Original Article

Data for life: Wearable technology and the design of self-care

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Abstract   Over the last 5 years, wearable technology – comprising devices whose embedded sensors and analytic algorithms can track, analyze and guide wearers' behavior – has increasingly captured the attention of venture capitalists, technology startups, established electronics companies and consumers. Drawing on ethnographic fieldwork conducted 2 years running at the Consumer Electronics Show and its Digital Health Summit, this article explores the vision of technologically assisted self-regulation that drives the design of wearable tracking technology. As key artifacts in a new cultural convergence of sensor technology and self-care that I call 'data for life', wearables are marketed as digital compasses whose continuous tracking capacities and big-data analytics can help consumers navigate the field of everyday choice making and better control how their bites, sips, steps and minutes of sleep add up to affect their health. By offering consumers a way to simultaneously embrace and outsource the task of lifestyle management, I argue, such products at once exemplify and short-circuit cultural ideals for individual responsibility and self-regulation.
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In January, 2014, exactly 1 week after President Obama's Affordable Care Act's mandate for universal coverage went into effect, I found myself standing in the back of a crowded conference room on the second floor of the Las Vegas Convention Center. Downstairs, the annual Consumer Electronics Show (CES) – the leading international venue for showcasing new consumer technologies – was in full swing. Over the next 2 days, 750 of the roughly 150 000 attendees would stream in and out of the room to hear the proceedings of the Digital Health Summit, a carefully curated lineup of keynotes, panels and super-sessions on how the tech sector might "capitalize on the new opportunities" brought by health reform.[1]

"Take a deep dive into the giant umbrella that is Digital Health", invited the press release, explaining that the term encompassed "telehealth systems, mobile health applications and devices, sensor-based technologies, big data and predictive analytics, chronic care

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1 The seed for this article was a short piece in the MIT Technology Review titled "Obamacare meets wearable technology" (Schüll, 2014).

management, genomics, wearables, and wellness and fitness devices". Throughout the proceedings, speakers described digital health technologies and the Affordable Care Act as a "dynamic duo", to take the title of one session, that would "work together to leverage each other to achieve mutual success". The new legislation would trigger a cascade of "incentivized compliance", compelling insurers, health care providers and consumers to cut costs. The audience learned how big data is transforming epidemiology and public health, how advances in electronic health record systems are streamlining the practice of medicine, and how continuous monitoring devices are shifting the management of chronic conditions like diabetes and heart disease away from hospitals and doctors and into the hands of patients themselves.[2]

Most of the discussion at the Digital Health Summit, however, focused on the well, not the sick. As speakers frequently reminded attendees, 50–75 per cent of the monstrous US $2.7 trillion expended annually in the United States on health care is spent on preventable conditions linked to everyday behavior such as overeating, under-exercising and smoking – "lifestyle diseases", or "diseases where you have a choice", as one presenter put it.[3] Consensus had it that the physical and financial costs of such conditions could be controlled by managing one's day-to-day decisions: what to eat and drink, how much to move one's body, how to avoid stress. The task of so-called lifestyle management was to keep oneself well by keeping one's quotidian choices in check.[4] "Health is not a side event, discrete and separate from everyday life", commented Tom Paul, Chief Consumer Officer for UnitedHealth and a panelist at the Digital Health Summit. "Now it can be part of day-to-day living, everyday life".

Such a claim corresponds with a recent mutation in the notion of health that the anthropologist Dumit (2012) has identified: once understood as a baseline state temporarily interrupted by anomalous moments of illness, health has been recast as a perpetually insecure state that depends on constant vigilance, assessment and intervention. "Health is no longer the silence of the organs", writes Dumit; "it is the illness that is silent, often with no symptoms" (p. 15).[5] The sociologist Rose (2007) makes a similar observation when he writes of a

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2 The US government's Obama administration has taken a keen interest in the power of big data to transform health care. The US Department of Health and Human Services, the US National Institutes of Health's Office of Behavioral and Social Sciences Research, and government-funded entities such as the National Science Foundation and the Robert Wood Johnson Foundation have invested in mHealth (or "mobile health") initiatives as a way to address wide-scale population health problems. Projects include smoker cessation apps, health text messaging, digital tools for the management of diabetes or for medication compliance, and the like. Market research shows that over one third of doctors recommend health or medical apps for their patients (MobiHealthNews, 2014). (See also Goetz, 2010; Topol, 2012, 2015).

3 For more on the rise of chronic disease, see the accounts of historians of medicine Weisz (2014), Armstrong (2014) and Greene (2007) who writes of "a shift in the basic conception of chronic disease from a model of inexorable degeneration to a model of surveillance and early detection" (p. 84). For analyses of the idea of "lifestyle" see Friedman (1994), Giddens (1991) and Dumit (2012).

4 In 1980, the sociologist Robert Crawford described an early version of lifestyle management linked to the simultaneous depoliticization and privatization of health then taking place in America: collective struggles for wellbeing were being replaced by an emphasis on individual self-care in the form of lifestyle modification (1980, p. 365). Solutions to bad diet, for instance, were located "within the realm of individual choice", in the ability to resist advertising and overcome bad habits (p. 368).

