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Personal health technologies, micropolitics and resistance: a new materialist analysis

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Abstract

Personal health technologies (PHTs) are near-body devices or applications designed for use by a single individual, principally outside healthcare facilities. They enable users to monitor physiological processes or body activity, are frequently communication-enabled, and sometimes also intervene therapeutically. This paper explores a range of PHTs, from blood pressure or blood glucose monitors purchased in pharmacies, fitness monitors such as FitBit and Nike+ Fuelband, through to drug pumps and implantable medical devices. It applies a new materialist analysis, first reverse engineering a range of PHTs to explore their micropolitics, and then forward-engineering PHTs to meet, variously, public health, corporate, patient and resisting-citizen agendas. The paper concludes with a critical discussion of PHTs, and the possibilities of designing devices and apps that might foster a subversive micropolitics and encourage collective and resisting 'citizen-health'.

Introduction

Medical devices range from CAT scanner to hospital bed; surgical instrument to hearing aid (Topham, 2003), with a market valued at $322bn in 2011 and annual growth of five per cent (Leonard, 2012). Both within and overlapping this category of technologies are the range of near-body health and fitness devices and digital 'apps' (henceforth described as 'personal health technologies' or PHTs) that are the specific focus of this paper. These may be characterised by the following features: they are designed to be mobile and can be carried, wearable or implanted; they are for use by a single individual, principally outside healthcare organisations; they enable self-tracking or monitoring of body functions or performance, either for self-care purposes or with medical oversight, while some may have capacities for an associated therapeutic intervention; and may employ some communication or networked functionality, using wireless internet or radio-frequency (RF) technology (Pantelopoulos and Bourbakis, 2010; Ren and Batra, 2013). Such personal health technologies have also been characterised in the literature as 'mobile' or 'mHealth' devices (Lupton, 2014c), as 'wearable self-monitoring systems' (Pantelopoulos and Bourbakis, 2010), as 'self-tracking devices' (Till, 2014), and as 'personal medical devices' (Ren and Batra, 2013).

Near-body health and medical devices are of course nothing new, and have been used since the innovation of false teeth in Roman times (Crubézy et al, 1998) and spectacles during the medieval period (Cashell, 1971), and more recently include devices such as asthma inhalers, artificial limbs or joint prostheses. The new generation of PHTs that I shall consider here provide a range of functionalities; many monitor body parameters, from blood pressure and chemistry to food intake or hours slept per night, while others sense body motion or activity (Kaplan and Stone, 2013: 478; Kay, 2014; Lupton, 2013: 393-394). Longitudinal monitoring can be used to manage diet or exercise regimes (Till, 2014), to identify rare or irregular events and syndromes that develop slowly over time (Rodgers et al, 2012: 936), or to alert emergency services, for example in the event of a fall or loss of consciousness (Patel et al, 2012: 2). Infusion pumps can deliver therapeutical doses of drugs such as insulin or analgesics, according to medically pre-designated schedules, while implantable devices both monitor and intervene, for example to provide heart pacing or – if needed – more dramatic interventions such as cardiac defibrillation (Goldenberg et al, 2010).

Devices with a specific medical application are subject to regulatory authority (the Food and Drug Administration in the US and Medical and Healthcare Regulatory Authority in the UK), while others such as 'Fitbit' or Nike+ 'Fuelband' and apps for mobile phones such as 'WellnessConnected' or the Apple 'HealthKit' that monitor activity are marketed commercially. Some of these latter devices have become part of the 'Quantified Self' self-tracking movement (Lee, 2013, Lupton, 2014c), and digital data gathered by these devices can be retained either for private use, or uploaded to servers provided by their manufacturers, enabling data analysis and data sharing with other users (Lupton, 2013: 394). These data are also increasingly used by the device manufacturers to target users for marketing purposes (Till, 2014: 447). There is growing enthusiasm for self-monitoring, with one recent poll suggesting 56 per cent of US citizens wished to monitor their health using connected devices (A&D Medical, 2015) and a global market in self-care monitors valued at $10.5bn in 2012 (Transparency Market Research, 2014).

The claimed benefits associated with the new generation of PHTs are improvements in health care delivery to an ageing population (Mort et al, 2013: 799; Silicon Labs, n.d.: 1) or to people with chronic illnesses (Patel et al, 2012; Pols, 2012: 11), and enhancing wellbeing and personal efficiency through self-monitoring of fitness and health indicators and time use (Paddock, 2013). It has been argued that networking devices via digital mobile technology can reduce costs in care delivery and connecting people to their health care providers, while improving access by patients and providers to reference materials, lab tests, and medical records (West, 2013; 1). However, warnings have been raised concerning security risks to networked PHTs from both malicious attacks and accidental breaches, in particular for those implanted in patients (Maisel and Kohno, 2010).

The new generation of PHTs are of interest sociologically in part because they personalise and domesticate monitoring and therapy previously located in healthcare settings, and social science authors have offered various critical perspectives on how they configure and reconfigure the body (for an extensive review, see Lupton, 2014a). Telecare extends the clinical gaze into non-clinical spaces, transforms the home into an outpost clinic and changed the relations between a client, their body, technology, self and close relatives (Oudshoorn, 2011). Mort et al.'s (2013) study of home monitoring found that older people were

sometimes coerced by care services to adopt telecare technologies such as alarms and falls monitors, while others were stigmatised for 'misusing' the technology in an attempt to increase their social contact with the outside world. These technologies individualise health states at the expense of recognition of the social determinants of health (Lupton (2014b), and while home monitors can reassure both patient and health professional (Pols, 2012: 67), the technologies themselves can seem impersonal and unresponsive, can demand much of their users and create a sense of failure when the data they generate are not promising (Mol, 2009: 1757).

