

The political economy of pulse : Techno-somatic rhythm and real-time data

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abstract : In the context of ubiquitous data capture and the politics of control, there is growing individual and managerial interest in 'pulse', both in the literal sense of arterial pulse (now monitored through wearable technology) and in a metaphorical sense of real-time tracking (for instance taking the 'pulse of an organisation'). This article uses the category of 'pulse' to explore post-Fordism as a set of techniques for governing rhythms, both of the body and of technologies. It draws on Lefebvre's work to introduce notions of eurhythmia, arrhythmia and 'internal measure' as ways of exploring somatic and organisational life. It then introduces two case studies where the idea and physical nature of 'pulse' are at work. These provide an insight into the real-time nature of post-Fordist life, where a chronic sensing of quantities becomes the basis of co-operation, rather than a judgement via measures.

Keywords : pulse ; techno-somatic rhythm ; real-time data ; post-Fordism ; quantification

Introduction

Virgin Pulse is a suite of workplace wellbeing products and services, which together promise 'technology to replenish the modern worker' [1]. It involves an app allowing employees to monitor their own behaviour with regards to sleep, activity, happiness, nutrition, stress and relaxation, and helps them to change their behaviour to pursue a healthier and happier lifestyle. Data is collected

via gym membership and use of wearable technology, and personalised improvement plans are produced for each employee, often using 'gamification' techniques of goal-setting, competition with other employees and rewards. The scheme is integrated with other HR systems, and produces a wellbeing data dashboard for managers to inspect.

Virgin Pulse is an example of how post-Fordist management practices have turned towards the body as a site of intervention and optimisation, eroding the distinction between the 'working' and the 'non-working' body in the process (Zoller, 2003 ; McGillivray, 2005a, 2005b). In its reliance on wearable, mobile and smart technology to collect data on wellbeing, it also indicates how this post-Fordist managerial project is gaining ever-greater surveillance capacities, now able to monitor the employee as she moves, eats, socialises and sleeps (Moore, 2014 ; Moore and Robinson, 2015). The arrival of wearables and connected smartphone apps, together with a culture of 'self-tracking', means that work and physical exercise morph into each other, both being represented in terms of quantitative inputs and outputs (Till, 2014 ; Gilmore, 2016 ; Smith, 2016).

But Virgin Pulse also exhibits something that has received less attention : its emphasis on pulse. It is immediately noticeable that the term 'pulse' might be understood in two parallel senses in this context. On the one hand, it would appear to signify the constant, twenty-four seven stream of data that the programme will generate and analyse. Meant metaphorically, taking the 'pulse' of an organisation (or other social system) means monitoring its various vital signs : movements, rhythms, patterns, peaks and troughs. The implication is that these are emergent and self-governing, rather than imposed via discipline or measurement. They are specifically extra-institutional, indeed existential, rather than limited to any designated location or time, other than the finitude of life itself. 'Pulse' is something that might belong to an urban neighbourhood, a financial market or an entertainment venue, to be sensed through a combination of human and non-human means. The use of the term 'pulse' to refer to Virgin's wellness programme might be interpreted as an appeal to a science that is both quantitative and 'real-time'.

On the other hand, actual pulse-rate is now one of the crucial data-points through which wellness can be monitored across time and space. Heart-rate, detected via wristbands, enables sleep and physical exertion to be tracked, without the user needing to be conscious of this. Heart-rate variability has long been viewed as a proxy for health : a healthy body experiences high levels of heart-rate variability, between periods of physical exertion and those of rest (Billman, 2011). It is a curiosity of much of the initial literature on 'self-tracking' and 'quantified self' practices that it dedicated a great deal of attention to the technologies through which data is generated (wristbands, apps, 'smart' devices etc) and the cultural practices of those that adopt them (the 'quantified self' movement, etc) but somewhat less to that which is being counted. More recent work on wearable technology has begun to address this (e.g. Lupton, 2016 ; Schull, 2017 ; Pink et al., 2017 ; Didžiokaitė et al., 2017). These are often mundane and necessary conditions of everyday vitality : eating, sleeping, drinking, breathing and walking. The banality of these movements and processes is a necessary condition of a broader project of ubiquitous, 24/7 monitoring. In order to monitor daily life itself, as opposed to the performances and skills developed for particular arenas, surveillance must be focused on the humdrum and the mundane, that transcends any formal evaluative or scientific framework. In tracking, quantifying and representing these behaviours, wearable technology acts upon agents via their most ordinary and repetitive day-to-day sources and modes of life. Pulse-rate is one of these necessary and ordinary vital rhythms that becomes a type of indicator under conditions of digital surveillance capitalism.

Research on self-tracking has typically treated it as a new site of knowledge-production, often drawing on Foucauldian notions of discipline or neoliberal subjectivity. It has been argued that this reinforces a Cartesian split between cognition and the body (Moore and Robinson, 2015), produces a new mode of self-discipline (Lupton, 2013 ; Sanders, 2017) and a new frontier in the 'healthism' that objectifies and optimises the body through a scientific gaze (Crawford, 1980 ; Lupton, 2012 ; Maturo, 2014). From this broadly Foucauldian perspective, tracking devices allow the body to be represented, benchmarked and disciplined in a more acute fashion, to produce a more rigorous form of self-management or entrepreneurial subjectivity. This treats wearable technology as epistemological in function. By contrast, this paper will seek to look at the interaction of body and technologies in terms of the dynamic techno-somatic rhythms that are sensed, but not necessarily *known* in Cartesian terms. The significance of pulse (both in its literal arterial sense and a metaphorical sense of real-time data) is precisely that it is pre-cognitive and environmentally adaptive, rather than cognitive or normative. By exploring the meaning and uses of pulse-monitoring, we might achieve a different perspective on techno-somatic interfaces, which doesn't privilege the acquisition of knowledge, but rather pursues cybernetic control of bodies, environments and the emergent interplay between the two. Against the supposition that wearable technology facilitates a Cartesian or positivist perspective on the body, I hope to explore the ways in which cognition and embodiment dissolve into each other, mediated by techno-somatic real-time sensing. This becomes possible if we switch our attention from the truth of bodies as such (pure Cartesian *res extensa*), to the rhythms of technically-equipped bodies in motion, with spatial-temporal properties.

