online tool (1%). The survey further found that one in five respondents had downloaded a health app to their digital device specifically to track or manage their health. Exercise, body weight and diet apps were the most commonly downloaded apps.

A critical perspective on mHealth technologies

The use of mobile and wearable mHealth technologies affords the temporal, spatial and interpersonal nature of health surveillance. Health-related data may easily and frequently be collected from users' mobile devices each time they log on to the relevant app. Such devices, thus, offer an unprecedented opportunity to monitor and measure individuals' health-related habits on the part of not only the users themselves, but also by health care and public health workers. What are the social and cultural implications for how we might think about health promotion practice and those individuals who are the target of mHealth campaigns or who are voluntarily self-tracking their biometric data?

In a previously published article (Lupton 2012), I noted that while there is a growing literature on mHealth in the medical and public health literature, very few critical analyses have yet appeared. In that discussion, I addressed such issues as how the concept of the cyborg (the human-machine hybrid) is relevant to theorising mHealth and how mobile digital technologies may be used not only as body prostheses, but also as interpreters of the body. I also drew upon surveillance studies to argue that digital health technologies act to configure and reconfigure surveillant assemblages (a term first introduced by Haggerty and Ericson 2000), or bodies/subjects that are configured by and through surveillance technologies, and that many individuals engage in voluntary self-surveillance as part of using mHealth technologies. This previous article also discussed some privacy, intimacy and ethical issues around the use of these technologies.

As part of my continuing sociological study of the mHealth phenomenon, in what follows I focus more specifically on the practice of monitoring biometric data using mobile digital devices. I suggest a number of theoretical approaches (by no means exhaustive) that may be adopted to theorise this practice. These include exploring concepts of technological bodily enhancement and techno-utopian visions of the perfect (ible) body, healthism and personal responsibility, visualisation and bodily display and the allure and power of metrics inherent in the use of these devices.

My overarching theoretical perspective, when analysing the mHealth phenomenon, conceptualises digital health technologies (like any other technologies) as actors (or in the argot of science and technology studies ‘actants’) in a network of heterogeneous discourses, bodies, practices, ideas and technologies. From this perspective, technologies bestow meaning and subjectivity upon their users, just as users shape the technologies and give them meaning as they incorporate them into their everyday practices. Technologies assume certain kinds of capacities, desires and embodiments; they also construct and configure them. Further, technologies are never politically neutral, but rather are always implicated in complex power relationships (Hadders 2009; Mort, Finch, and May 2009; Mort and Smith 2009; Rich and Miah 2009; Casper and Morrison 2010; Mansell 2010). Changes in technologies addressed at monitoring and regulating bodies and health states represent transformations in how bodies are conceptualised, touched, managed and visually displayed, not only from the perspective of professionals operating in the medical or public health field, but also for those who are their subject.

Techno-utopia and the perfect(ible) body

Some writers have compared the use of technological devices implanted upon or used with the body as part of the general desire to engage in ‘body projects’, practices of embodiment that serve to assist people in defining their identities (Shilling 1993; Featherstone 1999; Hogle 2005; Pitts 2005). Some of these practices are undertaken in the name of ‘good health’; others are used to adhere to standards of physical beauty; yet others are a way of demonstrating resistance of taken-for-granted norms of embodiment or to take control over disempowering bodily experiences, such as severe illness or surgery. Hogle (2005) uses the term ‘enhancement technologies’ to refer to such technologies as cosmetic surgery, pharmaceuticals such as Viagra, hormonal supplements, neurochemicals designed to improve cognitive functioning and computerised prosthetics. The point of such technologies is to ‘correct’ apparent ‘deficits’ in body functioning or appearance.

Mobile digital devices could similarly be viewed as enhancement technologies when they are used for health-related purposes. They extend the capacities of the body by supplying data that can then be used to display the body’s limits and capabilities and allow users to employ these data to work upon themselves and present themselves in certain ways. Writing before the advent of mobile digital devices, Chrysanthou (2002) noted the move towards individuals using information and computer technologies, such as online health assessments, over-the-counter diagnostic tests and self-administered genetic tests, as part of what he describes as a utopian vision of the perfect, imperishable body. These technologies participate in a kind of ‘techno-utopia’, in which technologies are positioned as harbingers of progress, keys to the promotion of human happiness, well-being and health (Davis 2012).

Techno-utopian discourses were particularly evident in discussions of the freedoms and liberation from the confines of the body offered by writers on cyberspace and the posthuman body in the 1990s (Lupton 1995a; Bell 2001). Yet the kind of techno-utopian discourses evident in discussions of biometric self-tracking do not suggest leaving the body behind. To the contrary, they direct the gaze directly at the body. They privilege an intense focus on and highly detailed knowledge of the body, in which it is suggested that possession of this knowledge of one’s body offers a means by which illness and disease may be prevented.