Self-tracking technologies have been criticised for adding a further level of surveillance to contemporary society, producing data that render people's lives transparent as they are transmitted, collected and aggregated by biomedical or corporate interests (Dodge and Kitchin, 2007: 432-433; Lupton, 2014a: 1353; Till, 2014). However, these technologies also impact reflexively upon their users, creating 'data doubles': disembodied and decontextualised flows of data that shape users' behaviours and self-perceptions and encourage them to act in certain ways (Ruckenstein, 2014: 70), or digital 'life-logs' that might augment or replace 'organic' memory (Dodge and Kitchin, 2007: 432). Gabrys (2014: 34) has suggested that the increased networking of bodies within systems of monitoring and sensing in 'smart cities' may draw a participant into a subjectivity and a citizenship narrowly defined in terms of their incorporation into these digitised sensing aggregations.

My intention in this paper is to explore some of the issues raised within these critical commentaries by examining the micropolitics inherent in the social, economic and political networks/assemblages surrounding PHTs. This analysis will then be used to assess what interests PHTs serve, and how they might be re-engineered to foster new forms of collective activity around health and well-being.

PHTs: a new materialist framework for analysis

The chosen theoretical tool for studying personal health technologies is the so-called 'new' materialism (Barad, 1996; Coole and Frost, 2010; DeLanda, 2006): an approach that focuses upon the interplay of material forces within the unstable assemblages that emerge around bodies and technologies such as PHTs (Author, 2014). New materialist ontology has been

informed by disparate social theoretical strands including actor-network theory (Latour, 2005), biophilosophy (Ansell Pearson 1997; Massumi, 1996), feminism and queer theory (Braidotti, 2006; Grosz, 1994; Haraway, 1997), philosophical posthumanism (Braidotti, 2013), quantum physics (Barad, 1996) and Spinozist/Deleuzian monism (Clough, 2008; Author, 2013). Like post-structuralism, this 'new' materialism is concerned fundamentally with the workings of power within physical and social spaces, but is focused firmly upon social production rather than social construction (Coole and Frost, 2010: 7), and upon matter rather than textuality (Braidotti, 2011: 128).

As an approach to studying social and natural phenomena, new materialism steps back from an anthropocentric emphasis upon the consequences of social processes (in the current case, PHTs and their application) for individual human bodies or human subjectivities. Furthermore, it shifts the ontological focus of social inquiry from entities to relationality: from what humans, their bodies and their identities are, to how relational networks or assemblages of animate and inanimate affect and are affected (DeLanda, 2006: 4), and toward the capacities to do, think and feel thereby produced in bodies, collectivities of bodies. Concomitantly, this shift from an agentic human to flows of 'affect' in assemblages acknowledges that things, organisations, social formations and concepts contribute to social production as much as – if not more than – human bodies/subjects.

However, this ontology also extends materialism beyond traditional concerns with structural and 'macro' level social phenomena. Power is explored not by positing 'causal' or 'explanatory' social structures such as 'capitalism' or 'biomedicine', but by unpicking the play of forces or 'affect economy' (Clough, 2004: 15) that assemble around the actions and events that produce and reproduce the world and human history. These forces may be physical, psychological or cultural, and – importantly, include the material products of thoughts, desires, feelings and abstract concepts (Braidotti, 2000: 159; DeLanda, 2006: 5), thereby cutting across both the nature/culture and mind/matter dualisms that invest much social theory (van der Tuin and Dolphijn, 2010: 155).

Applied to empirical research, a process ontology (DeLanda, 2013: xiii) of assemblages and affects requires an approach to data that can reveal the web of material relations surrounding

personal health technologies and their use (Author, 2013). These materialities range from the manufacturers and retailers that market these devices and apps, the science, engineering and design that makes them work, the medical and information technology professionals that develop technologies or assess data they produce, through to the domestic and other spaces where personal health technologies are used, the activities that they monitor, the physiological and biomedical processes that they monitor or manage, and the desires, expectations and concerns of users. As such, new materialist analysis dissolves boundaries between what are conventionally regarded as the 'macro' level of institutions and social organisation and the 'micro' level of human desires and experiences, recognising that what these aspects of the social have in common is an ability to affect or be affected.

The task of analysis will therefore be to document the assemblages of bodies, technologies and other relations that accrete around PHT use; to explore how these relations affect and are affected during PHT use; and to assess the micropolitics of these assemblages and the consequences for PHT users and others involved with them (Author, 2014). The first step in analysis will be to examine four very different PHTs – selected to present a range of technologies from those with a biomedical objective to those intended for use independent of clinical oversight, and from trivial to potentially life-saving purposes. For each of these technologies, the analysis will examine the relational assemblage surrounding its development and use, consider what this assemblage does, and evaluate the micropolitics that link the particular technology to bodies, organisations, ideas and desires. These micropolitical analyses will then be used to explore the different interests that may be served by PHTs, and what these suggest for the future development of such technologies.

Reverse engineering PHTs

The four personal health technologies to be examined in this section are a blood pressure monitor (which may be used with or without clinical supervision); the Fitbit – a posture-monitoring device typically used for independent self-monitoring; an insulin pump used by people with diabetes; and a device used to both monitor and manage heart arrhythmias: the implantable cardiovertor-defibrillator (ICD).

Blood Pressure Monitor

Electronic blood pressure (BP) monitors are used both in clinical settings and increasingly by people in their own homes. Devices are widely available over-the-counter in high street pharmacies for a modest outlay, as are other monitoring devices for blood glucose, cholesterol and other body chemistry.

