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Data, (bio)sensing and (other-)worldly stories from the cycle routes of London.

"What if we could capture more dynamic notions of form in which space is the result of tidal forces which may suddenly swirl, surge and swash in abrupt or drawn-out, pliant or emphatic, regular or irregular ways which close off or perpetuate arousal? What if they could accelerate and crest, swell and burst, surge and fade in ways which link motion and form? Territory still exists but it becomes a part of perpetually renaturalized movement and can be constantly redefined and shifted." Thrift 2014 p. 6

I want to tell a story about data and about how we might use it to reimagine the possibilities for humans and machines in the multiple worlds we co-inhabit. My story is an experimental one involving human, technological and political bodies—of the human body, bicycles, built (techno-material) infrastructures and the body politic, all of which weave their way through and into the streets of London. The story is one of promise, of something or somewhere else still only part formed, still open to more. Much more.

But first we must begin with what we have and where we are. Everybody has been talking about data and Big Data. From what we consume to how we tweet, data—we're told—cuts through it all and thus has much to tell us. Where data is plentiful, or *big*, "More Isn't Just More", as a spread in Wired (July 2008) put it, "More Is *Different*". But what is this difference, which worlds exactly might it affect, and how? As we well know, difference does do transformative work in/on worlds (Haraway 2003), but we need a better idea of what's at stake in this new "age" of data—how it is data might actually come to matter and make a difference.

Let us take biosensing as a thread feeding in to this rhetoric and a way to think through it. Biosensing introduces an imaginary of hybrids, of biology and machinic sensing entangled in new figurings of nature and technology. On the one hand, we are seeing advances in a new bread of sensors that are themselves biological. They consist of organisms that are, in a fashion, put to work in human-centric worlds to detect, measure and signify. Most famous amongst these are the reengineered organisms designed to detect the presence of deadly pathogens in water. On the other hand, we see more conventional sensors being assembled to monitor bio-based systems. These are sensors intervening in everything from expansive ecological systems—ecosystems—to single discrete bodies. In both of these cases, biosensing illustrates the capacities for reimagining natures and technologies, and what divides them, or, to use Donna Haraway's phrase, refiguring 'naturecultures' (1997).

Yet, in much the same way as Haraway's Cyborg (or indeed her canine companions (2003)), my suggestion in what follows will be that biosensing—in and amongst other sensed data—is, today, being mobilised to cement the same old subject categories and is failing to achieve its potential to (re-)imagine—let alone do—difference. Pedestrian it may be, but by using the data I've found linked to London's public bike rental scheme and some data I've generated riding the bikes myself, my suggestion will be that what I call the data-everywhere paradigm accumulates, sorts and aggregates data in ways that conform to very familiar 'systems'; biology, the body, the machine, the city, value, wealth, etc. are tightly policed categories, even when the data (may)

suggest otherwise. My hope is to show, tentatively, that there are other possibilities to be found in these distributed and heterogeneous data, new relations we might discover and thus new worlds of difference we might come to perform. This, I hope, will be a way for us to begin talking about moving towards something or somewhere else—a difference in the making.

Data, Clouds and computation

Before I get to this speculative experiment with London's rental bikes (and some of the stories surrounding them), let me say a little about what I see to be a pertinent relationship that can get overlooked in much of the hyperbole about sensing and biosensing. It's clear that the resurgence in sensing (that this book is, in part, a response to) is tightly bound up with data; impressive capacities to sense worldly phenomena have been built and these have in part led to the "deluge" in data that we are hearing so much about. However, as well as its production, what also undergirds data's proliferation is an infrastructure of storage, distribution and computation. Much of this falls into yet another popular and much touted term, the Cloud.