This article addresses the political economy of 'pulse' in both the metaphorical and the literal senses of the term simultaneously, using two case studies which reflect both senses. By studying these side by side, and looking at how they fit into contemporary working and organisational practices, we gain a different perspective on post-Fordist capitalism and the technologies of control that mediate and sustain it. 'Pulse' serves as *both* the cultural-ideational model of how all physical movement can be conceived *and* a particular somatic rhythm to be surveilled – both signifier and signified. This dual project of pulse-monitoring can be understood as an effort to sense and influence the rhythm of social and individual life, in ways that promise a new post-disciplinary mode of managerial control, underpinned by a post-disciplinary notion of economic time that is fluid but nevertheless numbered. By emphasising the metronomic, repetitive qualities of human life, it is possible to arrive at quantitative expressions that are (or at least appear) to be emergent and natural rather than measured.

The rest of the article is in four parts. Firstly, I lay out the article's theoretical premises, namely the post-Fordist context, the 'crisis of measure' that characterises it, and the alleged potential for tracking technologies to overcome that crisis. It is crucial here to distinguish between 'measurement' and 'quantification' and the relation of one to the other, conceptual issues that have sometimes been under-appreciated in literature on self-tracking. Secondly I look at how all of life potentially becomes conceived as rhythmical, in post-disciplinary societies, something that Lefebvre's notion of 'rhythm analysis' is ideally suited to explore. Thirdly, I look at two case studies, reflecting the metaphorical and literal status of 'pulse' in contemporary working life. One of these concerns a new wearable technology (though not a tracking device) aimed at moderating the wearer's pulse ; the other at a new workplace technology aimed at capturing employee sentiment (which refers to organisational 'pulse' in a metaphorical sense). This section of the paper draws on interviews with the developers and designers of the technologies concerned. Finally, the paper seeks to theorise these new techniques of rhythmic monitoring and control, and the mode of 'metronomic vitality' that they mediate.

Quantity before measure

It is widely recognised that a new style of technical economic government emerged following the crises of the 1970s, which allowed for more flexible management and monitoring of employees and consumers. This has been generally referred to as 'post-Fordism' (Jessop, 2002 ; Amin, 2011), a concept that is closely aligned with the idea of 'societies of control' (Deleuze, 1992). Following the crises of Fordism and Keynesianism that escalated from 1968 onwards, corporations adopted various new techniques through which to overcome political opposition and win the enthusiasm of employees and customers. Vertically-managed disciplinary institutions, such as the Taylorist factory and the Weberian bureaucracy, gave way to more fluid, horizontally-coordinated institutions that were more adaptable to fluctuations in market demand. Corporations co-opted anti-capitalist rhetoric in the service of management, thereby channelling non-capitalist hopes towards increased productivity and consumption (Frank, 2017 ; Boltanski and Chiapello, 2006). Meanwhile, the affective dimension of work and consumption became integral to economic value creation, often in a form of co-production between producer and consumer as signified by brands (Arvidsson, 2006, 2011). These changes required new forms of expertise and methods through which the 'soft' psychological and cultural dimensions of the economy could be known and managed, and change could become constant (Thrift, 2005, 2008).

The shift into post-Fordism has produced distinctive problematics of quantification and measurement in social and economic life. At the same time, it has seized the affordances of networked computing to enable a shift from techniques of routinized 'discipline' to more flexible forms of 'control' (Franklin, 2015). In many ways, the promises of data analytics that have emerged in the early 21st century represent a conjoining of these two issues, whereby ubiquitous digital data capture offers a new basis for quantification and measurement – that is an argument adopted in this paper, but it is worth unpacking that a little. Two features of 'post-Fordist control societies' need recognising, or else there is a risk of obscuring key differences from 'Fordist discipline'.

Firstly, post-Fordism is defined by a problem of intangible value, eliciting what has been referred to as a 'crisis of measure' (Virno, 2004 ; Hardt and Negri, 2005). Taylorist factories could measure inputs and outputs in a relatively explicit way, tracking productivity using linear Cartesian principles of time and space. Measures have an a priori status : they transcend the contingency of a situation to provide a basis for comparison or 'commensuration' (Espeland and Stevens, 1998). Arguably the most transformative (or at least iconic) example of a modern measurement device is that of double-entry book-keeping, which provided a standard way to account for credit and debit across time and space (Carruthers and Espeland, 1991 ; Poovey, 1998). The crucial quality of any measure is that it holds its form across time and space, providing a basis on which to judge certain outcomes repeatedly, reliably and impersonally. Hence, the 9-5 working day is a possible *measure* through which to assess productivity ; an intelligence test is a possible *measure* through which to assess job candidates. Measures may be quantitative (as with a tape measure) and are often a way of introducing quantity in a disciplinary fashion (as with an IQ test). They are tools of discipline and of judgement – but they are not *necessarily* tools of quantification. For example, a market research survey acts as a measure for comparing people in a standardised fashion, but it may do so simply by putting people into qualitative categories, rather than attaching a number to them. Standardised processes of judgement, such as workplace performance reviews, may draw on numerical data, but not necessarily. A measurement device may be far more efficient (as a basis for comparison) if it quantifies, but it needn't do so.