5 Unlike acute diseases that arise suddenly, lifestyle diseases pose "a more sinister threat, another type of mortal hazard with slower effects that go stealthily into the blood one cancerous bacon sandwich or poisonous drink at a time, potential killers by degrees that might catch up with us later in life" (Blastand and Speigelhafter, 2014).

pervasive sense of susceptibility or "the sense that some, perhaps all, persons, though existentially healthy are actually asymptomatically or pre-symptomatically ill" (p. 20). In the era of lifestyle disease, everyone is *potentially* sick and must take measures to keep well.

Dumit is specifically concerned with the characterization of health as lifelong pharmaceutical treatment, what he calls "drugs for life". The culturally valorized mode of living that corresponds to this notion of wellness entails closely watching one's bio-levels and adjusting pharma-cocktails at any sign of slipping above or below ever-shifting thresholds of normality. At stake in this article is what I call 'data for life', a related, complimentary response to the notion that we are all potentially sick in which wellness depends on the continuous collection, analysis and management of personal data through digital sensor technologies (see Swan, 2012). "We discovered that people didn't necessarily need more data about their *medical lives*", reads a report on the value of personal data by the Robert Wood Johnson Foundation health care think tank; "instead, they needed more information about how their *everyday actions* influence their health". Following this logic, "constant informational body monitoring is imperative", as Viseu and Suchman (2010, p. 173) have described the mandate of wearable computing.

Although people have long used simple, analog devices to record, reflect upon and regulate their bodily states and processes (for example, diaries, scales, wristwatches, thermometers), the present historical moment is witnessing a dramatic efflorescence in the use of digital technology to self-track (Crawford *et al*, 2015). As mobile technology spreads, as electronic sensors become more accurate, portable and affordable, and as analytical software becomes more powerful and nuanced, consumers are offered an ever-expanding array of gadgets equipped to gather real-time information from their bodies and lives, convert this information into electrical signals, and run it through algorithms programmed to discern patterns and inform interventions into future behavior.[6]

As recently as 5 years ago, individuals who embraced such technology were likely to identify as members of Quantified Self, a community of avid self-trackers whose tagline is "self-knowledge through numbers".[7] Yet wearable technology has increasingly captured the attention of venture capitalists, technology startups, established electronics companies and

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6 Scholars of the "Internet of things" (Halpern *et al*, 2013) and "sensor society" (Andrejevic and Burdon, 2014) have called attention to the importance of sensor technology to contemporary life. Dramatic increases in the sensitivity and sophistication of sensors along with decreases in their size means they can be loaded into clothing, pillboxes, toothbrushes and smartphones – which are becoming wearable tracking devices in themselves. Algorithms operating on the tracked data "can analyze data along multiple lines – time, frequency, episode, cycle and systemic variables", writes Swan (2013) , a science and technology innovator and philosopher, and in this way detect "elements that are not clear in traditional time-linear data": patterns, cycles, exceptions, the emergence of new trends, episodic triggers, variability, correlations and early warning signs (p. 90).

7 Founded by two former editors of Wired magazine in 2007, Quantified Self currently claims 45 000 members in 40 countries. In online forums and in meetings around the world, quantified selfers share their attempts to experiment with diet and meditation, monitor drug side effects, correlate hormone levels with mood fluctuations and relationship dynamics, or even evaluate semantic content in daily email correspondence for clues to stress and unhappiness. Social studies of quantified self include Lupton, 2015, 2013a, 2016; Albrechtslund, 2013; Boesel (see her blog, http://www.thesocietypages.org/cyborgology/author/whitneyerinboesel/), Mackenzie, 2008; Nafus and Neff, 2016; Nafus and Sherman, 2014; Oxlund, 2012; Pantzar and Ruckenstein, 2015; Ruckenstein, 2014; Potts, 2010; Schüll, forthcoming; Till, 2014; Berson, 2015; Watson, 2013. While journalists typically cast those who live by numbers as narcissistic and obsessive in their zeal for personal data, digital health pundits hold them up as beacons of a sensible tracking future. At the same time, they recognize that mass-market users are not as responsive to quantification as the typical QS member and that technology must be designed in a way that makes it "automated, easy, inexpensive, and comfortable" (Swan, 2013, p. 93).

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mass-market consumers. Revenue from digital fitness devices such as the popular Fitbit[TM] wristband totaled $330 million in 2013 and is expected to reach $1.8 billion in 2015 – and $5.8 billion by 2018 (GovLab, 2014; Consumer Electronics Association, 2015). Attesting to the robustness of this new market, the aisles of Best Buy and Walmart are abundantly stocked with gadgets designed to record personal metrics, the Internet rife with downloadable smartphone apps that can monitor and help adjust behavior. The online marketplace Amazon has launched a specialty shop for "Wearable Technology" featuring approximately 800 products, the vast majority categorized under "fitness and wellness"; the shop includes a buyer's guide for understanding what wearables are and how to incorporate them into one's lifestyle. Personal electronics and smartphone giants Apple and Samsung, as well as software and Internet leaders Google and Microsoft, have all recently introduced health and fitness tracking systems. Consumer tech pundits have forecast that by the close of 2015 well over 500 million people will use mobile health applications and devices (Rahns *et al*, 2013).