The Cloud references an information technology and storage infrastructure that distributes data across remote machines, and often across more than one machine, simultaneously. The burden of storage is shifted to high-capacity data centres, server farms, etc., thus doing away with many of the attendant issues associated with local storage, such as data loss, restricted (location-/machine-dependent) access, finite capacity, and so on. These technological capacities are having a profound impact on how the presence of data is being felt in daily life. Most visibly we encounter an ever-growing army of people tethered to smart phones, tablets, wearables and similarly connected devices, all relying on services hosted in the Cloud. Also, many of us have felt, acutely, the very real and often vexing problems faced with the widespread distribution of data. It seems we quickly run into difficulties when we store, create and share things remotely. The widely publicised furores over ownership rights and privacy with Facebook, Google and Apple's iCloud offer an insight into just how fraught the problems can be for both the providers and the consumers of Cloud computing. More detailed and grounded research also shows that there is an unease with the nascent cloud-based models of interacting with data and content. The long and short of it is, with our use of the Cloud, we're often not sure where our digital stuff is anymore, how to keep track of it, and who else can see and get hold of it (Shklovski et al., 2014; Lindley et al, 2013).

Less visible, but more relevant to the points I want to develop are the capacities to aggregate, mine and interpret this widely distributed data. These capacities are evident in products that would be unfamiliar to many like Amazon's *Elastic MapReduce* or Microsoft's *WindowsAzure*. With these products the capacity for computation on a vast scale underlies most of the services consumers and professionals take for granted in their daily dealings with data. For instance, the service that let's you digitally tag and comment on real bricks and mortar places and geographical locations, *foursquare*, subjects the data its 55 million users produce to learning algorithms and long-term trend analysis, and this is all done using the cloud-based, computational services available from Amazon.

Although biosensors have yet to operate and be sold at any kind of significant scale, one doesn't need to look hard to find this model being used with bio-sensing

technology. HealthPatch™ by Vital Connect Inc., uses sensors to measure heart rate, motion and skin temperature. The company's purported claim is that "the HealthPatch biosensor is your solution to tracking your health and wellness or that of a loved one."[1] Putting to one side, for a moment, the imagined use of the technology, HealthPatch is built to be coupled with other devices and services so that data is amassed and aggregated to infer a human body's status and specifically health. What I want to draw attention to here is that the viability of HealthPatch is heavily reliant not just on sensing data, but also on data aggregation and distribution across these devices and services, and in the Cloud. Indeed, even though Vital Connect has a privacy policy[2] that assures "good faith" in protecting personally identifiable information, it leaves plenty of room for using the data its sensors collect. In its data integrity policy, for example, it explains it "processes personal information only for the purposes for which it was collected and in accordance with this Privacy Policy or any applicable service-specific privacy notice."

My suggestion is not that Vital Connect has any intention of breaching people's privacy or misusing personally identifiable information, but rather the vision for its biosensors is tightly bound up with what is done with the data. This is made slightly clearer in the promotional material from Aventyn Inc., the company providing the information systems platform for Vital Connect and its biosensors. On one of its webpages, Aventyn promotes the health-sector quality improvements and efficiencies it enables by producing "technologies to connect electronic patient-centric health information for anytime, anywhere, anyplace access." The benefits are realized because their products enable them to "aggregate, filter and route interoperable patient health and connected medical device asset information…".[3] In short, their platform is dependent on underlying computational capacities for data aggregation and distribution—capacities that allow heterogeneous kinds of data to be brought together and put in relation to each other.

Placing this within a wider, critical dialogue, I find a lot of value in a point made by boyd and Crawford in which they highlight the importance relational networks play in Big Data: "Big Data is notable not because of its size, but because of its relationality to other data." (p. 1, boyd and Crawford, 2011). What seems new then is not the data, *per se*, but the ways the relations are being figured. boyd and Crawford's point also alludes to the importance of the infrastructural substrate to underlies big data, that it is 'big' because the structural qualities of computation and the internet (and now the Cloud) enable large and disparate, but still very particular sets of data to be sorted, assembled and re-assembled (Graham, 2005). In other words, the cuts made using Big Data are all about configuring connections and these connections are contingent on the particular kinds of networks that can be set in relation to one another using the new infrastructures of the web, the Cloud, aggregation, etc. Big data is about networks all the way down and my point is that bio-sensing and biosensors appear to be tightly knit into these networks. Indeed it would seem impossible (or at least less than adequate) to separate (bio)sensors from the capacities for drawing data together and