Measures are therefore fundamentally normative tools, that can be introduced into situations to win consensus (Boltanski and Thevenot, 2006). In order to work, they need to possess a quasi-liberal authority, which can apply a fixed set of criteria to a plurality of cases (Davies, 2014). The question of measurement is therefore intimately associated with the question of hegemony, which in the case of Fordism is 'born in the factory', because hegemony implies an over-arching ethical framework which renders capitalist production *legitimate* and not only technically viable (Gramsci, 2011 : 285). The a priori nature of measures provides the juridical principle which produces hegemony. Measures such as clock time allow the working day to be brought within a normatively governed framework.

To argue that post-Fordism witnesses a 'crisis of measure' is not to suggest that value becomes unquantifiable, but that it eludes the quasi-juridical routines and consensual quality of effective measurement. Where value is intangible (and partly captured subjectively in the experiences of the consumer) there is an absence of stable, publicly legitimate commensuration devices and rituals through which it can be assessed and ranked. This raises the importance of processes of critical deliberation and the social search for value (Stark, 2009), which is potentially democratising, but also less efficient from a narrowly capitalist perspective (Arvidsson and Peiterson, 2013). Qualitative methods of evaluation and research, such as focus groups, rise in importance, but do not serve to provide robust commensuration in the way that quantitative tools of measurement do.

Secondly, as digitisation has spread further into economic, cultural and personal life, it has radically increased possibilities for quantification, which have rapidly turned into inevitabilities of quantification. Increasingly, quantification is something that we can try to ignore by deliberately avoiding or concealing pieces of data, but not something that we can opt out of. Computer power has long extended beyond the capabilities of human cognition, but the ubiquity of data capture now extends beyond the *needs* or *intentions* of human societies as well (Hansen, 2015). Data is captured by default, generating archives of so-called 'Big Data', which we then face the challenge of interrogating should we find a reason or desire to (Andrejevic, 2013).

As Hansen argues, the distinguishing 'tendency' of 21st century media is to capture far more than human consciousness could ever accommodate. This is not a prosthetic enhancement of human consciousness, but a transformation going on beyond the limits of human perception (Hansen, 2015 : 53). Whereas the camera, for example, offered an augmentation of existing forms of human vision, something like a fitness tracker allows human beings to engage with the world (and themselves) in ways that previously evaded our own subjectivity altogether. These are, Hansen argues, tools of *sensation* not of perception : their function is to monitor in unfathomable detail, generating quantitative data in the process. Fitness trackers have not replaced human cognition, but perform sensory activities of movements (steps, sleep, pulse etc) that were previously un-sensed and hence unquantified. They open up 'the possibility of experiencing something not immediately available to consciousness' (Hansen, 2015 : 139).

Following Hansen's analysis, we might say that ubiquitous digital tracking facilitates vast expansion in possibilities for *quantification*, but without offering any new *measure*. This isn't necessarily true of self-tracking in general, which can be carried out using various forms of quantitative measure such as weight-scales or diaries (Crawford et al., 2015), but it is certainly true of something like pulse-tracking. Measures may be present - minutes, kilometres, calories, degrees Celsius - but it is not always the main affordance of the technology to introduce these, in the way that it is of (say) a tape measure. As devices of *sensation*, rather than of perception or evaluation, digital tracking technologies often perform a relatively banal function of *counting as much as possible*

(quantification), rather than of *comparing* as much as possible (measurement). Wearable self-tracking technologies have a bias towards aspects of the human that can be counted, even in the absence of any measure – steps, inhalations and exhalations, arterial pulse – just as social media platforms serve to quantify social connections without necessarily helping to judge them. Where these movements and moments are quantified, measures can of course be introduced, such as setting a target or norm for the number of steps to be taken each day. But the primary affordance of the device is to count not to compare.

A critical question for post-Fordist organisation and government is whether technologies of control can ever become sufficiently extensive and empirically sensitive as to replace the need for normative measurement altogether. To put that another way, does the crisis of measure and the problem of hegemony eventually evaporate, once enough data has been collected ? To the extent that post-Fordism brings about new cyborg-type assemblages of bodies, codes, screens and machines, it arguably avoids or circumvents the requirement for hegemonic discursive consensus-formation, of the sort that Fordism depended on (Lash, 2007 ; Lazzarato, 2014). Semiotic and inter-subjective conventions potentially become replaced by interfaces which mediate non-representational code, in a constant cybernetic loop of action, feedback and adaptation. Decision-making can potentially bypass spaces of conscious deliberative judgement (as the case of high-frequency trading exemplifies) and consciousness is then presented with a world that has already been rearranged by ‘pre-cognitive’ techniques of analysis and decision (Hansen, 2015). Epistemologically, this translates into the hope that algorithmic data analytics can supplant disciplinary methods, spotting and responding to patterns as they emerge from data sets, rather than imposing measures upon them (Savage and Burrows, 2007).

Governing through rhythm

However, the post-hegemonic vision of control does place one crucial obligation on agents, without which ubiquitous data capture is not possible : they must keep moving and interacting across interfaces of various kinds. This is scarcely a normative duty, as it is unspecified what the form or telos of this activity should be, and movement might equally be unconsciously physiological as consciously decided. And as interfaces become embedded in the physical environment and body, there is reduced normative injunction to consciously ‘use’ them. But the managerial and epistemological project of achieving control without consensus does require that nothing ever stay fixed in place. As Boltanski and Chiapello observe of the post-Fordist workplace, ‘to be doing something, to move to change – this is what enjoys prestige as against stability, which is often regarded as synonymous with inaction’ (Boltanski and Chiapello, 2007 : 155). Apple CEO Tim Cook’s notorious 2015 remark that “sitting is the new cancer” was made while promoting the Apple Watch, which can buzz to remind the wearer to stand up and move.