The self-knowledge that is viewed as emerging from the minutiae of data recording a myriad of aspects of the body is a psychological salve to the fear of bodily degeneration. The 'Massive Health' website (Massive Health 2012), for example, notes that 'Your body is the ultimate interface problem. Sometimes, it just doesn't give you the feedback you need ... We create the tight feedback loops your body is missing to keep you healthy'. This company offers such apps as 'The Eatery', which allows users to photograph their meals. The app then calculates not only the nutritional values of the food, but provides what is described as 'deep insights' into eating habits, such as whether the user eats more nutritious food in the morning or evening and where their 'weak points' lie. According to the website: 'Other apps tell you about your food. We're telling you about yourself.'

Healthism and personal responsibility

Accounts of self-tracking technologies for health, in both the health promotional and the lay self-tracking literatures, tend to place emphasis on the potential for the 'empowerment' of lay people offered by these technologies and the importance of 'taking responsibility' for one's health. In their privileging of good health as the reason for using such devices, they are engaging in and promoting the discourse of 'healthism'.

Sociologists writing on healthism have identified the intense focus on health and the prevention of illness that has emerged since the 1970s. Healthism positions the achievement and maintenance of good health above many other aspects of life and features of one's identity, so that an individual's everyday activities and thoughts are continually directed towards this goal. A dominant belief underlying healthism is that fate can be controlled, at least to some extent, by personal action and the taking of responsibility for one's health (Crawford 1980, 2006). Healthism tends to be a discourse embraced by the socio-economically privileged, who are able to position 'health' as a priority in their lives and have the economic and educational resources to do so. This discourse tends to gloss over the social and economic determinants of health states for a focus on 'empowerment' and 'taking charge' of one's own health. Healthist discourses, therefore, value those who take such responsibility and represent them as ideal citizens, while people who are viewed as lacking self-responsibility or who are ill are positioned as inferior and morally deficient (Lupton 1995b; Crawford 2006; Buse 2010).

Medical advice and health promotion campaigns are predicated on and reproduce the values of healthism (Lupton 1995b; Petersen and Lupton 1996). The advent of Web 2.0 technologies and mobile digital devices has allowed healthism to be promoted and promulgated in more detail and more intensely than ever before. While self-tracking is directed at other aspects of life and not only health-related metrics, the idea that collecting data on oneself is a primary means by which good health can be established and maintained is dominant in discourses of self-tracking and the quantified self. Indeed, self-tracking represents the apotheosis of self-reflexivity in its intense focus on the self and using data about the self to make choices about future behaviours. In relation to health matters, self-tracking offers users of such technologies a strategy by which they feel as if they can gather data upon their health indicators as a means of avoiding illness and disease.

The discourse of healthism in the mHealth literature configures users as ideal-type responsible citizens who possess the economic and motivational capacity to engage in self-surveillance via these technologies. As one advocate of self-tracking in preventive medicine put it, using these technologies represents a paradigm shift from 'My health is

the responsibility of my physician' to 'My health is my responsibility, and I have the tools to manage it' (Swan 2012, 108). These individuals have readily adopted the subject of the responsible, entrepreneurial citizen as it is privileged in neoliberal governmentality in seeking to take action to achieve healthy and fit embodiment and engaging in self-governance (Lupton 1995b; Petersen and Lupton 1996). Questions about the oft-cited problem of the 'digital divide', or the lack of access of many people to digital technologies because of their socio-economic status, geographical location, disability, lack of skills or sheer unwillingness to learn about new digital technologies (Blanchard et al. 2008; Frederico, Tiago, and Fernando, 2012) are ignored in these discourses.

Visualisation technologies and bodily display

The use of digital mobile technologies to record, measure and monitor bodily functions, as part of health promotion and voluntary self-tracking, is a logical extension of the employment of visualising technologies in medicine. Technologies for screening and diagnostic purposes, such as X-rays, computer tomography, ultrasound and magnetic resonance imaging, have been used for some decades to monitor, record and interpret the body, to gaze into and produce images of its interior. In recent times, digital technologies have become increasingly important for the visualisation and display of the human body in medicine. Indeed, it has been argued that these technologies are participating in an important historical transformation of bodies at which a key site is medicine (Duden 1993; Waldby 1997).