"Dashboards 24–7", said Michael Yang of Comcast Ventures when pressed to give his own prediction at the 2014 Digital Health Summit. That year, summiteers frequently invoked the 2013 Pew report "Tracking for Health" (Fox and Duggan, 2013) and its finding that nearly 70 per cent of American adults already tracked weight, diet, or exercise while one-third tracked health indicators such as blood pressure, blood sugar, headaches, or sleep patterns.[8] What made these trackers an especially promising market was the fact that only 20 per cent tracked with *technology*; the rest, who used pen and paper or simply tracked "in their heads", could be targeted for conversion to the use of digital tools. Although it is too early to tell whether wide-scale digital tracking will come to pass (indeed, studies are beginning to show that mainstream consumers do not use wearables consistently or as intended),[9] people are purchasing self-tracking gadgets and downloading self-tracking apps in rising numbers; tech companies are dedicating significant resources to the development of new gadgets and apps; health-care policymakers and insurance companies are optimistic that these technologies will help mitigate lifestyle diseases; and drug companies hope they will help solve the problem of medication compliance.[10] Whatever the future holds, the present moment is one of heavy investment in tracking technology by multiple stakeholders.

Social scientists who have begun to explore this moment most often focus on the experience and practices of self-trackers, particularly their ambivalent embrace, creative repurposing, or outright rejection of tracking technology and the project of "living by numbers" (Mackenzie, 2008; Mol, 2009; Potts, 2010; Oudshoorn, 2011; Boesel, 2012a, b; Oxlund, 2012; Schüll, forthcoming; Albrechtslund, 2013; Watson, 2013; Nafus and Sherman, 2014; Ruckenstein,

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8 "People living with chronic conditions", the authors of the report write, "are significantly more likely to track a health indicator or symptom" (Fox and Duggan, 2013, p. 2). They go on to note that two-thirds of US adults are considered overweight or obese and half are living with at least one chronic condition – most often high blood pressure and diabetes (ibid., p. 6).

9 According to recent reports by industry analysts, a third of people discontinue tracking within the first 6 months (Ledger, 2014; Ledger and McCaffrey, 2014). Nafus and Sherman (2014) have shown how trackers frequently switch between devices, interrupting data streams and amounting to a form of "soft resistance".

10 Dumit (2012) has observed (personal communication) that what I call 'data for life' is becoming a part of the "drugs for life" agenda; although "changes in lifestyle such as exercising more and watching one's diet are rendered secondary" to the administration of pharmaceuticals (p. 127), drug companies are increasingly looking to self-tracking technology to help solve the problem of medication compliance. As in the case of diabetes, it is suggested that ongoing glucose monitoring, exercise and diet be combined with a lifetime of drug-taking.

2014; Berson, 2015; Lupton, 2015, 2013a, 2016; Pantzar and Ruckenstein, 2015). Here I focus on an even less examined aspect of the contemporary tracking moment: the vision of technologically assisted self-care that drives the design of wearable tracking technology. "Little knowledge", writes the sociologist Lupton (2014) in a recent article on tracking apps (p. 618), "is available on the practices and tacit assumptions of app developers and designers and the companies that commission apps". While Lupton attempts to illuminate these practices and tacit assumptions by considering product logos, Websites and advertisements, my approach in this article is primarily ethnographic, looking 'behind' finished products to document the debates, challenges and emergent articulations of wearable technology stakeholders.

What models of human behavior shape technologies of continuous tracking? How do the technologies, in turn, shape new models for living? How does 'data for life' as a mode of self-regulation reflect and contribute to the broader field of contemporary liberal-democratic regulative rationalities? The Consumer Electronics Show, where I conducted two consecutive years of ethnographic research (in 2014 and 2015), affords a uniquely illuminating vantage on these questions. In the aisles, booths and meeting rooms of its sprawling exposition floor, new technologies are showcased and demonstrated, financed and bought, while on the panels of its carefully curated Digital Health Summit, new definitions of health and healthy behavior are formulated, promoted and debated.

Keeping Track: Designing Digital Self-care

Of the 3300 companies exhibiting at the 2014 Consumer Electronics Show, 300 ministered to digital health. Such exhibitors occupied 40 per cent more floor space than the previous year, with most clustered in the far lower wing of the Las Vegas Convention Center's South Hall, in a 36 000 ft^2 area that consisted of adjacent "Fitness Tech" and "Digital Health" zones. In these zones, tech companies showed off a dizzying array of devices for tracking personal data and promoting healthy behavior: heart-rate detecting ear buds, body-fat measuring bathroom scales, electronic skin patches that monitor blood flow, smart toothbrushes that help people brush their teeth correctly and long enough, and an impressive collection of wristbands packed with sensors to log footsteps, heart rate, sleep phases and more. By way of demonstration, gymnasts performed feats of physical prowess, showgirls danced and athletically clad young women speed-walked on treadmills while wearing the bands, their data displayed on large screens. A small podium at the intersection of the Fitness, Health, and Aging zones was busy throughout the conference with product demonstrations.