In societies of ‘discipline’, movement occurs between different designated spaces and institutions (factory, hospital, home etc), but movement itself is not a crucial object of observation (Deleuze, 1992). The regular time displayed on the clock is what determines when the subject of discipline moves from one such enclosed space to another, as the notion of ‘clocking on’ and ‘off’ suggests. Time is interrupted by disciplinary measurement, (as notions of audit and inspection suggest) rather than its object. Any repetition of movement over time is a contingent side-effect of normative convention. The dominance of clocks indicates that time is really being subsumed under space, producing what Bergson termed ‘homogeneous time’, which uses spatial metaphors (and devices such as clocks) to represent time in regular, concise units such as ‘minutes’ and ‘days’ (Bergson, 2002 : 86). This emphasis on disciplinary technologies such as clocks is a denial or avoidance of time

as 'pure duration', allowing the units of 'homogeneous time' to create the illusion that temporality consists of separate, isolated moments. This experience of time as amenable to delineation and separation is a significant effect of Fordist and disciplinary techniques of power.

By contrast, societies of 'control' require bodies in motion to be monitored, such that patterns and rhythms can be detected, in the absence of a priori normative conventions. Many aspects of social rhythm are effects and legacies of disciplinary norms and institutions, such as the working day, the weekend, commuting, a 2-week holiday and so on. But other repetitive movements are emergent, such as socialising, leisure activities, sexual activity and the rhythms of the body itself. Lefebvre argued that it is the interaction between these two forms that generates the rhythm of modern life, that in the synthesis between the two is 'natural and rational, and neither one nor the other' (Lefebvre, 2013 : 19). As he argued :

Everyday time is measured in two ways, or rather simultaneously measures and is measured. On the one hand, fundamental rhythms and cycles remain steady and on the other, the quantified time of watches and clocks imposes monotonous repetitions. (Lefebvre, 2013 : 83)

As digital interfaces become embedded in our physical environments and bodies, this raises the possibility that emergent, unmeasured rhythms might become visible in and of themselves, even in the absence of any institutions to govern them. Quasi-natural movements – some of which, such as arterial pulse, are constant – can simply be tracked rather than subjected to measurement. Repetitions and patterns that emerge *outside* of the realms of measured behaviour or disciplinary activity might suggest a form of systemic sustainability, that is emergent rather than imposed – a form of rhythmic harmony that Lefebvre identifies as 'eurhythmia'. In some cases, 'homogeneous time' keeping tools may even be deliberately removed to facilitate this harmonious, repetitive movement across interfaces, as the absence of clocks in casinos suggests or the clock in the therapists consulting room that the client is unable to see. The absence of 'clock time' may help individuals to enter a greater condition of post-cognitive, embodied harmony or 'perfect contingency' with their physical environment, of the sort that Schull discovers amongst machine-gambling addicts (Schüll, 2012).

In the practical settings of neoliberal capitalism, the distinction between 'discipline' and 'control' is rarely absolute. The rise of the latter's rationality does not in itself signal the subsidence of the former, any more than the rise of disciplinary power meant the disappearance of sovereignty (Munro, 2000). Often technologies and practices of control will be employed to achieve a higher level of discipline than disciplinary institutions themselves could achieve on their own. Disciplinary tools of audit, testing and measurement continue to provide an organising template for institutions under post-Fordism, but now a much wider range of behaviors and 'data points' are being tracked to anticipate how individuals or organisations are likely to perform in these moments of disciplinary judgement. Thanks to control technologies (which are ubiquitous and radically empiricist), it becomes possible to orient the self even more acutely towards disciplinary technologies (which are periodic and decisive), potentially bringing the norms of discipline closer to the psyche and body (Hardt and Negri, 2000 : 23). Many emergent social rhythms and forms of playfulness, which can now be captured digitally, arise in the time and space that discipline ostensibly leaves alone, such as the weekend, public space or night-time. This renders the relationship between discipline and control ambiguous : on the one hand, it allows spontaneous order to be optimised, potentially to subsume it under disciplinary power, but on the other it points to the possibility of a post-

disciplinary order, in which the power of measurement gradually recedes.

What Lefebvre terms the 'natural' dimensions of rhythm (which really means those aspects which are not imposed by 'rationality') resists the Cartesian gaze of scientific analysis. Or rather, efforts to subject it to objective scrutiny (such as those imposed by disciplinary measure) immediately misrepresent or damage it. Lefebvre's example is of horse dressage, which cannot be simply imposed on the horse in the way a dog is trained (Lefebvre, 2013 : 49). Instead, if one is to 'grasp this fleeting object, which is not exactly an object, it is therefore necessary to situate oneself simultaneously inside and outside', to try and feel the rhythm and to know the rhythm simultaneously (Lefebvre, 2013 : 37). The task is one of sensation rather than of judgement - hence it lends itself to technologies of monitoring rather than of measuring. The more sensory devices there are embedded in the physical environment and human body, the greater the potential to adopt this 'inside and outside', feeling and knowing, orientation towards rhythm, be that of the city, the organisation, the social network or the organism.