Part of this increasing use of visualising technologies is a significant shift in how the body and health states are conceptualised, articulated and portrayed. Where once people relied upon the haptic sensations they felt in their bodies and reported to their physicians, medical technologies devoted to producing images of the body have altered the experience and treatment of bodies. The optic has come to take pre-eminence over the haptic in revealing the 'truth' of the body (Duden 1993). Such technologies produce a virtual patient, a 'screen body'. The visual image or data they generate are often privileged as more 'objective' than the signs offered by the 'real', fleshly body and patients' own accounts of their bodies (Chrysanthou 2002; Blaxter 2009).

Like these medical imaging technologies, mobile digital technologies that measure bodily movement and body functioning, and report these data to the device user and those with whom they choose to share these data, produce a spectacular body, one in which the internal workings are similarly displayed and made visible. As part of the project of seeking security and stability of 'taming uncertainty' (Lupton 1995b), the 'transparent body' is created using such technologies in the effort to penetrate the dark interior of the body, render it visible, knowable and thereby (it is assumed) manageable. By generating biometric data, these devices are producing 'bodies that are *simultaneously* hyper text and flesh' (Rich and Miah 2009, 172, emphasis in the original).

Because they constantly collect data on bodies that are constantly moving and engaging in a wide variety of activities, the 'digital archive' (Waldby 1997) of the body these technologies are able to construct is subject to constant change and revision. When users employ devices which allow them to measure their bodily functioning, movement and consumption habits and then to display the collected data via social media platforms, they are, in effect, sharing personal body displays, using them for their own purposes of 'performing health'.

Sometimes this display of one's biometric data may take an overtly competitive form, as in websites such as strava.com, where people can upload data from digital

devices which have GPS and heart monitor functions from a run, hike or cycle which show how many kilometres they have covered and at what speeds, power and heart rates, and then compare these data with others engaging in similar activities on the same route. Exercisers can also strive for their personal best by comparing data from previous outings with their latest and again broadcast the resultant data to their social networks. These functions, therefore, are able to contribute to the configuration of identity and the presentation of the self online that have been identified as important elements in analyses of social media platforms, such as Facebook (Zhao, Grasmuck, and Martin 2008; Ellis 2010; Davis 2012).

The allure and power of metrics

Self-tracking mHealth devices not only configure the body and health states into visual displays, they are also based on quantification, often using complex algorithms to process and display the data collected. The visual data on the body produced by mobile digital devices – the ‘numbers’ that allow users to compare their biometrics with those generated on previous days or against others’ data – contribute to a new way of conceptualising one’s body and one’s health status. These ‘numbers’ have been vitally important in promoting the cause of the self-tracking movement. Indeed for some, the achievement of ‘self knowledge through numbers’ as the official Quantified Self movement website (Quantified Self 2013) has it, is the primary objective of self-tracking.

As recent sociological analyses into questions of measure and value have argued, there has been a huge increase generally in the use of metrics in many aspects of social life, which has been greatly impelled by the development of technologies for achieving, interpreting and displaying quantification. Yet, there is a politics of measurement: numbers are not neutral, despite the accepted concept of them as devoid of value judgements, assumptions and meanings. The ways in which phenomena are quantified and interpreted, and the purposes to which these measurements are put, are always implicated in social relationships, power dynamics and ways of seeing (Savage and Burrows 2007; Adkins and Lury 2011; Ruppert 2012).

Using self-tracking technologies encourages people to think about their bodies and their selves through numbers. The implication of the ‘self knowledge through numbers’ motto is that ‘self-knowledge’ as it accomplished via self-tracking and the production of ‘numbers’ is a worthy goal for individuals to aspire to. The more we know about ourselves and our bodies, the more productive, wealthier, wiser, healthier, emotionally-stable and so on we can be. It is assumed that the production of such hard/objective data is the best way of assessing and representing the value of one’s life and that better ‘self-knowledge’ will result.

The lure of the ‘numbers’ produced from self-tracking is that they appear scientifically neutral. The body/self as it is produced through self-tracking, therefore, is both subject and product of ‘scientific’ measurement and interpretation. Such a transformation extends further the move from the haptic to the optic in the configuring of the body/self. As one’s bodily states and functions become ever more recordable and visualised via data displays, it becomes easier to trust the ‘numbers’ over physical sensations.

Concluding comments

In this article, I have raised some possibilities for thinking about mHealth technologies as they are used or promoted for monitoring and displaying health states and bodily

functions. There is much yet to explore concerning the incorporation of these technologies into everyday life. Like any other material object, mobile digital devices have their own social lives and histories (Appadurai 1988), as they are taken up and used as part of embodied practices. Some cultural theorists use the term ‘domesticate’ to describe the ways in which technologies are incorporated into everyday use and how they are transformed or ‘tamed’ to fit into routines. Technologies may retain some of their unpredictable ‘wildness’, however, as technologies are not simply configured by their users, but in turn shape their users in various ways by creating new ways of thinking, feeling and being (Pols and Willems 2011). This is a dimension of mobile digital devices that is not always recognised or acknowledged.