A central booth in the Fitness Tech zone belonged to Fitbit, currently the undisputed market leader in wearable fitness.[11] The company makes a wearable movement-tracker that syncs with users' personal computers, mobile phones, and now smart watches to continuously monitor steps taken, hours slept and other data they might choose to enter. The stated purpose is to bring about "a healthier you" (see Figure 1). Elaborating on this aspiration, a video advertisement for the device that played on a loop for the duration of the exposition featured close-up shots of different body parts in motion as the voiceover celebrated the arrival of a

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11 One of Fitbit's chief officers chairs the newly formed Health and Fitness Technology Division of the Consumer Electronics Association, which oversees the presence of digital health technology at each year's Consumer Electronics Show.

Figure 1: "Small daily decisions = BIG results." Still image from a promotional video for the Fitbit Zip from 2012, available online at youtube.com (https://youtu.be/fsKvNB0Fvb0).

sensor that could keep track of routine activities. "Every step you take, every goal you set, every choice you make to be active" would be recorded – either by the band slipped over the wrist or the pendant clipped to the waist. A runner was shown in slow motion, concentric circles radiating out from his feet as they struck the pavement, illustrating the technical achievement of accurate, consumer-grade signal processing and prompting potential users to attend to the rippling consequences of their every movement. Next a woman was shown playing with her children in their backyard, segueing to her home office where crisp imaginary lines extended from her blurry form in the window to the smartphone and laptop on her desk. The sequence suggested that consumers could trust the device to capture the information they generated as they moved through their days – calories burned, distance covered, duration of activity, fluctuation in weight – and keep it synchronized in real-time, across all screens.

Partway through the advertisement, a man paused at the turnstile of a subway entrance, then slowly turned to face the camera as a digital overlay indicated the choice before him: Monorail versus WALK. With a smile he rejected the train and set off on an illuminated footpath to realize the "potential 2000 steps" he would thereby add to his daily count. At the press of a button on his mobile smartphone, he broadcast his choice to a group of friends, his new step-count advancing him on the leaderboard of life. The advertisement closed on the figure of a woman sleeping, an expression of contentment on her face, her exposed arm revealing the band that promised to optimize "even inactivity".

Fitbit competitor Jawbone's "idle alert" also addresses inactivity, vibrating when wearers are still for too long. Some wearables focus entirely on bodily stillness – tracking it, preventing it, helping users maintain proper posture during it. A simple gadget called the Rise sits in one's pocket and records time sat throughout the day. CES 2014, saw the debut of Lumo Lift posture technology, an update to the Lumo Back. In its latest iteration, the Lumo sensor fastens upon one's lapel or brassiere strap, whence it records and corrects posture with subtle (or not so subtle) vibration. "Through the app, you can control when you're buzzed, how you're buzzed, and even how intensely it buzzes", informed the plasma display in Lumo's

booth. While the technology performs standard activity tracking, its primary purpose is to monitor and regulate the stationary states of sitting or standing: "All about your posture. All about your life. *One move changes everything*". A promotional video for the Lift closes with images from a corporate meeting in which the wearer briefly pauses to lift her head and bring her shoulders back, seemingly unprovoked, and allows a triumphal smile to play across her face. "Small changes can be empowering", the ad exults.

Kitty corner from the Fitbit exposition booth was a smaller booth featuring a device designed to entrain users to more mindful eating habits. The smart utensil HAPIfork intervenes in the habit of feeding by monitoring and recording the length of each meal, the number of fork-servings per meal and the time between each of these servings; if shorter than 10 seconds, the fork will oscillate so that the eater knows to slow down – an effect achieved via proprietary "slow control" technology. "You are advised to take about 10–20 chews. If you trigger the HAPIfork's alarm [by eating too fast], don't panic. Set the fork down at the side of the plate and wait until the light turns green again, signaling that it is safe to take another bite". The device, which turns something as routine as a single bite of food into a matter of potential danger, is presented as an "everyday technology" that helps users "take control of their health". The company recommends keeping smartphones in view so users can see their data as it is collected in real time; as they feed themselves, their data is fed back to them. "Every bite is a potential teaching experience", noted a user in a *TechCrunch* review (Lawler, 2013.)[12]

Hydration, another mundane yet vital human action, is the focus of the H20-Pal monitoring device, a small wireless scale that one attaches to the bottom of any water bottle where it keeps track (using built-in flash memory and a weight measuring sensor and accelerometer) of how much liquid is consumed from it, conveying this information to a users' smartphones where a corresponding application is programmed to alert those who have not hydrated enough. Similarly, BluFit's bottle "passive hydration tracking" bottle uses built-in sensors to measure how much has been drunk, automatically adjusting daily goals based on temperature and humidity and providing feedback in the form of flashing lights. Yet another smart water bottle, the Ilumi, changes color from red, to yellow, to green throughout the day to signal users' proximity or distance to their preset hydration goals. Like the other devices in the "Fitness Tech" and "Digital Health" zones at CES 2014, these devices transfer the burden of tracking – and, in some cases, behavior change – from selves to sensors and computational algorithms.