To *feel* rhythm from the 'inside' is one way of understanding the promise offered by 'real-time' data capture. In the context of 'smart cities', for example, the ideal behind the blanket monitoring of all urban life is that surges of movement, sentiment or market demand can be sensed as they occur, allowing for responses to be made instantly (Kitchin, 2014). Equally, in the context of security, the hope is a post-Cartesian one, that threats can be sensed and acted upon before they are empirically known (Amoore, 2013). The monitoring of movement over time allows a sense of 'normal' rhythm to emerge, and consequently the capacity to detect abnormal movement ('arrhythmia') or sudden changes in speed of movement. Stock market tickers offer an early example of a technology geared around the detection of rhythm, focused on price movements rather than on price levels as such (Preda, 2006). Yet ubiquitous digitisation of social life - the city, the human body, the home - facilitates a new attention to the sensing of rhythm. Much of this monitoring and reactivity takes place beyond the limits of public discourse or subjective consciousness, shaping the world that is encountered subjectively (Hansen, 2015). Alternatively, it enters our field of perception via the interface of dashboards of various kinds, a particular mode of representation that seeks to influence decision-making without issuing facts or judgements (Mattern, 2015).

The rhythm of arterial pulse

Scientific and medical interest in arterial pulse has always advanced in tandem with time-measuring devices (Ghasemzadeh and Zafari, 2011). The earliest known attempt to measure arterial pulse is that of Herophilus (335-280 BC), who measured it using a water clock known as the 'clepsydra'. Galileo's invention of the pendulum in the early 17th century was followed by the invention of the pulsilogy by Santorio Sanctorius, a pendulum that could be adjusted to match pulse rate. The contemporary approach to arterial pulse measurement is credited to John Floyer circa 1707-10, who took advantage of advances in the design of clocks to introduce the medical practice of counting the number of heart-beats in a single minute. While pulse offers a way of sensing the body's rhythm, which may or may not be subjected to any formal measure in terms of 'homogeneous time', it is worth recognising that it cannot be represented objectively, without some standardised notion of time (typically minutes) with which to compare it.

There is still controversy amongst medical researchers as to what exactly determines heart-rate, though the most significant factor is respiration (Billman, 2011). It increases during inhalation and decreases during expiration, and accelerates during times of accelerated inhalation such as exercise.

Various social and physical cues can influence heart-rate, for instance the speed of a piece of music (Larsen and Galletly, 2006). From a medical perspective, the most significant trait of a human heart-rate is not its level at any one moment, but its capacity to vary : low rates of heart-rate variability are an indicator of poor health, while high-rates of heart-rate variability indicate higher fitness levels. But pulse also carries a more existentially significant medical status : it is the first thing that is sought in distinguishing whether an apparently unconscious body is alive or dead. Equally, pulse-checking is one of the first techniques of first aid that is taught to the non-medical specialist, suggesting that arterial pulse is what grants the human body its ordinary, day-to-day status as a 'living' organism.

Immediately we might note certain attributes of arterial pulse that would resonate with the cybernetic imaginary of control under post-Fordism. Firstly, arterial pulse respects no limits of time and space, and is an indicator that functions '24/7' (Crary, 2015). The condition of human beings in 'societies of control', Deleuze argues, is one of constant 'modulation' and 'surfing', never being finished with anything (Deleuze, 1992). Arterial pulse is something the human body does so long as it is alive, regardless of whether it is at work, asleep or on holiday. However, the scientific focus on pulse-rate has nevertheless been confined to experts and expert institutions until relatively recently. The stethoscope, dating back to the early 19th century, enabled hearts to be listened to by doctors, while the first heart-rate monitoring technology (ECG) was developed for hospitals in the early 20th century. But it wasn't until 1983 that a wireless (hence mobile) heart-rate monitoring device was developed (Pantzar and Ruckenstein, 2015). The subsequent mass-market development of pulse-monitoring wristbands and smart watches represents a major step in the amateurisation of pulse-monitoring, which enables pulse to become not only an everyday behavioural phenomenon, but also an everyday quantitative indicator. Wearable and wireless pulse monitors are therefore vehicles for the quantification of everyday life.

Secondly, pulse-rate is a way in which bodies can 'speak' without being mediated by language. This quest for non-semiotic or post-representational modes of communication has been dubbed the 'decline of symbolic efficiency', and analysed as a key feature of post-Fordist modes of management and regulation (Dean, 2009 ; Andrejevic, 2013). Yet the interest in pulse as the language of the body (as opposed to the subject) has a much longer history. When considering how the intensity of other people's pleasure might be monitored in a utilitarian society, Bentham proposed two possible solutions (McReynolds, 1968). The first was to use money as a proxy (on the assumption that consumers would spend money in direct proportion to the utility that resulted) but the other was that pulse-rate might serve as an indicator of affective states. Pulse-rate was one of various physical symptoms that physiologists of the late 19th century focused on, in seeking to understand how physical laws of energy and entropy affected the human body, especially the labouring body (Rabinbach, 1992 ; Danziger, 1994). The interest in pulse suggested a proto-cybernetic imaginary, in which the body contained its own mechanical rhythms that could be brought into dialogue with those of experimental equipment. By the same token, it suggests a desire to get around the reports of the subject (Davies, 2017).

What the body is able to authoritatively communicate via signs such as arterial pulse is '*how I am right now*'. The self-conscious subject is less trustworthy on this matter, because she has a tendency to bring in broader reflections on how things are generally or have been over time. The cyborg body, however, cannot help but provide accurate data on its present state. It does so in a 'pre-cognitive' form, that thereby avoids being mediated by semiotic and cultural representations, and which potentially bi-passes subjective consciousness altogether (Hansen, 2015).