Given that mobile digital technologies are so novel, research directed at how people actually use them for health purposes – how they ‘domesticate’ them and incorporate them into their everyday lives – has yet to be published. What types of people self-track? How do the devices they use come to acquire meaning in the context of everyday use? What are the social lives of these commodities? Aspects of how and to what extent these devices are incorporated in concepts of selfhood and embodiment also remain to be fully explored.

Related to these questions are those concerning how concepts of ‘health’ are configured and understood via these technologies and what types of resistance users may offer to incorporating them into their everyday worlds? Given the simulated nature of the ‘data doubles’ (Haggerty and Ericson 2000) produced via digital technologies, ‘health’ at least partly potentially becomes a simulacrum. If the statistics recorded by one’s digital device show that one’s BMI is ‘normal’, that one is not imbibing too much alcohol, engaging in enough exercise, has a normal resting pulse or blood pressure, these data comprise a simulated ‘healthy body’, regardless of how well an individual may actually feel. Such questions as how users respond to the data produced by self-tracking on a day-to-day basis, how they react to others’ responses when these data are shared and what credence users ascribe to the data derived from these devices compared with other sources of bodily experience and information deserve in-depth research and analysis.

Freund (2004, 273) uses the term ‘technological habitus’ to describe the ‘internalised control’ and kinds of consciousness required of individuals to function in technological environments such as those currently offered in contemporary western societies. The human/machine entity, he argues, is not seamless: rather there are disjunctions – or, as he puts it, ‘seams in the cyborg’ – where fleshly body and machine do not intermesh smoothly, and discomfort, stress or disempowerment may result. Sleep patterns, increasing work and commuting time and a decrease in leisure time, for example, can be disrupted by the use of technologies, causing illness, stress and fatigue. People may feel overwhelmed by the sheer mass of data conveyed by their digital devices and the need to keep up with social network updates. They may begin to resent the imperative to self-track their body’s functions and performances, even if the decision to do so was their own rather than urged upon them by a medical or public health professional. There is also the possibility that the intense focus on one’s body produced through self-tracking – making the body ever more ‘visible’, rendering it open to ever-more detailed monitoring – may eventuate not only in greater certainty, but also create greater anxiety.

The capacity of the mobile digital device to develop an intimate relationship with their users – to be viewed as a friend, helpmeet, and in the context of mHealth even as one’s proxy doctor, health coach or mental health professional – requires greater examination. So too the ambivalence that users may feel about continuing the use of mHealth

technologies or sharing the data they derive from this use is a feature that should be acknowledged. The greater reliance one may have upon a particular technology, the more it is incorporated into everyday life, subjectivity and embodiment, the more one feels an emotional connection to it, the greater the potential for ambivalence (Lupton 1995a). Analyses of social media platforms, such as Facebook, are beginning to appear that suggest that users may express feelings of ambivalence towards these technologies. Users may simultaneously recognise their dependence upon social media to maintain their social network, but may also resent this dependence and the time that is taken up in engaging with them, even fearing that they may be ‘addicted’ to their use (Davis 2012).

It is possible that the practice of self-tracking may also come to be experienced as a burden rather than a vital source of self-knowledge and empowerment. Anecdotal accounts of self-tracking from sites such as the Quantified Self suggest that some regular self-trackers do experience significant health benefits from doing so, claiming that they feel more in control of their health and bodies and have successfully lost weight, engaged in regular exercise, dealt with sleep problems, reduced the consumption of cigarettes and alcohol or managed a chronic medical condition using these devices. However, other users find self-tracking too onerous, find the devices inconvenient, unfashionable or uncomfortable to wear or that the apps are not compatible with their smartphones. Some have commented that engaging in self-tracking led them to become overly focused on their health and to experience feelings of failure, anxiety or self-hatred (Lupton 2013).

The implications of mHealth technologies for health promotion work also remain under-explored and under-theorised. Some survey research has suggested that many medical and health professionals are not themselves using social or other digital media in their professional practice to any great extent as yet, because of lack of knowledge about how best to do so or concern about having to learn about using new technologies (Giordano and Giordano 2011; Hanson et al. 2011; Usher 2011, 2012). Here again, more extensive and in-depth research is required to explore the attitudes and experiences of health promoters in relation to these technologies and how they are being domesticated and incorporated into their everyday working practices and knowledges.

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