From a general understanding of the practical application of a BP monitor, we may conjecture that use of this device assembles at least the following relations:

vascular system – device – user – manufacturer – biomedicine – health professionals.

Within this assemblage, these relations affect and are affected, producing a specific 'affect economy (Clough, 2004: 15) that determines what the device and the other relations in the assemblage can do. Thus the primary affective capacity of the monitor is to provide feedback to a user on an otherwise unobservable parameters; this in turn produces a capacity in the user to assess her/his BP in relation to norms or to previous readings, and thereby to judge current risk level, or to manage body physiology or biochemistry (for instance, through diet or exercise, reducing sodium intake and so forth).

Analysis of this affective flow in the BP monitor assemblage also permits an assessment of the 'micropolitics' between the assembled relations. Thus, this assemblage makes a user responsible both for monitoring and acting in response to the readings; it extends a biomedical gaze over the user's body functions beyond clinical settings into domestic spaces; and furthermore, it both outsources and privatises medical monitoring.

Fitbit: a self-tracking PHT

The Fitbit is one of a number of commercial products (others include the Nike+ Fuelband, Misfit Shine and Garmin Vivofit) that can be worn or carried on the body. The Fitbit monitors various body parameters including heart rate, and incorporates an accelerometer to monitor and record motion and posture, hours slept and so forth. Data are send wirelessly to a computer or mobile phone where they can be displayed graphically and calories burned and other functions calculated; data can also be shared.

The Fitbit-user assemblage comprises at least the following relations

body movements – terrain – product – wearer – manufacturer – associates.

The key affect driving this assemblage is the Fitbit's capacity to gather data on posture, movement and heart rate and turning these into quantifiable outputs that can be displayed, analysed and interpreted. However, the affect economy that links assembled relations produces not only the product's specific functionalities but also new capacities in the user (including motivations towards certain behaviours such as exercise or sleep), new opportunities to share and compare behaviours with peers, as well as the commercial basis for the product.

These complex affective flows generate a specific micropolitics that has the outcome of responsibilising the user, but at the same time – by quantifying and making explicit certain aspects of daily life, and enabling comparisons with other users – encouraging certain normative behaviours around fitness, sleep, weight etc, creating new body routines and regimens, and producing competitiveness with self/others. By drawing users into an assemblage with commercial interests, private aspects of a user's life are commodified and commercialised. Till (2014) has argued that these social relations turn exercise into a new kind of productive labour.

Insulin Pump

The third PHT to be assessed moves beyond simply monitoring body functions to also provide an automated clinical response. Insulin pumps are wearable devices used typically by people with Type I (insulin-dependent) diabetes, but also occasionally for Type 2 diabetes (Pickup, 2014). The latest generation of devices (for example, the Accu-chek Combo or the Cellnovo) monitor and manage blood sugar levels, automatically providing users with doses of insulin subcutaneously, and connecting wirelessly to provide data to users or their diabetic care specialists. The device removes the need for a person with diabetes to manage their own blood sugar levels through blood tests and regular intravenous insulin injections, and reduces the risk of severe consequences of inadequate management (blood glucose levels that are too high or too low), including diabetic coma and death.

The insulin pump assemblage comprises at least the following relations:

blood sugar – insulin – diabetes – pump – user – clinical specialist

with an affective flow between these relations that operates at levels from blood biochemistry to social and psychological processes associated with a chronic illness and relations between patients and medical professionals. The main affects that makes the device work are a blood glucose monitor and an associated pump. However the affect economy around the pump also shapes the relations between user, disease and health professionals, and between the user and the device manufacturers.

While arguably a fully-integrated blood glucose monitor/insulin pump liberates people with diabetes from time-consuming and complex self-management, the micropolitics of such devices fundamentally alters the relations between patient, disease and professionals. Responsibility for self-management is removed from users, replacing an 'expert patient' (Shaw and Baker, 2004) with sophisticated understanding of their disease and its management with a 'dumb patient' who merely has to wear the device and follow any instructions it provides to the user (for example, to inject an additional insulin bolus if blood glucose goes too high). A collaborative relationship between patient and professional is now replaced with a much more traditional relationship in which the patient is passive and the active relations in the assemblage are the device, its manufacturer and the medical specialist (cf. Szasz and Hollender, 1956).

Implantable Cardiovertor-Defibrillator (ICD)

The final PHT in this review is an implantable device that both monitors health rhythms and intervenes with three differing functions to maintain a regular rhythm. It is used in people with sustained heart arrhythmias following heart attacks or other heart disease (Goldenberg et al, 2010). The device has the capacity to a) provide a series of small rapid electrical impulses to pace an irregular heartbeat; b) one or more small electrical shocks to restore an abnormal rhythm; or c) a larger series of shocks to defibrillate heart muscle that has ceased to beat normally (fibrillation). The ICD-assemblage comprises at least the following relations:

heart muscles – disease – device – electricity - patient – surgeon – cardiologist

with an affectivity that operates both at the level of human heart physiology, and between patients and clinicians. The affects that make the device work are one that monitors heart rhythm and one that supplies the appropriate electrical impulses to address any detected abnormality in the rhythm. However, the affect economy of the ICD-assemblage draws user, device and cardiology specialists together in a relationship with life or death implications.