Thirdly, arterial pulse offers the prospect of a quantity that is prior to measure, and therefore a post-hegemonic mode of control. Pulse is what Lefebvre terms a 'natural' rhythm, rather than a 'rational' one, though pulse-rate is only discernible once pulse is judged using clock time. Where clock time beats at a steady speed, with the ticking of the second hand, and the slow moving of the minute and hour hands, the speed of pulse changes depending on circumstances. It offers a rhythm that adjusts to activity and environment, speeding up during times of anxiety or stress, and slowing down during times of relaxation. Arterial pulse signifies a mode of non-disciplinary temporality that is contingent upon the situation. In a world where arterial pulse was a more important rhythm than clocks, the goal would not be punctuality (as in societies of discipline) but *eurhythmia*, in which body speed is well synchronised with environmental speed, rising and falling appropriately. The capacity of pulse-rate to vary according to circumstances is its key attribute. That said, the possibility of pulse-rate being represented as a number does require that (in Lefebvre's terms) *natural* rhythm be married to *rational* rhythm, such that the number of bodily beats is compared to the number of mechanical seconds. The pulse-rate monitor is therefore both a sensing device and a measuring device.

If competitive sport offers a defining symbol of measured physical quantification (with a whistle being blown, goals being awarded), then jogging offers the equivalent for unmeasured quantification, whereby the body enters a state of flow, and the passage of time becomes forgotten. The former has an explicit telos and evaluative benchmark which the players must keep in mind, whereas the purpose of the latter is to achieve some state of health-enhancing, unconscious bodily rhythm, a central component of which is accelerated respiration and pulse-rate. The addition of wearable technologies makes visible aspects of a jog that would otherwise remain outside of cognition (such as steps taken, as well as heart rate). Yet it also allows for further technical augmentations, such as the selection of a musical playlist that is synchronised with speed and pulse, something that the Spotify music-streaming service offers.

Arterial pulse is a tangible, quantifiable sign of how the body is (or is not) adjusting to its immediate situation, right now. But because it has this status as a 24/7, cybernetic, post-disciplinary indicator, the term 'pulse' has also taken on a metaphorical status which implies data that is collected and shared in real-time, for instance via 'smart city' infrastructures. It is here that we might speak of 'pulse' more as ideology, inasmuch as the idea promotes the logic of control. In particular, it promotes an ideal of bodies so eurhythmically immersed in their situations as to lose track of Cartesian coordinates of time and space - the worker, for example, who has achieved such a state of flow that they have forgotten to leave the workplace or ceased to notice any distinction between 'work' and 'leisure'. The ideology of 'pulse' seeks not only the privatisation of space, but also the privatisation of time, where public measures of time are withdrawn. This is in contrast to Fordism, where the factory is privately owned, but its routines (9-5, lunch-break, cigarette break etc) are not. Then again, measure does not entirely disappear from post-Fordist contexts : if pulse is to be represented as 'pulse-rate', then an observer (an experimenter, doctor, manager, governor etc) in possession of a clock is required. Thus the ideal of pulse tacitly implies a panoptical power structure, in which the majority are lost in 'natural' rhythms, while a minority observe these via 'rational' ones. As in the case of the therapy room, one party cannot see the clock, but the other one can.

Controlling pulse

I now want to turn to two empirical examples of technologies which are designed around the sensing and/or controlling of pulse. As will become clear, one of these is focused on arterial pulse in a literal sense, though not to measure pulse-rate ; the other is focused on 'pulse' in the metaphorical sense, of an emergent social rhythm that (as Lefebvre puts it) can be sensed from the 'inside'. By exploring

‘pulse’ in these two ways simultaneously, we can think about how ‘natural’ or emergent rhythm can be sensed from both within and without the body itself. The significance of pulse as a matter of concern (whether medically, economically or whatever) is that it provides a way of knowing or feeling how well adapted a body is to its environment. In its metaphorical sense, it comes to signify seemingly natural rhythms of the environment (workplace, city etc) itself.

Both these cases are implicitly geared around managerial agendas, be that the management of the self or of the organisation. Both are technologies of control, which take ‘pulse’ (either literally or metaphorically) as that which needs to be controlled. Yet neither is necessarily oriented towards performance optimisation or discipline, even if that is an implicit or background agenda. To research these two cases, I conducted interviews with the entrepreneurs and designers who were responsible for conceiving of and developing the technologies. They are both at a relatively early stage of development, and only recently arrived on the market. Contact with these interviewees was established by cold emailing, and interviews conducted in late 2015 and early 2016, either in person in the interviewee’s office or via Skype. I will introduce them in turn, and then explore some of the common themes that emerge.

- Cases

The first case, Moodbox, is a new technology, which arrived on the market in 2012, that aims to monitor employee engagement on a day-to-day basis [2]. It does this principally through two instruments : an interface which employees are invited to interact with as they leave work, and a dashboard display providing managers (and potentially employees) with an indicator of responses over time. The interface is a small box that attaches to the wall, displaying a red and a green button under the question ‘How was your day ?’. As the employee leaves work, they press one of these to signal positive or negative emotions, and as they do so lights flash up indicating the aggregate of others’ responses. These interfaces send the data to a central repository, from where they are displayed in graphical form for the benefit of managers. The read-out of mood is called ‘The Daily Pulse’, whose fluctuations can then be seen over several days and weeks.

Some significant design features of Moodbox are worth noting. Firstly, it takes the working day as its temporal unit of analysis. The developer explained to me that ‘daily’ is ‘pretty much the rhythm of a company’ ; in Lefebvre’s terms, it provides the ‘rational’ rhythm that then interacts with ‘natural’ rhythm. The legacy of Fordism provides structures that post-Fordist practices can exploit, at least from a managerial perspective. Or, to put that another way, the problem of ‘control’ remains located within the time-space legacies of ‘discipline’. Secondly, the employee does not offer a score for their mood, but simply selects one of two options : positive or negative. This was a deliberate decision by the designers, deliberately avoided a neutral option, thereby requiring a choice to be made one way or the other. This referred to as ‘casting your pulse’, implying some hybrid of democracy (as in ‘casting’ a vote) and behavioural reflex.