[1] Vital Connect HealthPatch Biosensor. Retrieved on 10 April 2015 from http://www.vitalconnect.com/healthpatch-biosensor.
[2] Privacy Policy Terms & Conditions, Vital Connect, Inc. Privacy Policy (2013, Jan 1). Retrieved from http://www.vitalconnect.com./legal.
[3] Digital Health: Interoperable Secure, Scalable with High-availability (n.d). Retrieved on 10 April 2015 from http://aventyn.com/Solutions.html.

the "coding technologies" (Wilson, 2011) used to look for and produce intelligible relationships.

Data, and especially data under the rubric of Big Data, has certainly seen sizeable coverage of this data 'mining' in the popular press, often with commentaries to fit the unfortunate allusions to Orwellian newspeak in the term. Yet there is little in the way of concerted research to examine what the less visible analytics and computation that enable data aggregation and distribution are doing in practice and what it in fact means (or could mean) for people. There seems something of a kneejerk out-of-sight-out-of-mind response here, where much like the infrastructures that underlay ordinary operation in built environments, we simply don't want to know or think about what goes on below or beneath (Star and Strauss 1999; Graham and Marvin 2001). The underworld that pervades ordinary life but remains invisible (most of the time) is seen as too dirty or, in the case of computation, complicated, and while it may on occasion worry many of us we seem prepared to think of it as "a necessary evil".

The questions begged are what in actual fact do these data services do, how do we come into contact with them (if we do), and what *might* we want them to do if we knew more about them and their potential. These, on the face of it, may seem purely human, even moral concerns. Again, the technology would appear to be simply the backbone to these usage questions, constituting the enabling infrastructures or platforms that people will eventually use. To understand what's at stake, such questions, though, evidently demand—at the very least—a depth of understanding in the technological capacities intrinsic to (bio)sensors, data and the Cloud. As I see it, also needed is a much better understanding of how data operates *vis-à-vis* the kinds of "techno social complexes" detailed by the geographer Steven Graham (2005). We have much to learn in how to think about people and social life in relation to city-wide, geo-spatial data infrastructures, and what, in combination, they enact.

How then might we look past the grand claims, and recognise data and (bio)sensing for the differences they might enable; not as a panacea for everything from the ultimate market research tool to displacing the need for theory in science (Bowker, 2014, Kitchin, 2014), but as a means of difference-making through a distinctive assembly of techniques and resources.

Boris Bikes

So, in broad terms, I want to argue that one useful way to think through data and (bio)sensing is in how, together, they offer particular cuts into and enactments of worldly phenomena. As I've said, in this chapter I want to experiment with both thinking and doing to explore our understandings along these lines. The exercise will be one of cutting through a set of bodies, spaces, data, computation, etc. to think about, one, what kinds of worlds are being materialized when things like biosensors are entangled in wider human-machine assemblies and, two, what other different worlds could possibly be imagined.

The particular cut I'd like to use to develop this line of thinking concentrates on the journeys people make through cities and how these intersect and entangle with data and computation. Broadly, the relations configured here are between people, their movements in cities, and the data generated and computed by these movements. My focus will be on London's public bike rental scheme that was launched in 2010 by the

city's mayor, Boris Johnson (hence the nickname for the bikes: 'Boris Bikes'), and a number of efforts that have been made to access and use the data the scheme generates.

Although this bike data arguably doesn't quite deserve the moniker big data, my hope is it will help to illustrate how data of a sizeable scale—both in terms of quantity and the duration over which it is being generated—must inevitably be seen in terms of relationality and worlds enacted. My aim is to explore how the data weaves its way into particular individual and political motives, programmatic and computational contingencies, and the various ways people interface with the scheme at both an individual and urban scale. I want to examine how sensors and biosenors come to be a part of these always emerging assemblies, introducing data that enables yet further relations and cuts through the networks. I'll be especially interested in how the different data extends beyond the digital and how entangled relations transform the organisation of the data, how people interface with it, what it comes to represent, and ultimately what worlds are made in these entangled processes and practices. In short, I want to see how data may be wasting its potential when treated purely as a set of numbers to be computed and processed, as inhabiting an immaterial or ethereal cyberstructure, or representative of some set of stable phenomena. The promise, I'll speculate, is in seeing data as emergent, at one and the same time evolving in and performing particular material relations, and along unfolding trajectories.