As with the previous device, the micropolitics of the ICD-assemblage establishes medical control over a person's physiology, but arguably in a more extreme way. Here the device imposes a biomedically-defined normative heart rhythm and rate upon a diseased heart, both monitoring and intervening. Because the ICD is implanted, a user cedes all control to the device, and has no capacity to over-ride a device that has effectively hijacked the body's internal physiological mechanisms. Indeed, the role an ICD plays in sustaining life in a person with serious heart disease or heart failure is such that removal of the device may effectively condemn them to death. This eventuality has led to bizarre situations in which it has been deemed ethically questionable for a doctor to remove an ICD, even when requested by a patient or when considered humane in palliative care settings where a patient is dying from an unrelated condition (England et al, 2007; Ngai, 2010).

Re-engineering PHTs

Thus far, the assemblage perspective has been applied to analyse four PHTs, and in each case has been able to disclose the economy of affects that make the technology do what it does. This extends beyond its technological functionality, however, to also understand the social relations that surround the use of the technology in question. From this, the micropolitics of the assemblage was drawn out for each case, applying a sociologically-informed assessment of the social consequences of the assemblage. This mode of materialist analysis can be applied to any PHT, to move beyond a cursory assessment of its functions, to reveal the complex flux of affects that surround a technology's actual use. This enables a critical perspective on different PHTs, grounding a critique of the social, economic and political relations in each PHT assemblage.

However, if we can reverse engineer PHTs in this way, it should also be possible to forward-engineer technologies, to produce specific micropolitics and capacities, and the rest of the

paper is devoted to this objective. But while technology manufacturers typically define their products narrowly, as if there were a single purpose for which a technology may be employed and a defined range of affordances that it can supply, a sociological assessment recognises that the uses to which technologies are put depends upon the social contexts of their deployment (Author, 2011: 82). Consequently, it is essential for a PHT forward-engineering enterprise to clearly define the perspective from which a technology is to be designed. To understand the differing affective economies that can be achieved by a PHT, this section of the paper will analyse potential technologies from four differing points-of-view, namely a) public health; b) corporate interests; c) a 'patient' perspective; and d) a resistant sensibility or 'citizen health' perspective. The paper will situate itself heuristically within each perspective in turn, to assess what kinds of PHT would serve its interests. In each case, this will also enable a critique of the micropolitics underpinning a perspective and the PHTs it might engender.

Public Health Perspective

From this perspective, we might seek to develop PHTs that can produce capacities in bodies and users that further specific public health or biomedical objectives. PHTs can produce capacities for:

- Population surveillance – enabling body data to be gathered from individuals and collated to provide population-level understanding of health-associated behaviour and activity, in order to develop appropriate interventions.
- Responsibilisation – encouraging individuals to take responsibility for their behaviour and activity and hence enhance health outcomes.
- Reduce patient delay – providing early data from individuals or collectivities (e.g. geographically or economically-defined) on clinical signs that may indicate health problems.
- Manage health care use levels – enhancing early treatment/prevention in primary care settings rather than advanced stages of disease in secondary care.
- Control expenditure – automating routine therapeutic interventions; develop just-in-time services to meet needs of a community, based upon data collected from a population.

A PHT inspired by this public health/biomedicine perspective might be a wireless-connected personal monitoring device issued to a target group of people. This device would monitor a range of signs and parameters, notify wearers of health risks, invite people to attend primary care to address abnormal signs or to undergo appropriate screening or tests, remind people to take prescribed medications and so forth. An example is the European Union-funded Splendid project (Maramis et al, 2014), currently being piloted as part of a public health intervention to prevent obesity among adolescents and young adults. This technology uses sensors that detect meal portion size and chewing and an activity meter, all linked via Bluetooth technology and smartphones, to enable clinicians and public health professionals to monitor food consumption and body activity in 'at risk' populations, and provide real-time feedback to users as an encouragement to maintain healthy diet and exercise.

The micropolitics of PHT-assemblages based in this perspective may be critiqued in terms of various sociological commentaries on public health (Armstrong, 1995; Petersen and Lupton, 1996). Such technologies are intrusive on people's daily lives, and go against principles of personal autonomy or rights to privacy. They extend an individualising, biomedicalised model of health and illness (Lupton, 2014b: 5), subjecting people in the community to a medical gaze that defines them as individual bodies rather than as parts of social assemblages, and contributing to the domestication of health care technologies (Fox and Ward, 2008) and the 'medicalisation of everyday life' (Conrad, 2007) Furthermore, such a technology could be criticised for dumbing down, removing people's capacity for assessing their health needs in relation to their own lives, and replacing it with a remote expertise with its own agenda. It is probable that this PHT would exacerbate rather than diminish health inequalities, as it would inevitably have lower take-up among hard-to-reach groups, those living in deprived or in tenuous life-situations, those with mental health problems and so forth. It would in effect punish non-compliance by removing access to services. Finally, such a PHT could be used to ration health care by simply altering the parameters for intervention in response to collected body data.

Corporate Perspective

The second perspective focuses on a corporate affect-economy that furthers the commercial potential deriving from development of a PHT. Leaving aside the traditional commercial relations between health services and the manufacturer of medical devices from wheelchairs to surgical instruments, the new generation of networked PHTs can be engineered to produce capacities for:

- Marketing health and fitness – selling PHTs that meet current consumer demands for devices such as step counters, personal satnavs, wearable technologies.
- Create and exploit health consumerism – developing innovative technologies that can be used as health, well-being and fitness commodities; use social media to establish brand loyalty for a technology and related products.
- Link marketing to individual data gathered from PHTs – targeting advertising and promotions of relevant products directly at individuals, based on activity recorded from PHTs (for example, targeted marketing of protein shakes or sleep aids based on records of calories consumed or hours slept per night).
- Analysing collated data from PHTs to identify market trends – synthesising disparate data to reveal population-level marketing opportunities.
- Sales of data to third parties – maximising the exploitation of data for commercial purposes.