Back upstairs at the Digital Health Summit, technology designers, doctors and government representatives continued to brainstorm on how to get personal data technology onto the wrists and into the pockets of more consumers. The accuracy and feasibility of monitoring, they reported, was good and getting better, and data scientists were continuing to refine analytic algorithms; the challenge when it came to self-tracking devices and programs was consistent use – "getting people to use the damn thing, so that it becomes part of their lifestyle", as the Executive Vice President and Chief Medical Officer of the UnitedHealth insurance company put it.

To make data tracking a habitual facet of lifestyle, it was not enough, all agreed, to simply provide the data. "Ninety to ninety-five percent of people are just not motivated by looking at data", reported the CEO of Lark Technologies, a mobile and wireless technology company

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12 Although comical to some ears, the HAPIfork is not marketed in jest. Many journalists have mocked the product, including Stephen Colbert who called the fork an "un-American" product because of its effort to slow consumption. Some have critiqued the fork for addressing a first-world problem.

that focuses on behavior change via automated coaching and feedback. Indeed, the growing consensus was that most would be overwhelmed or discouraged by "seeing their numbers". "We're gathering about 5000 data points a minute off the body", commented the CEO of BodyMedia. "Now, you and I can't deal with that much, so we have to trickle it into meaningful insights to help us understand how our lifestyle choices affect our health".

By the 2015 Digital Health Summit, the emphasis on dequantification and meaningful insight had become especially pronounced. "Old school products show a number", said the CEO of the wearable tech company Valencell; "but the next generation will simply tell you how you're doing: *You have improved 10* per cent. They'll give you personalized direction and meaning". New weighing scales, for instance, would communicate the amount gained or lost since last weigh-in rather than one's total weight – or simply show a smiley face to signal that one's weight was on track; one company's scale had no screen at all, providing only audio encouragement in the form of a friendly voice or even just a confirming vibration under the feet. "Measurements don't mean anything without telling us what to make of the measurements", said the chief medical officer for Qualcomm Life. "You need a coach, feedback, a sense of accountability". Instead of conveying numerical data, or even patterns and correlations across different streams of data, it was essential for designers of wearable technology to "reflect or refract data in a way that the individual can *act* on it".

How exactly to do that was a question of ongoing debate. Should wearables unobtrusively suggest or recommend courses of action? Offer messages of encouragement, praise, or shame? Engage wearers in motivating games? Deliver rewards of some sort for the accomplishment of small milestones? Ping, buzz, or even zap users to remind them of goals they have not met? Simply let them know they are on track? "We are still in the infancy of motivational elements", commented Fitbit's James Park at the Summit.

The internal debates of the digital health industry over how to change user behavior through technology, provisional and unsettled as they may be, indicate the emergent contours of a distinctive model of digitally assisted self-care. In the remainder of this essay I examine the normative assumptions and sociopolitical stakes underpinning this model. I begin by considering the kind of self that is drafted – by which I mean imagined, sketched and also enrolled – as the ideal subject of continuous tracking and its technologies; I call this the 'self as database'. I then turn to consider the behavioral-informatic mode of regulation that corresponds to such a self, which I call 'governance by micronudge', focusing on how this mode of regulation at once exemplifies and short-circuits cultural ideals for individual responsibility.

Self as Database

The selves of self-tracking are understood, by those invested in wearable technology, to be *choosing* subjects; more precisely, they are construed as consumers whose well-being depends on and derives from the market choices they make. Choice making has been identified by a number of scholars as a distinctively valued – and fraught – domain of life in advanced liberal societies. Individuals are urged to shape their lives through choice in the manner of savvy, ever vigilant entrepreneurs and yet, more often than not, lack the knowledge, foresight, or recourses to navigate the abundance of potential choices they face (Giddens, 1991; Rose, 1999; Hunt, 2003; Schwartz, 2005). Dumit (2012) aptly notes the "double insecurity" of

"always being at risk" while "never knowing enough about what one could and should be doing" (p. 1). As we have seen, the wearable tech industry banks on this double insecurity: the customers they imagine, unsure whether to trust their own senses, desires and intuitions as they make mundane yet vital choices – when and what to eat and drink, when and how much to move or rest – "fly blind" through their daily routines.

Digital tracking products and applications promise to help fill in the blind spots and take the guesswork out of everyday living by supplementing the myopic vantage of real-time experience with a continuous, informatic mode of perception. Unlike the clinical gaze that Foucault (1973) described, which focused on the sights, sounds and smells of acutely ill bodies, sensor technology and big-data analytics[13] attend to the "digital exhaust" of well bodies – informational bits whose cumulative diagnostic value could never be detected by the eyes of a doctor in real-time. This mode of apprehending and assessing the subject happens remotely from the space and time of the body – in the cloud, not the examination room. It is an epistemology that concerns itself with time-series data rather than immediate experience; correlation rather than causation; patterns rather than events.