Some history

In August 2010, when London's Mayor, Boris Johnson, launched the Barclays Cycle Hire scheme (privately sponsored by Barclays Bank) the promise was to make as much of the bike usage data available as possible. The data was presented as a resource for third-party developers, and London's overarching public transport organisation, *Transport for London* (TfL), committed to supplying the data without competing in the consumer market itself. As a public authority, the unfettered availability of the data was also congruous with TfL's obligations under the UK's *Freedom of Information Act*.

Despite these pledges, all that was initially provided was a website listing the availability of the rental bikes, limiting not only the kinds of data made available but also useful access to it. It was left to developers with initiative to 'scrape' this data from the site to build tools and mobile apps for users. Those that appeared ranged from relatively straightforward sites indicating the availability of bikes at the docking stations dotted around the city, to more innovative uses, identifying, for instance, the busiest stations or even predicting future bike and docking station availability.

Alongside this, a number of attempts were made to gain better access to the bike data. One particularly effective attempt was pursued by the developer and open data advocate, Adrian Short. On the public announcement of the millionth journey and the surrounding fanfare, Short requested information on bike usage for these million trips. His correspondence with Transport for London is conveniently logged on the site *What Do They Know*, which keeps a record of all FoI requests. The original request, dated 8 Oct 2010, asked for a data file including the following:

```
Journey ID
Bike ID
Time and date of the start of the journey
Time and date of the end of the journey
```

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Origin docking station ID
Destination docking station ID
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What the log of correspondence shows is TfL's apparent initial resistance to releasing the data, in full, and the date, the 5 Jan 2011, TfL eventually made a downloadable file available on what they call their "Developers' area". It also shows an eventual recognition of TfL's failure to fully comply with the FoI act by delaying the compliance to this request by 42 working days more than the allotted 20 working day limit, and not offering any reason for this delay.

As Short has documented on his own blog (Short, 2011), however, it's his opinion that TfL remained in contravention of FoI, even when the data was made downloadable. He forcefully criticised London's transport authority for insisting people who download the data provide identifying details and in effect enter into a contractual agreement with TfL. As Short puts it:

> "So why was the data delayed… The answer lies in TfL's desire to wrap the data in a complicated contract rather than make it available to me or anyone else directly and legally unencumbered. This might make sense in the context of some data and some data users but it's directly inimical to the aims and indeed the law of freedom of information. The data in TfL's developers' area isn't open data and it's not available to everyone."

Now, all this may seem far removed from (bio)sensing, people's everyday use of the Boris Bikes and Big Data. However, the point I want to make is that these seemingly obtuse issues around TfL, FoI and the access to the bike data provide one way to see the relations between the data, the use of the bikes, people's sense of and orientation to the wider bike rental scheme, and ultimately how bodies are figured in and move through a city. By following the data, we find very particular kinds of assemblies being enacted, ones knitted together by transport agencies, regulatory frameworks, data flows and (political) ideals. The data comes into being and flows through not just technological networks, but a specific configuration of actors and agencies. Data comes to matters, if you will, and is enacted through (individual, organisational and technological) bodies, and their relations to one another.