An example of a PHT developed from this corporate perspective is a technology that monitors specific body parameters, sending back data to the manufacturer in order to target users with monetised spin-off products (phone apps, add-ons, data analysis packages). Using social media and targeted promotions, the aim is to build a community of users who will purchase upgrades and identify with the manufacturer's catalogue of products, and establish health consumers dependent on technology. Such a project is discernible in the Apple Healthkit initiative, which establishes a commercial platform from which web developers can market monetised health and fitness apps such as Vida, and app which – for a weekly fee – crunches data from self-tracking monitors to create a picture of an individual's health and provides online coaching (Hodson, 2014).

The micropolitics of PHT-assemblages developed within this perspective may be criticised in terms of a general sociological critique of the neoliberal marketisation of health and health care (McGregor, 2001; Mooney, 2012): these technologies turn bodies into elements within a market assemblage, with health and fitness becoming ways to make money rather than ends in themselves (Lupton, 2014a: 1353). In addition, such products outsource to technology businesses what are arguably the tasks of a health care system to sustain health and fitness. A further criticism is that networked PHTs threaten data security, privacy and confidentiality, with users potentially unwittingly agreeing to personal data being shared with manufacturers or even third parties.

Patient Perspective

From a traditional 'patient' perspective, the objective here is to engineer a PHT that can meet the needs of an individual to address illness and enhance health and well being, and improve access to health care by deprived groups, those with mobility problems, those in rural locations and so forth . So a technology might be developed to provide the following capacities.

- Monitoring internal signs – providing regular information such as heart rate, blood sugar levels to user and to her/his health care professionals.
- Managing a condition – providing longitudinal data on body functions; reminders to take medication; automated medication delivery; communication of data to health professionals.
- Emergency therapeutic intervention – intervening to address urgent health needs or critical health threats; enabling emergency requests for medical attendance.
- Assessing needs for professional advice – flagging signs as requiring medical attention, including routine screening; books appointments.
- Managing prescriptions – automated repeat prescription management and delivery.

An example of a PHT engineered to meet patient needs would be an integrated, wireless solution that monitors vital signs; advises on age-appropriate screening/tests; notifies professionals of abnormal clinical data; books primary or secondary care appointments and

manages repeat prescriptions; and administers prescribed pharmaceuticals. The foundations of such an integrated system may be seen in the case study of Dutch telecare for people with chronic illnesses described by Pols (2012). This system used a range of monitoring devices linked to a networked home computer, and webcams to enable surveillance of patient progress and communication between patients and health professionals for regular check-ups or to arrange hospital appointments or online consultations with other professionals.

The critique of PHT-assemblages developed from within this perspective include some of those noted earlier for public health: that they subject people to an individualising medical gaze that emphasises physiology over social capacities; medicalise everyday life (Conrad, 2007), and create 'dumb patients' connected via technology to a remote and anonymous clinical expertise with its own agenda. In addition, such a PHT might be criticised for creating dependency on technology, biomedicine and health care systems, removing responsibility for daily life, generating negative emotions (for instance, fear or anxiety about abnormal data or unexpected therapeutic interventions), and posing questions of informed consent (Lupton 2014a :1352). Health and wellbeing are now narrowly defined in terms of the quantified data gathered by the PHT (Lupton, 2014b: 5). Finally, a PHT designed from this perspective adds further to the privatisation of health care by technology companies, and potentially the replacement of skilled health professionals with semi-skilled jobs monitoring data remotely or maintaining technologies.

A resistance perspective

Unlike the previous three perspectives developed above, the fourth is not currently represented in any existing personal health technology. What might be called a 'resistance perspective' has to be developed heuristically, as its micropolitics are conceptualised by definition as antithetical to assemblages engineered to meet public health, corporate and patient functionalities.[1] In opposition to the public health technology-assemblage, PHT-assemblages engineered within a resistance perspective would resist surveillance and responsibilisation; contra the corporate assemblage, they would oppose a marketised approach to health and fitness; and against a patient-oriented assemblage, they would reject an individualistic approach to health and illness and the invasion of private or domestic spaces.

Based on these antitheses, a PHT-assemblage engineered within this resisting perspective would have the following capacities.

- Promote health and illness not in terms of a biomedical model – linking health not to individual biology or psychology, but to the capacities of people and collectivities to engage productively with social, economic, political and cultural milieux.
- Provide a means for collective and intersectional responses to health and illness issues – enhancing capacities for people and communities to address health and illness threats and opportunities together and across sectional (social class, gender, sexuality, race etc.) divides, rather than as individuals.
- Challenge and develop health policy – providing data and analytical capacities and resources that can inform health policy development or campaigns for health-related improvements to a locale or sector.
- Organise against health corporate interests – offering a means to challenge the power of corporations such as environmental polluters, purveyors of fast and processed foods, and against corporate health care providers.
- Synchronise health and environmental sustainability – rejecting policy initiatives that seek human health or development gains at the expense of the environment and sustainability.

Such a resisting technology articualtes with concepts such as ‘health activism’ (Zoller, 2005) and critical public health (Green and Labonté, 2008), and might support a ‘citizen health’ agenda (Rimal et al, 1997). This agenda rejects an individualised approach to health and recognises structural or systemic factors in health, opposes or subverts biomedical or corporate interests, including the neo-liberalisation and privatisation of health care and the monetisation of health and fitness. Instead of the many-to-one or ‘hub-and-spoke’ communication architecture that link bodies individually to health professionals or to corporate databanks, it would use a many-to-many communication protocol to build networks of connected bodies and social formations to challenge biomedical health care, neo-liberalism and individualising PHTs.