Thirdly, there is no way in which the device can avoid a single employee pressing a button repeatedly, which makes it unlike a survey that aims for ‘representativeness’. I asked the developer about this problem, but he didn’t view it as a defect, instead opting implicitly to view the data as ontological not epistemological :

Yes, people could cheat but nonetheless, maybe the fact of things is that there have been so many pulses, that is factual... the key thing is that metric is useful for you to improve.

Finally, Moodbox makes no attempt to collect any additional data that might help explain why mood was rising or falling over time. As my interviewee said to me, 'sometimes management doesn't know why they are having a very good day, sometimes they have to research it'. To use Hansen's dichotomy, it creates an infrastructure of sensation that only subsequently is available to perception on the part of management (Hansen, 2015). My interviewee referred to the Daily Pulse as generating a 'brutal fact' that was then available to management to grapple with, but without providing any cognitive or interpretive assistance for doing so. The brutality of this 'fact' derives from the way it is presented without any a priori evaluative framework (i.e. a measure) with which to interpret it : the quantity of mood has simply changed.

The second case is a wearable technology, Ripple, that is still in development phase. Ripple is a wrist-band, but unlike many wearable technologies its purpose is not to collect data for the wearer to then view, so much as to stimulate the body in one of two directions. Influenced by experiments on social influences on heart-rate (for instance of the synching of two lovers' heart-rates), Ripple provides what the developers call a 'mechanical heart-beat' that the wearer can select and which influences their own heart-rate. The wrist-band sits directly above the arterial pulse on the wrist, and provides a just-noticeable double rhythm onto the inside of the wrist to which the wearer's actual heart-beat is then expected to synch. This is like a ticking clock, but one which is privately experienced by a single individual and adjustable depending on circumstances. The wearer sets the pace of the rhythm by caressing a small black disc on the wristband, moving their finger in one direction for 'speed up' and the opposite direction for 'slow down'. The design principle behind this is to allow the wearer to change the pace of their Ripple as unobtrusively as possible, for instance while in a meeting. Research on the technology (including randomised control trials) confirms to the developers that this technology can work in altering the pace of heart-rate.

Ripple assumes, as per William James's theory of emotions, that altering physiological responses is a way to influence psychological affective states (James, 1884). One of my interviewees at Ripple volunteered James's theory to me in explaining why the technology worked. Altering one's pulse-rate might therefore have various uses. It could calm someone down during a moment of anxiety or stress, or help them relax prior to going to bed. Or it could energise them like caffeine, immediately after lunch or when they first wake up. I asked one interviewee if there were any competitors on the market, to which she only half-jokingly replied 'coffee'.

Ripple interacts with an app, but not so as to collect and represent heart-rate, as various wearable technologies do. It doesn't seek to provide measurement of any kind, for instance via a dashboard that can track the body over time. The technology can gauge whether it is in synch with the heart-rate, and thereby learns what the wearer's resting heart-rate is. The user then identifies a range of different rates around that (which can be named 'jogging' or 'pre-bed-time' or 'giving a presentation' etc) which can be selected via the app. The whole purpose of the device is to grant control over physiological rhythm, rather than to achieve measurement of time and space. This is a technology that is not so much 'pre-cognitive' (in Hansen's phrase) as 'non-cognitive' : it exists purely as an interface between body and environment, that offers the wearer some additional control, but not any empirical representation. While such a technology may be useful in supporting the wearer in situations where they need to perform or improve, it might equally be useful in helping them wind

down from these situations or escape them.

- Control through 'internal measure'

These cases both present examples of technologies of 'control', inasmuch as they seek to render individuals (or in Ripple's case, selves) manageable in something close to 'real-time'. But there are some very obvious differences between their technical capabilities and strategic functions. Moodbox is a tool of monitoring and subsequent representation, which collects 'pulse' only in the metaphorical sense of an unconscious, always-on data point. Ripple is an interface between the conscious subject and their physiology which seeks to influence the pace of the body, in the hope of enhancing some ideal of subjective autonomy. Yet 'pulse' is entirely literal in this example. However, in order to consider how 'pulse' works as an ideal and a physical feature of contemporary post-Fordist control, I want to identify some common features of these technologies. By doing so, I hope to indicate something of how management might work in post-hegemonic or what Lazzarato terms 'asemiotic' forms (Lazzarato, 2014).

The first issue to consider is the role of rhythmic synchronisation that is implied in the governance of pulse. As with a dance or Lefebvre's example of horse dressage, these technologies do not govern the individual via norms or discipline, but nevertheless they provide some choreographic rhythm to which the individual might conform, perhaps without even noticing it. Moodbox does not only function in a panoptical fashion to provide facts to the manager, but also provides daily feedback to employees as to how they are 'fitting in' with the mood of the organisation (i.e. after 'casting their pulse' they then see a display signalling collective mood that day). The developer explained to me that :

What we think is that when you go and press red and you see that everybody's pressing green, hope that that is also going to trigger a thinking process. After which point are you part of the problem ?

An unhappy employee might, over time, come to appear like they're 'out of step' (to use an apt choreographic metaphor) with the rest of the company. This is something that emerges and which they discover, rather than something which is judged or decided by management via evaluation, but it is nevertheless exclusionary.

The question of synchronisation is more explicit in the case of Ripple, where the challenge of achieving eurhythmia operates on two levels. The technology is inspired by the potential problem of an individual whose pulse is not operating at the pace best suited to their environment. Either it is faster than they would like, and making them feel anxious or overstimulated ; or it is slower than they would like, and making them feel drowsy or unproductive. The purpose of the technology is to achieve greater synchronisation between subject and world, but it pursues this by achieving synchronisation between 'mechanical heart-rate' and 'natural heart-rate', creating a unified technosomatic rhythm. Here the individual is seeking to manage themselves, and there is no panoptical structure at work at all (no data is being collected or shared). However, there is nevertheless a teleology of conformity at work, albeit not one that is generated by externally-binding or public

norms. It is a conformity to routines that are emergent, contingent and private, as opposed to those that characterise Fordist management which are normative and public.