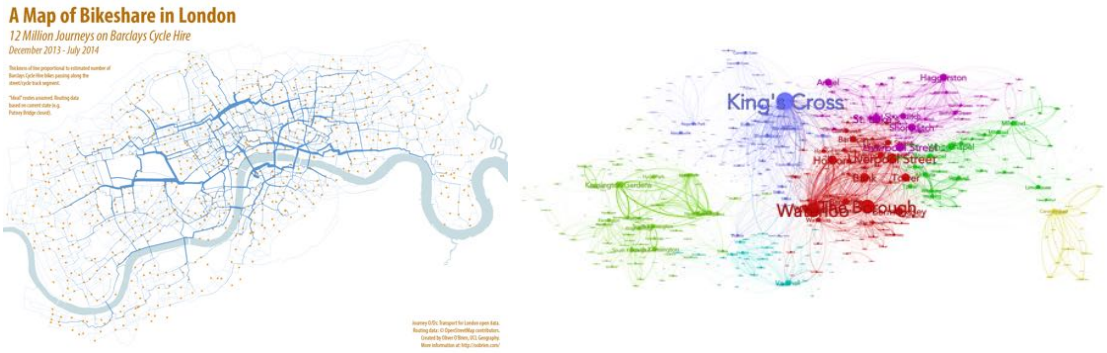
A figured city

Let us stand back for a moment and see what the data and entangled relations mean for the city as a body—and the body politic. What initiatives like Short's have ultimately resulted in is the release of a "Barclays Cycle Hire availability feed" for tracking the use of individual Boris Bikes. Through direct requests such as those above as well as their innovative uses of the available data, Short and others continually pushed TfL to produce a viable system for accessing a real-time data feed of bike usage. These efforts have also mobilised at least some of the development initiatives being coordinated under an open data mandate.

For example, Short was one of the people who, early on, scraped data from TfL's bike rental scheme website, but he did so with the express intention of giving other developers better access to the data. This move to open up the data led to the release of numerous apps for visualizing bike availability, and a recognition of Short's efforts from the small development community. As a consequence, it also offered Boris Bike users an early way to locate the docking stations across the city and check availability

either online and using apps developed for smart phones. The effect was thus an interleaving of the bike networks, data and usage. Each came to be meaningful and indeed useful with respect to the other.

One striking example of this intermingling is evident in the duration of rental bike journeys. When renting a bike, the first thirty minutes is defined as 'free' on the official Cycle Hire website (although this does not include the "Bike Access" charge). It's not surprising then that the data show that bike journeys on average hover around twenty minutes and that well over ninety per cent of all journeys fall under the 'free' 30 minute time limit. More interesting is that developers have recognised the importance of this and in some cases have included features in their apps that predict cycle times from any given docking station to another. The net result is that an urban geography emerges through calculated and predicted time intervals and most markedly the limits of 30 minute bicycle journeys. For bike travel, at least, London comes to be figured as a city divided up into sub-30-minute cycle journey segments, giving shape to its own distinctive network of nodes and connections (Fig. 1).



(a) (b)

Figure 1.(a) Map of Barclays Cycle Hire usage by Oliver O'Brien (2014), showing 'calculated routes' and volume of 12 million journeys between December 2014 to July 2014, and (b), "Connected clusters" of bike docking stations by James Siddle (2014).

People's movements, mass urban transport, software, code, computation, etc. intermingle to materialise city (infra)structures in the making (Fig. 1a). Real-time computed bike availability data from TfL, developers computational tools used to estimate routes and times, accessible cartographic maps plotted with docking stations and road networks, and flows of people and bikes across these networks, etch a visible spatial and temporal patterna onto and into the city. From up on high, the data-infused (infra)structures enliven flows that course, like arteries, producing a shifting patchwork of macrocosms (Fig. 1b).

A Caesura

Now let us imagine things from somewhere else, from what at first glance may seem a different level of detail. To put myself in these networks of data, I have on one fine autumn day in London taken my first Boris Bike journey. My ride, on Friday, October 3rd, 2014, is on bike number 2175. Transport for London's publically available records show in the preceding week it being used between 5 to 8 times a day from its starting point in a Western neighbourhood of London, Battersea. As I set off, the bike has rested, locked to its docking station, for almost 24 hours.

My journey is between two docking stations that lie at the Eastern edge of the cycle scheme's cartography of routes and stops. The starting point is the Aberfeldy Street docking station, situated on a largely residential road, with rows of low-rise, rundown apartment buildings and street-fronted shops (most bordered up). Heading off, the route I take leads me further East (about 5km beyond the scheme's eastern most docking station), through a series of neighbourhoods that, despite their proximity to the finical district, Canary Wharf, still feel a long way from London's ever increasing prosperity and cycles of gentrification. After riding North along the popular market street in Newham, Green Street, I then come back on myself, heading due West to a docking station in Bow, eventually just 0.5km North of Aberfeldy Street. In total, my journey takes 45 minutes, starting at 16:45 and ending at 17:30. The average journey time for the 74 rides that began at the same time, across the scheme, was 15 minutes.