My proposition of a resisting assemblage that could deliver on some or all of these objectives would be a network of wearable PHTs that could be used to gather and crunch relevant health data (physiological, social, environmental) in order to assess health status and risks to health across a locality (or a specific sub-community such as LGBT citizens or teenage parents); notify participants of relevant policy or risks; co-ordinate action and build coalitions with health professionals, politicians, researchers and others; access knowledge resources via local libraries and universities; support policy development. This kind of resisting PHT could build on established Web 2.0 collaborative technologies, but more particularly upon the peer-to-peer software used in non-health contexts for file sharing (for instance for images, music or media), the freeware solutions that enable the creation and management of a virtual private network via digital devices, and analytical software to crunch data from monitoring devices. More imaginatively, it might also develop software such as RECAP, an unofficial search software solution that improved access to official US legal documents.[1] I discuss this resistance re-engineering of PHTs further in the following discussion.

Discussion: from quantified bodies to citizen health

Adopting a new materialist analysis of personal health technologies has enabled this paper to consider various technologies, not as physical things, but as located within assemblages that comprise a wide range of different relations drawn from natural and sociocultural, human and non-human, physical and semiotic realms. The analysis has allowed these relations to be treated in the same way – in terms of how they affect and are affected within a specific PHT-assemblage – rather than considering a technology first as a medical engineering solution and then separately as a socio-cultural phenomenon to be analysed form a social perspective. Instead, the analysis has regarded PHTs not as pre-existing, stand-alone entities, but in terms of what they do, in the widest sense, within the assemblages of human and non-human relations that enable them work. By exploring different PHT-assemblages, it has been possible to reveal the specific affect economies that mediate the relations between bodies and technology in each case, and by assessing these economies also to identify the micropolitics that these various PHT-assemblages manifest and sustain. This approach thereby enables a materialist reading of any specific PHT, and an opportunity to offer a critical assessment of how technologies contribute to different agendas, for instance, of biomedicine, business or activists.

In these concluding remarks, I want to draw out two different considerations, first from an 'academic' perspective on the micropolitics of PHTs, and secondly, a discussion in terms of critical social theory and an activist agenda. In terms of the first of these, the paper noted at its outset both the remarkable breadth of medical devices currently used in health settings and the long history of such 'personal' technologies. All of these technologies, from a new materialist perspective, assemble together a mix of human and non-human, and all may be subject to the reverse-engineering approach applied here. What the analysis in this paper suggests however, is that the new generation of PHTs, and in particular those that incorporate a networked element, are of profound sociological interest because they manifest affect economies that reflect a range of inter-connected technical, medical, personal and business affectivities, and associated micropolitical engagements.

The aim has been to demonstrate, both by reverse engineering PHTs from the Fitbit to the ICD and by forward engineering technologies according to specific agendas, how these devices incorporate bodies into assemblages, producing specific capacities in users, professionals, manufacturers and so forth. Thus for example, an infusion pump contributes to a biomedicalisation agenda, producing in the process a 'dumb patient' who has relinquished control of their self-care. A Fuelband or a health app on a mobile phone monetises health and fitness, establishing both a quantified body that competes with others or with itself, and a means to further corporatise and monetise daily health activities by gathering data and targeting users for future marketing. The literature suggests that the potential offered by network technologies and the 'Internet of Things' is being firmly grasped by technologists (Gabrys, 2014: 37-40) and by the business world, in the search for new ways to make money from health (Lupton, 2013, 2014b; Till, 2014). Furthermore, there is evidence that people are willing or even enthusiastic to monitor their health with connected health devices or apps that send information to their doctor or other third parties (A&D Medical, 2015). The seductions of technology may overwhelm more critical voices warning how PHTs intentionally or unintentionally reinforce subject-positions such as 'citizen', 'patient' or neoliberal 'health consumer'. These subject-positions are not neutral and have consequences for the capacities of people to engage with the world around them.

Of course it may be argued that these subjectifications are an acceptable price to pay for health improvements and early diagnosis, to address public health problems such as obesity and heart disease, and sustain the quality of life of those with chronic or even life-threatening conditions. There must be a concern however that – as with many technical advances – both issues of access and the neoliberal marketing of PHTs may contribute to a further ratcheting-up of health inequalities. Access to health technologies of all sorts tends to favour the affluent and advantaged, the young, and Western people in general (Davis, 1991; Lupton, 2014c: 1353; Phelan et al, 2010), who can literally or metaphorically buy into this networked world of PHTs in ways unavailable to those with more limited resources or capacities. This division is exacerbated if use of those PHTs that have been developed explicitly for commercial objectives become widespread in advantaged social groups, with knock-on effects such as differential consultation rates from the 'worried well' whose self-monitoring have picked up early signs of as-yet asymptomatic disease (for example raised cholesterol or blood pressure or sugar). It also poses the possibility of privatisation of preventive care by the back door.

This leads on to the second, 'activist' perspective on the analysis of PHTs conducted here. Health activism may be regarded as 'a challenge to the existing order and power relationships that are perceived to influence some aspects of health negatively or impede health' (Zoller, 2005: 344), often focusing on inequality or inequity, or facilitating collective mobilisation (Parker et al, 2012; 100). The materialist approach offers the potential to design technology assemblages with specific micropolitics and affect economies that can further such objectives, and the paper has offered the possibility of a 'resisting' technology-assemblage that might adapt exiting PHDs and other technologies to achieve certain capacities to address community-level health needs or counter threats to health, for instance, from local polluters or developers. In part, such a resisting assemblage works because of the affects designed into the technology (for example, enabling many-to-many sharing of data and community information, and providing access to resources), but it also inheres in the affectivity of its users, which in the example articulated earlier within this resisting perspective included a collective rather than individualised orientation and an antagonism to top-down power associated with both biomedicine and commercial corporations.