When these patterns are rendered into humanly digestible ratings, scores and visualizations, suggested digital health summiteer Scott Kzicki of Verizon's Health Care Management Markets group, they can enhance self-awareness: "You can build a profile or picture of what it is you're doing and this lets you see and understand the choices you're making on a daily basis, which is really who you *are*: the choices that you make all day long, whether to take the stairs or the elevator, what you will eat or not eat". It was important, he continued, to remain in constant touch with one's data profile, so as to grasp "how your choices are impacting you *now* – see how the gauges are moving *as* you make choices ...". In this way, he suggested, personal sensor technology could function as a kind of "sixth sense". Traditionally a phrase to describe uncanny insights that seem to come from some ethereal, extra-sensory domain, here "sixth sense" connotes the discernment of otherwise imperceptible effects of habit by electro-mechanical sensors and data-processing software.[14]

The science and technology pundit Swan (2013, p. 95) uses a similar metaphor to describe this supplemental insight into being, suggesting that the transposition of big-data epistemologies to the scale of the individual affords "a sort of fourth-person perspective" on the self and, ultimately, a new kind of truth – one that is "not possible with ordinary senses" in that it does not correspond to a phenomenological self (temporally and spatially located) but to a database self whose truth lies in scattered points, associations and dynamic accretions. This is "a type of selfhood that is distributed between different and constantly changing data sets", writes Lupton (2015). We are invited to view ourselves as longitudinal databases constantly accruing new content: 'You are your data' is the frequent refrain.

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13 'Big data' has come to mean many things. Typically the phrase characterizes the continuous collection of data streams and the convergence of multiple streams and types of data such that previously undetectable patterns can be discerned – with the right tools. Some definitions of big data include the novel analytic tools that are brought to bear on vast data sets, such as advanced mining techniques, predictive modeling, dynamic systems modeling and new machine learning algorithms.

14 Microcomputational data-gathering and "passive" sensing, writes Hansen (2014, p. 24), gives us "digital insight" into our lives to which we would not otherwise have access; they grant us "a sort of sixth sense, a *datasense*," write Kang and Cuff (2005, p. 110).

Some worry that the rhetoric of self-as-database opens a problematic gap between the 'you' of the data set and the epistemologies by which that data set is amassed, studied and made meaningful. Marketers of wearable computing, note anthropologists Viseu and Suchman (2010, p. 175), present their wares as the only way to bridge the "epistemological lacuna" that divides "the modern body and the knowing and acting self", and as the sole means of bringing "physiological fact into the grasp of the experiencing subject". For instance, the electronics company Samsung poses the following question in a recent video promoting its health and fitness technology: "What if you could ask your body questions and listen to the answers, every minute of every day? You could adjust your habits according to your body's advice. Imagine the insights gained, the mysteries unlocked; it would change your life". The "body", here, is not a sensing organ through which one gains self-knowledge but, instead, a data-generating device that must be coupled to sensor technology and analytic algorithms in order to be known. "This is a body that is continually emitting signs, albeit in forms inaccessible to the self that might act to maintain it", write Viseu and Suchman.

The idea of a self limited in its capacity to keep track of, digest, or parse its own data emissions calls to mind the figure of the "dividual" introduced by the French philosopher Deleuze in 1990, just as digital information and communication technologies were coming into widespread use. Dividuals, he argued, were endlessly subdividable collections of data points; they were not subject to the architectural enclosures, institutional arrangements and postural rules of disciplinary societies (as described by Foucault) but, rather, moved through a networked Web of continuous monitoring, assessment and modulation – technologies of "control society" (Deleuze, 1990). The scenario he sketched a quarter of a century ago bears a striking resemblance to the tracking-intensive world of today, in which the bodies, movements and choices of citizens and consumers are ever more seamlessly monitored and mined by governments and corporations (Cheney-Lippold, 2011). "It's a constant pipeline of data streaming in from consumers", commented a participant in the Digital Health Summit.

And yet, the anthropologist Berson notes, what escaped Deleuze's prescience was the degree to which the tracking and coding of bodies and acts would come to define the living of a good life. The contemporary world, he writes, is characterized by "an intimacy of surveillance encompassing patterns of data generation we impose on ourselves" in the name of self-care (2015, p. 40; see also Rich and Miah, 2014).[15] What Berson points to here is a blurring of the line between control and self-control, governance and self-governance, in our datafied present. In the final section of this article, I examine how this blurring plays out in the case of wearable technology and its mediations of everyday life.

Step, Bite, Sip: Governance by Micronudge

In the late 1970s, Foucault coined the term *biopower* to describe how, at the threshold of modernity, the vital characteristics of human life became political objects – elements to be understood, regulated and controlled (Foucault, 1980). He identified two poles of biopower:

15 It should be noted that personal data streams can be bought, sold, transferred and mined for insight in comparison with those of others, and in this sense holds value as a kind of bioeconomic capital or "biocapital" that government-sponsored researchers or multinational corporations can harness and exploit (Rabinow and Rose, 2006, p. 203; Beer and Burrows, 2013; Lupton, 2014; Till, 2014).

the anatomo-political, which concerned the discipline and optimization of the capacities of individual human bodies (efficiency, docility, posture and the like); and the biopolitical, which concerned the regulation of the biological life of the "species body" – the population's birth, disease, productivity and mortality rates (Rabinow and Rose, 2006, p. 196). Foucault (1980) argued that this "great bipolar technology – anatomic and biological" was instrumental to the spread of capitalism, which economic system "would not have been possible without the controlled insertion of bodies into the machinery of production and the adjustment of the phenomena of population to economic processes" (p. 141).