For my journey, I carry three devices that generate data. Taped to my upper chest I wear one of Vital Connect's biosensor HealthPatches (Fig. 2c), measuring my heart rate and calculating other derivatives of this including my heart rate variability (HRV).[4] To monitor activity though changes in bodily orientation and movement, I also carry a *Withings* personal 'activity tracker', the *Pulse 02* (Fig. 2a). Finally, clipped to my coat is an *Autographer* (Fig. 2b), a camera device that automatically captures image sequences using, as the promotional material claims, five sensors "fused by a sophisticated algorithm to tell the camera exactly the right moments to take photos."[5] These three devices, a range of off-the-shelf biosensors or self-monitoring systems, each purport to capture in some shape or form individual physiological or bodily phenomena.

[4] Heart rate variability (HRV) is the variation in the beat-to-beat interval of heartbeats.

[5] The Autographer (now discontinued) is born of a project begun at my research laboratory in 2013. Presented in various guises, it has received considerable attention as a 'memory augmentation' device, *SenseCam*. Purportedly, the streaming photos taken using SenseCam have been associated with improved memory recall for people suffering memory loss (Flemming, 2014).

Figure 2. Withings "Pulse O2" activity tracker (a), the "Autographer" (b), and Vital Connects "HealthPatch" biosensor kit (c).

My journey—equipped with sensors—is an intentional move to the edges of London's bike rental docking stations and the associated data trails of bike flows. The cynically inclined would see the two docking stations at each end of my route as needed to fill the void between the glass clad, elegant office blocks and high-rise apartment towers of Canary Wharf (to the South) and the heavily invested Stratford City (to the North). Both docking stations are in an area much like South East London that has so far not been on any plans to extend the bike rental scheme. During my 45 minute journey no activity is recorded at the Aberfeldy Street docking station while a total of 1,810 were completed across the network. In the week preceding my journey 18 journeys began from Aberfeldy Street against a seven day total of 139,793 for the entire scheme. So the numbers show Aberfeldy Street's docking station to be at the quiet periphery of the rental scheme. Indeed, it's hard not to wonder how decisions are made about docking station locations and why out of the ways streets like Aberfeldy Street have them installed.

My aim then in starting off from Aberfeldy Street is to make space, space where the bike data is sparse and where the introduction of new mixtures of data might give us some clues to something else, something different. I want to avoid visualising, yet again, the most common cycle journeys or where the flows are most dense (visualisations that seem to conveniently remind us where the wealth flows in London), and instead to see whether we might find other kinds of entangled relations.

So, taking the claims of difference surrounding data and (bio)sensing seriously, this is one shot at asking how the separations and associations might be cut differently, conforming not to long-established 'regimes of existence', to borrow Genevieve Tiel's (2013) evocative phrase, but, instead, offering up possibilities for refiguring the relational assemblies. The edges of the bike network, the introduction of bodily and

geo-spatial and temporal data, are thus drawn together because of their capacities for change, for re-figuring naturecultures. Although it may seem otherwise, this is a pragmatic quest. It is to begin thinking about data (with all its promise) as a real and material means of intervening in and disrupting the regimes. It is, as Karen Barad (2007) describes it, an attempt to participate in a responsive and responsible technoscience where the apparatus of scientific (and more generally how we know things) are understood as means to make worlds, and thus also the means through which we might undo and remake them.

So, in closing, let me experiment with a way of recounting my bike ride and some of what surfaces along the way. In turning to the data, so to speak, I've picked out a moment that looks to me like one not of drama—of simultaneous peaks or troughs, or points of intersection—but where *the action* in the data appears to wane or dip (if only momentarily). I have sought out here the "caesura", as Paul Harrison (2002) calls it, not a point or span in the data where things add up or offer up some explanatory power, but where there seems to be no other way of judging it but as an exposure to the sensorium, of "that which incessantly, irretrievably, excessively, *happens*" (ibid. 2002. p. 490, emphasis in original).