While this is just one personal vision of an assemblage that promotes what might be called 'citizen health' (cf. Rimal et al, 1997), the broader point of this exercise is to suggest that PHTs can be radically re-engineered to serve different, radical and critical, agendas. It is not hard to envisage producing apps for digital devices such as smart phones that can subvert the principles underpinning commercially-developed monitoring PHTs; indeed, as noted earlier platform providers such as Apple encourage developers to contribute to their Healthkit app portfolio. It is therefore not fanciful to see possibilities for PHTs that may deliver to collectivities some of the capacities suggested under the rubric of citizen health, or even transform the micropolitics of a device such as the ICD discussed earlier, by simply incorporating a user-accessible 'off' button.

In this paper I have used new materialist ontology to pull apart and put together some personal health technology assemblages, with the objective of disclosing the affectivity and micropolitics that these PHTs produce. PHTs offer significant challenges for users and providers of health care, from the dumbing of patients to the monetisation and corporatisation of preventive care. But they also supply opportunities, and social science, public health and activist groups can contribute to setting the agenda for a new generation of technologies that resist and subvert the consumerisation, biomedicalisation and individualisation of health.

Note

1. See https://www.recapthelaw.org/

References

A&D Medical (2015) Connected Health Study: Harris Poll. Available at http://www.wellnessconnected.com/ad-connected-health-survey. (Accessed 1 Jan 2015)/

Ansell Pearson K (1999) Germinal Life. London: Routledge.

Armstrong D (1995) The rise of surveillance medicine. Sociology of Health and Illness 17: 393-404.

Barad K (1996) Meeting the universe halfway; realism and social constructivism without contradiction. In: Nelson LH. and Nelson J (eds) Feminism, Science and the Philosophy of

Science. Dordrecht: Kluwer.

Braidotti R (2000) Teratologies. In: Buchanan I and Colebrook C (eds) Deleuze and Feminist Theory Edinburgh: Edinburgh University Press, pp. 156-172.

Braidotti R (2006) Transpositions. Cambridge: Polity.

Braidotti R (2013) The Posthuman. Cambridge: Polity.

Braidotti, R (2011) Nomadic Theory. New York: Columbia University Press.

Cashell GTW (1971) A short history of spectacles. Proceedings of the Royal Society of Medicine 64: 1063-1064.

Clough PT (2004) Future matters: technoscience, global politics, and cultural criticism. Social Text 22(3): 1-23.

Clough PT (2008) The affective turn: political economy, biomedia and bodies. Theory, Culture & Society 25: 1-22.

Conrad P (2007) The Medicalization of Society. Baltimore MD: Johns Hopkins University Press.

Coole DH and Frost S (2010) Introducing the new materialisms. In: Coole DH and Frost S (eds) New Materialisms: Ontology, Agency, and Politics. Durham, NC: Duke University Press.

Crubézy E, Murail P, Girard L et al. (1998) False teeth of the Roman world. Nature 391 (1 Jan 1998): 29.

Davis K (1991) Inequality and access to health care. The Milbank Quarterly 69(2): 253-273.

DeLanda M (2006) A New Philosophy of Society. London: Continuum.

DeLanda M (2013) Intensive Science and Virtual Philosophy. London: Bloomsbury Academic.

Dodge M and Kitchin R (2007) 'Outlines of a world coming into existence': pervasive computing and the ethics of forgetting, Environment and Planning B: Planning & Design, 34 (3): 431-45.

England R, England T and Coggon J (2007) The ethical and legal implications of deactivating an implantable cardioverter-defibrillator in a patient with terminal cancer. Journal of Medical Ethics 9(1): 538-540.

Fox NJ and Ward KJ (2008) Pharma in the bedroom … and the kitchen. The pharmaceuticalisation of daily life. Sociology of Health and Illness Monograph 30(6): 856-868.

Gabrys J (2014) Programming environments: environmentality and citizen sensing in the smart city, Environment and Planning D: Society and Space, 32(1): 30-48.

Goldenberg I, Gillespie J, Moss AJ et al. (2010) Long-term benefit of primary prevention with an implantable cardioverter-defibrillator. Circulation 122: 1265-1271.

Green J and Labonté R (2008) Introduction: from critique to engagement. In: Green J and Labonté R (eds.) Critical Perspectives in Public Health. London: Routledge, pp.1-11.

Grosz E (1994) Volatile Bodies, Bloomington: Indiana University Press.

Haraway D (1997) Modest Witness @ Second Millennium. Femaleman Meets Oncomouse. New York: Routledge.

Hodson H (2014) A check-up in your pocket. New Scientist (18 November 2014): 22.

Kaplan RM and Stone AA (2013) Bringing the laboratory and clinic to the community: mobile technologies for health promotion and disease prevention. Annual Review of Psychology 64: 471-498.

Kay M (2014) Challenges in personal health tracking: The data isn't enough. Crossroads 21(2): 32-37. DOI: 10.1145/2678024

Latour B (2005) Reassembling the Social. Oxford: Oxford University Press.

Lee VR (2013) The Quantified Self (QS) movement and some emerging opportunities for the educational technology field. Educational Technology (Nov/Dec 2013): 39-42. Available at http://digitalcommons.usu.edu/itls_facpub/480

Leonard S (2012) Despite challenges ahead, global medical device market to reach $415 billion in 2016. QMed, 16 May 2012. Available at http://www.qmed.com/mpmn/medtechpulse/despite-challenges-ahead-global-medical-device-market-reach-415-billion-2016

Lupton D (2013) Quantifying the body: monitoring and measuring health in the age of mHealth technologies. Critical Public Health 23(4): 393–403.