Rose has developed a number of conceptual tools for grasping contemporary mutations of biopower. Particularly relevant to the inquiry at hand is his idea of the molecularization of power, in which advances in biology, particularly genetics, have made biological life available to governance in new ways, opening the interior of the human body to intervention (Rose, 2001, 2007). With a nod to Foucault's later work on practices of self-care, Rose suggests that molecularization brings into being a new mode of subjectification, "somatic individuality" that is "grounded in our fleshy, corporeal existence" and filtered through the language of biomedicine (p. 25). Somatic individuals in post-disciplinary, advanced liberal societies, he argues, are expected to be prudent, calculating actors who "aspire to autonomy", embracing responsibility for their bodies and the choices they make. "The self government of the autonomous individual", writes Rose (2007), is "connected up with the imperatives of good government" (p. 27).

On first consideration, Rose's description of a contemporary biopower that works through autonomy and responsibility appears to be a good fit for the case of self-tracking. At the Digital Health Summit, the self-government of autonomous individuals through data tracking was repeatedly "connected up" with the vision of health care that linked the Affordable Care Act, the prevention and management of chronic conditions linked to lifestyle choices, and the good life (understood as "wellness"). "Increasingly, we as consumers are asked to take on a role in our healthcare," said Paul Slavin of Everyday Health, a company that provides online tools to help people manage their personal health data, during a session called The Empowered Consumer. In another session, physician and author Reed Tuckson noted that he advises patients to "Be the CEO of your own health". Just as a CEO manages his company by tracking its data in quarterly reports or in the rise and fall of stock prices, and through the unceasing operation of analytical programs to detect potential downturns in earnings, one should approach one's own life as an ever-accumulating data set to be kept healthy through diligent recording, analysis and intervention. Lupton (2013a) has argued that digital self-tracking exemplifies "a neoliberal political orientation to patient care and preventative health" in which the burden of responsibility moves from the state to citizens who are "ready and willing to actively engage in their own healthcare and promote their own health" (p. 266; see also Lupton, 2013b, p. 28; Lupton, 2012, 2014, 2016; Oxlund, 2012; Till, 2014).

And yet, before proffering data-for-life as another illustration of the contemporary molecularization of biopower and the neoliberal 'responsibilization' of individuals, it is worth pausing to ask what might be distinctive about this emerging vision for health. For one, it is distinctive because self-tracking, although an exercise in granularity, is not undertaken on a molecular, genetic, or even fully somatic register but, rather, on an informatic-behavioral register: the number of steps and sips taken in a day, the speed at which bites are taken during

a meal, degrees of slouching, rate of respiration. These small units – bits of data about the conduct of life rather than bits of biological life – are taken as a measure and a means of individual and collective health.[16] Instead of a molecularization of biopower, it constitutes a 'datafication' (van Dijck, 2014; see also Hansen, 2014, p. 20).[17]

The difference is significant, because the sorts of intervention that pertain to the datafication of biopower and its datafied subject – a dividual, as Deleuze (1992 [1990]) would have it – are neither those of discipline nor those of responsibilization (nor even those of control as Deleuze conceived it) but, rather, those of the 'nudge'. The governance rationality of the nudge, brainchild of Thaler (a leading figure in behavioral economics and the attempt to undermine the rational, sovereign subject of neoclassical economics) and Sunstein (law scholar, former policy czar to the Obama administration, and design consultant to the Affordable Care Act), define the nudge as a way to guide consumers to healthier decisions by reframing rather than constraining their choices, leveraging free choice through the design of "choice architecture" (Thaler and Sunstein, 2008). The nudge is a curious mechanism, for it both presupposes and pushes against freedom; it assumes a choosing subject, but one who is constitutionally ill equipped to make rational, healthy choices.[18] The nudgeable subject addressed by the wearable technology industry, I argue, does not neatly correspond to Rose's autonomy-aspiring actor.

The injunction to self-manage through tracking and its nudging technology is not a purely autonomizing formula but instead falls somewhere between enterprise and submission, responsibility and discipline; we might say that it is constituted by these tensions. To self-track is to heavily value one's choices and the need to be responsible for them while, at the same time, relieving oneself of responsibility by delegating it to external technology. What the self delegates is the responsibility to "calculate and act upon itself", to paraphrase Rose's characterization of the choosing self; calculation is given over to big-data analytics while self-steering is supplemented by the data-driven nudge – or, more precisely, the micronudge.

Melichar, a Nike Fuelband wearing labor economist employed by the Robert Wood Johnson Foundation, is one proponent of the data-driven micronudge. When she spoke at an MIT seminar called Tools for Well-being, she argued that data tracking could help "microtarget nudges for healthy lifestyle" (Melichar, 2014). Her definition of health echoed the one I had encountered at the Consumer Electronics Show and its Digital Health Summit:

16 Data collected by individuals for their own health or fitness projects can be recombined with that of others to draw population-wide correlations and inferences (Cukier and Mayer-Schönberger, 2013; Mayer-Schönberger and Cukier, 2013, Chapter 6). Steve Downs of the Robert Wood Johnson Foundation has commented that personal informatics "creates new opportunities to roll data up on an aggregate level and really look at the population, bringing the potential to find really interesting connections among the data" (RWJF Website).