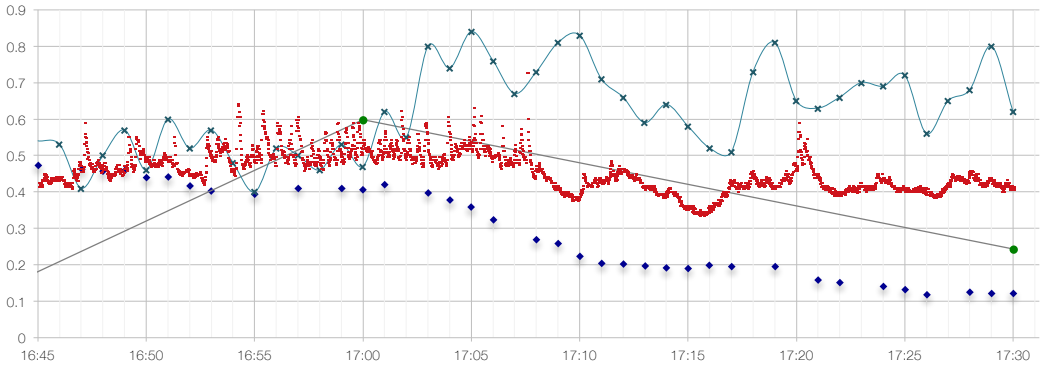


Figure 3. Graph of HRV levels (red small dashes), rate of bike availability (blue diamonds), new bike rentals/100 (crosses/teal line), and body 'activity' (green dots/straight line).

Look then to 17:12 along the x-axis of the chart (Fig 3). There is a brief (~5mins) settling of my heart rate variability, seen in the denseness and relatively uniform swell of the red dashed graph. The number of bikes rented (teal line) follows a not dissimilar curve. At the same time, the bike rate availability momentarily steadies with a flattening of the blue markers—where (roughly) as many bikes are being taken from docking stations as being replaced.[6] What appeals to me in this narrow window onto three different data series is that the data doesn't 'add up', they don't perform a story that coheres to what we know. Any correspondence between my biometric and bike data, especially, seem to be mere coincidence. The mutable moment of something like synchrony catches the eye, but at the same time the relations drift apart, forming connections that, if they exist at all, are a long way from anything we know.

[6] The data from the activity monitor (Withings Pulse 02) is only accessible for half hour intervals so it is of little use to the time-window considered here.

Figure 4. Autograph stream (right). Image from 17:12 (top left) and image from 17:17 (above), with Abbey Mill pumping station to left, in sun light.

Overlaying these data onto other kinds of data, this time geo-spatial, weaves yet longer unconnected/connected strands into this small window of time and space. Again, at 17:12, my ride intersects with an embankment running over the 150 year old Northern Outfall Sewer, part of London's network of Victorian sewage systems (Lat 51° 31' 39.4435"N, Long 0° 1' 2.2544"E). Here, I move from the road to *The Greenway*, a raised foot and cycle path running about 7km over sewage pipes and outlets between Bow and Beckton. Riding westward at 17:17 (as my momentary window falls away) and still on the Greenway, I catch site of and find myself immediately North of the Abbey Mills pumping station (51°31'53.6"N 0°00'04.6"W), another still operating monument to London's Victorian waterworks infrastructure (Fig. 4).