Lupton D (2014a) Critical perspectives on digital health technologies, Sociology Compass, 8

(12): 1344-59.

Lupton D (2014b) Health promotion in the digital era: a critical commentary. Health Promotion International. doi:10.1093/heapro/dau091

Lupton D (2014c) Self-tracking modes: reflexive self-monitoring and data practices. In: Imminent Citizenships: Personhood and Identity Politics in the Informatic Age workshop, Australian National University, Canberra, 27 August 2014. Available at http://ssrn.com/abstract=2483549

Maisel WH and Kohno T (2010) Improving the security and privacy of implantable medical devices. New England Journal of Medicine 362(13): 1164-1166.

Maramis C, Diou C, Ioakeimidis I et al. (2014) Preventing obesity and eating disorders through behavioural modifications: the SPLENDID vision. 4th International Conference on Wireless Mobile Communication and Healthcare, Athens. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=7015895

Massumi B (1996) The autonomy of affect. In Patton P (ed) Deleuze: a Critical Reader. Oxford: Blackwell, pp. 217-239.

McGregor S (2001) Neoliberalism and health care. International Journal of Consumer Studies 25(2): 82-89.

MHRA (2014) Borderlines with Medical Devices. London: Medicines and Healthcare Products Regulatory Agency.

Mol A (2009) Living with diabetes: care beyond choice and control, Lancet, 373(9677): 1756-57.

Mooney G (2012) Neoliberalism is bad for our health. International Journal of Health Services 42(3): 383-401.

Mort M, Roberts C, and Callén B (2013) Ageing with telecare: care or coercion in austerity? Sociology of Health & Illness, 35(6): 799-812.

Ngai D (2010) Turning off the implantable cardioverter defibrillator to prevent pre-death electrical shocks: an exercise and right in the refusal of medical treatment. The Internet Journal of Law, Healthcare and Ethics 7(1). Available at https://ispub.com/IJLHE/7/1/6279

Oudshoorn N (2011) Telecare Technologies and the Transformation of Healthcare.

Houndmills: Palgrave Macmillan.

Paddock C (2013) How self-monitoring is transforming health. Medical News Today (15 August 2013). Available at http://www.medicalnewstoday.com/articles/264784.php

Pantelopoulos A and Bourbakis NG (2010) A survey on wearable sensor-based systems for health monitoring and prognosis. IEEE Transactions on Systems, Man and Cybernetics – Part C: Applications and Reviews 40(1): 1-12.

Parker AG, Kantroo V, Lee HR et al. (2012) Health promotion as activism: building community capacity to effect social change. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 99-108). DOI: 10.1145/2207676.2207692

Patel S, Park H, Bonato P, et al. (2012) A review of wearable sensors and systems with application in rehabilitation. Journal of NeuroEngineering and Rehabilitation 9: 21. DOI: 10.1186/1743-0003-9-21.

Petersen A and Lupton D (1996) The New Public Health: Health and Self in the Age of Risk. London: Sage.

Phelan JC, Link BG and Tehranifar P (2010) Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications. Journal of Health and Social Behavior 51: S28-S40.

Pickup JC (2014) Diabetes: insulin pump therapy for type 2 diabetes mellitus. Nature Reviews Endocrinology 10(11): 647–649.

Pols J (2012) Care at a Distance: On the Closeness of Technology. Amsterdam: Amsterdam University Press.

Ren J and Batra J (2013) Personal Medical Device Technology-as-a-Service. Sunnyvale, CA: MQ Identity Inc.

Rimal RN, Ratzan SC, Arnston P et al. (1997) Reconceptualizing the 'patient': health care promotion as increasing citizens' decision-making competencies. Health Communication 9(1): 61-74.

Rodgers MM, Cohen ZA, Joseph L et al. (2012) Workshop on personal motion technologies for healthy independent living: executive summary. Archives of Physical Medicine and Rehabilitation 93(6): 935-939.

Ruckenstein M (2014) Visualized and interacted life: personal analytics and engagements

with data doubles, Societies, 4(1): 68-84.

Shaw J and Baker M (2004) Expert patient: dream or nightmare? British Medical Journal 328, 723–724.

Silicon Laboratories (n.d.) The heartbeat behind portable medical devices: ultra-low-power mixed-signal microcontrollers. Available at http://www.silabs.com/Support%20Documents/TechnicalDocs/Personal-medical-device-market-white-paper.pdf

Szasz T and Hollender M (1956). A contribution to the philosophy of medicine. Archives of Internal Medicine 97: 585–592.

Till C (2014) Exercise as labour: quantified self and the transformation of exercise into labour. Societies 4: 446–462.

Topham D (2003) Medical Devices: The UK Industry and its Technology Development. Loughborough: Prime Faraday Partnership, University of Loughborough.

Transparency Market Research (2014) Self-Care Medical Devices Market - Global Industry Analysis 2013 – 2019. Available at http://www.transparencymarketresearch.com/self-care-medical-devices.html

van der Tuin I and Dolphijn R (2010) The transversality of new materialism. Women: A Cultural Review 21(2): 153-171.

West DM (2013) Improving Health Care through Mobile Medical Devices and Sensors. Brookings Brief (22 October 2013). Available at http://www.brookings.edu/research/papers/2013/10/22-improving-health-care-mobile-medical-devices-apps-sensors-west

Zoller HM (2005) Health activism: communication theory and action for social change. Communication Theory 15(4): 341–364.