17 Koopman (2014) suggests the term "infopower" as a way to extend Foucault's concept of biopower, noting that "if biopower in its first functioning made heavy use of technologies of statistics and recordkeeping, then those very technologies have in the century since developed a gravity of their own in part due to the contributions of electrification, digitization, and other processes at the heart of our contemporary information societies" (p. 89). The concept of biopower, he suggests, "cannot fully exhaust the new modes of information surveillance, aggregation, and distribution in our midst" (p. 106; see also Koopman, 2015, n.p.).

18 Nudge philosophers Thaler and Sunstein (2008) mark the tension of freedom and submission in the name they give to the governance rationality of the nudge: "libertarian paternalism". See also Sunstein's, 2015 book, *Choosing not to choose*.

"Health is about small cumulative changes that add up over time". One of the biggest barriers to health, she pointed out, is our own behavior: "It turns out we are not rational actors when it comes to making decisions *now* about things that affect us in the future, even when we know what we should choose". Melichar imagined that nudges could be deployed by smart technologies at the point of decision making, rendering bad choices harder, more taxing. The example she went on to give was not obviously health related (such as a pill dispenser to support medical compliance, for example); instead, she foretold of software that would sense when an individual was unable to stop binge-watching episodes of television drama online and trigger a reconfiguration of the choice landscape, enabling self-stopping:

> Our devices could sense that we are decision-fatigued at the end of the day and could intervene to make the decision to stop Netflix-binging *for* us, or they could make that choice possible for us to make on our own – by dimming the screen where we're watching or turning the sound down after an episode, so you'd have to choose to turn it back up to keep watching.

The point of such software, as Melichar saw it, was to "relieve the stress of a person's choice and free up bandwidth for that person to make other choices that are more important".

Digital nudge technology, here, is not cast as passive or static but as active, sensing, guiding – a sort of compass to help individuals navigate a world of choices. "Our cars have dashboards, our homes have thermostats – why don't we have that for our own bodies?" asked a speaker at the Digital Health Summit. "A technology might sense that you are stressed out and advise you not to make a decision", suggested another; "or it might immediately try to remedy your compromised state by providing input into your system to bring you back into a non-stressed state, in the fashion of a thermostat". Designers and marketers of digital data-tracking technology pitch it as a way to embrace the project of self-enterprise without undertaking the tedious, nebulous, and anxiety-provoking work of lifestyle management (Singer, 2015; see also Viseu 2013, p. 131). "We're on the brink of really exciting things – devices that monitor things and then give you actionable updates before you even need to ask" said Leslie Zeigler, a health-technology designer and longtime self-tracker, in her capacity as moderator for a panel at the Digital Health Summit. "I don't want to track – I want it to be done for me", she went on. "Insert a chip in my mouth and have it record the calories for me!" The customers that device-makers imagine resemble Zeliger: instead of aspiring to autonomy, they wish to outsource the labor of self-regulation to personal sensor technology.

Adams *et al* (2009, p. 259) argue that the contemporary world is characterized by a "regime of anticipation" in which "the obligation to 'stay informed' about possible futures has become mandatory for good citizenship and morality, engendering alertness and vigilance as normative affective states". Yet Zeigler's words suggest that consumers of wearable technology are – quite desperately – looking for a way to relieve themselves of the work of anticipation, or at least to share the burden. Whatever the actual motives driving sales of wearable tracking technology, this is the model of consumer motivation that drives its design and marketing. Although it is evident that "digital health technologies can advance the withdrawal of the welfare state from citizens' lives" (Levina, 2012; Rich and Miah 2014), it is not evident that they "position the neoliberal self as a responsible citizen, willing and able to take care of her or his self-interest and welfare" (Lupton, 2013b, p. 28; Lupton, 2013c; 2016).

In fact, they position users of self-tracking technology as desiring *not* to be in charge; the technology presents itself as a solution to this desire, offering rationality and empowerment precisely where it is lacking.

The subject of wearable tracking technology is thus not the "active, choosing" self that Rose describes; rather, she is figured by the wearable tech industry as a *passive*, choosing self who will want to employ devices to actively help her. One imagines a future iteration of the Fitbit advertisement in which the protagonist who gives herself over to carefree backyard play will not only trust her suite of devices and software to remotely *track* her but also to keep her *on track,* interrupting the flow of her experience to prompt her – when an algorithmic analysis of her own real-time data deems it necessary – to eat, drink, or rest.

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Natasha Dow Schüll is a Cultural Anthropologist and Associate Professor in New York University's Department of Media, Culture and Communication. Her first book, *Addiction by Design: Machine Gambling in Las Vegas* (Princeton University Press, 2012), is an ethnographic exploration of the relationship between technology design and the experience of addiction. Her current book project, "Keeping Track: Personal Informatics, Self-Regulation, and the Data-Driven Life," concerns the rise of digital self-tracking technologies and the new modes of introspection and self-governance they engender.

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