Connected to this technical ambition of synchronicity of individual, mechanical and social rhythm is a second common feature of Moodbox and Ripple that deserves recognising. This is the way that they are calibrated around the existing rhythm of the user, deliberately avoiding employing measures or benchmarks from other organisations, individuals, experts or the public at large. Instead, it is variations in pulse that are being controlled in both cases. Just as heart-rate variability is a more important indicator of health than actual heart-rate, so the technologies being studied here both aim to detect or influence changes in rhythm rather than to offer a judgement of rhythm.

The developer of Moodbox was unconcerned with the epistemological dimension of the technology. As he said in our interview :

We might accept that there is a scope for inaccuracy in our metric but it is very consistent that it is a good guide to improve your workplace.

The way Moodbox's Daily Pulse is represented in a dashboard is not in terms of any externally consistent scale, but in how far fluctuations have diverged from that specific organisation's norm. Equally, Ripple establishes the resting heart-rate of the wearer, and then allows them to select their own personally useful pulse-rates in relation to that. The idea of normality is influential here, but it is an emergent one or what Lefebvre characterised as an 'internal measure' (2013 : 87).

This notion of an 'internal measure' is intriguing and apparently oxymoronic. It implies a form of quantitative judgement, but without the possibility of comparison, rendering it utterly unlike a standard measure. In that sense, it is closer to an aesthetic judgement than to an empirical one. As in Kant's aesthetics, it judges the particular in its particularity, creating a standard for others in the process, rather than adopting a standard by which to carry out judgement (Kant, 2007). It ascends from the particular to the general, while empirical judgement (like a measured evaluation) moves in the opposite direction. But unlike an aesthetic judgement, it is expressed numerically, rather as a dancer or conductor might say "one, two, one, two" in time to a piece of music. Such judgement is rooted in the feel of the immediate situation, not in any external standard that is brought to bear.

Conclusion : Tactics become strategies

The central dilemma of post-Fordism is of how to achieve co-operation, conformity and consent, but without resort to juridical, disciplinary techniques of power, which might damage the 'creative' and affective value that is privileged under post-Fordist capitalism. This can produce some seemingly paradoxical forms of governance and management, such as for instance the employment of anti-capitalist rhetorics in the service of capitalism (Boltanski and Chiapello, 2006), a representation of work as 'leisure' and of social life as a form of 'work'. The boundaries of the 'economic' seem to dissolve, yet there is still a need for economic rationality to dominate, if organisations are to survive in competitive economic conditions such as those of capitalism. Given this, a gradual permeation of working life by cultural value can quite easily flip into its opposite, a radicalised Taylorism where economic life becomes reduced to post-human assemblages of machines and bodies, under conditions of digital surveillance (Lazzarato, 2014). The radical optimism of some visions of post-

Fordism (in which society itself becomes the source of all value) can, with a modicum of technological enhancement, swiftly turn into something more frightening, where all of society becomes permeated by private management.

By focusing on the rhythm of pulse-rate – understood both in its somatic and metaphorical sense – this paper has explored contemporary techniques of power which carve a path between the most optimistic and most pessimistic analyses of post-Fordism. Post-Fordism is characterised by a ‘crisis of measure’, though not a crisis of quantification necessarily. The affordances of sensory devices and data analytics are to derive what Lefebvre terms ‘internal measures’ from data that is constantly accumulating in close to real-time. One thing that distinguishes an ‘internal measure’ is that it exists necessarily in time. It refers to the feel of rhythm, that emerges naturally from the body or social context, like a pulse-rate. A healthy pulse-rate is one that is in synch with its situation, but also which varies in appropriate and revealing ways in time. Heart-rate variability is a useful indicator of health, but the rate at any one time is not a useful fact.

This eurhythmic ideal is of co-operation, but without convention or convenor ; of quantification but without measure. It takes the practices and behaviours that were traditionally viewed as beyond management, and seeks to influence them into some conformity with each other, though not into conformity with a disciplinary norm. Politically speaking, this challenges assumptions about techniques of power and also about those of resistance. In De Certeau’s famous distinction between ‘strategies’ and ‘tactics’, domination operates through the separation of discrete spaces, which then come to signify different times. This is what he terms ‘strategies’, resonating with Fordist and disciplinary power, and the ‘homogeneous time’ produced by clocks (De Certeau, 1988 : 36). Resistance to this occurs through ‘tactics’, which exploit contingent opportunities for emergent practices of play, jokes, conversation and pranks, in those moments and marginal spaces that evade strategic oversight. ‘Tactics’ are opportunistic.

Post-Fordist societies of control are no longer dominated by explicit ‘strategies’, of the planned, rational form described by De Certeau. The ideal of control is to insinuate power into ‘tactics’ instead, penetrating ostensibly contingent and emergent rhythms of everyday life, and co-opting them towards managerial goals. But what use or value is there in a ‘tactic’ if there is no ‘strategy’ to play tricks on or to hide from ? Whether this be understood pessimistically or optimistically, we might therefore conclude that we are witnessing a convergence of ‘tactics’ and ‘strategies’, producing an ideal of ‘internally measured’ eurhythmia of human and non-human pulse. Like ‘tactics’, this can only be understood as a temporal phenomenon ; but like ‘strategies’, it is rooted in surveillance capacities. The question is what mode of resistance or politics lies dormant in the idea of arrhythmia, the body or machine that does not, cannot or will not converge with the pulse-rate of its environment.

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Notes

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[2] Names of case studies have been changed.