My 5-minute ride is then over a very much living network, one that channels organic and molecular life, an effluent, smelt, intensely, in the air. The origins of the Northern Outfall Sewer and its tributaries channelling this sewage are bound up with an economically vibrant London in the mid to late 1800s, a city rapidly expanding due to its role as a major port and the massive industrialisation of particular regions of the country. The Northern Outfall Sewer and its history also weaves into the cholera epidemics in London at the time and the acknowledged regulatory and political wrangling that put London's waterworks and drainage systems at the heart of the 1866 epidemic concentrated in the socially and economically deprived areas of East London (Halliday, 2013). In 1886, the Abbey Mills pumping station was, originally, a temporary solution to pump low-level sewage into the Northern Outfall, with the

express aim of at least partially sanitising the water supply for those in the heavily affected areas of the East (*ibid.*)

And now, on and between these historic sewers, other kinds of infrastructural networks are taking shape. The bike rental scheme and divisive discussions about the directions of its planned expansion fold into the political atmosphere of contemporary London, where the politically conservative Mayor is seeking to reduce the ever-spiralling costs of the city's transport system and at the same time reduce the proportion of public expenditure. Data here is of a kind that fits into a political/ideological and fiscal logic, where transport schemes (such as the rental bikes) are judged by their capital costs and the capacities they have for private investment (Hill, 2014; Martin, 2015). Also, this line drawn between my two coordinates of travel mark reconfigurations of a city's demographic, and the separations of wealth and poverty.

Looking East and South from the Greenway, you see aging housing stock, densely populated with 1st or 2nd generation immigrant families mostly from South East Asia and a smattering of white communities carried over from a family ancestry in the docks and in itinerant factory and doss house work in the East End (wonderfully recorded by Orwell (1949)). Nested amongst the Victorian terraced houses, Green Street's market stalls and shops swell with life, people bustle amongst stalls and windows bright with gold jewellery, glittering saris and bridal ware, and colourful sweets, fruits and vegetables. In contrast, 'regeneration' to the North and West, symbolised by towering cranes and skeletal steel frames of buildings being built, is spurred on by heavy public-private investment—a legacy to the 2012 Olympics. Newham Council puts the levels of investment at £9billon so far,[7] but it's clear—looking from the raised embankment of the Greenway cutting through Newham—that much of this is concentrated to the North East of the borough.

Amidst the smells and Victorian network of tunnels, sewers and pumping stations, is then a dense mixture of pulsing mechanical and digital machines, bicycle and money flows, webs spun of human and political bodies, and, *in toto*, a city always already coming into being. The data continuously present/produced and brought together thickens things, it brings yet more life to a place. Above, is my experiment with cutting into this data phylum. The dips and flat lines in my own personally generated data etch new contours into the geography, ones intimately bound to place and time. Together, this spatio-temporal data may seem an odd mixture, one that mixes and matches unrelated ebbs and flows of stuff, worlds apart. Yet, at the same time they bring another kind of place to mind where past and present stories can be knitted into the land; recovered are the intermingling trajectories of heart's beating, lived lives, machines, infrastructural networks, spaces, times, politics, etc. A body-in-place surfaces a panoply of data and relations, revealing the streams from "the hidden flows and their technological framing", drawing out, "the social relations and power mechanisms that are scripted in and enacted through these flows" (Kaika and Swyngedouw, 2000, p. 121).

[7] Nine billion pounds of private investment in Stratford, Newham, since the 2012 games were announced. (2013 ,26 July). Retrieved from http://www.newham.gov.uk/Pages/News/Nine-billion-pounds-of-private-investment-in-Stratford,-Newham,-since-the-2012-gaames-were-announced.aspx.

I want to say, to be clear, that my point here is not to make claims of any sort about how the data correlate, whether there are any right or wrong, or better or worse ways to slice through the aggregates. Rather, my interest is in how we begin to work with the "speculative possibilities" (Sengers, p.22) and how the data might suggest ways of doing things differently. How can we start to ask different questions about and with the product of (bio)sensors, possibly more profound questions about the places we live in and how we live together.

Other Worlds

So, certainly one thing we might take away from these meanderings is that data structures and tools should be built to accommodate an expansion and thickening of worldly phenomena. The computational substrates that undergird the Cloud and that are constitutive of Big Data should be given over to enlivening the relations, not flattening them. The trick here, as I see it, is to build in computational capacities that keep the vastness open, that don't slip too soon into neat classes—regimes even—of data that we know too well. Biosensing, self-tracking, and the like present the building blocks for such progressive capacities. Not merely ends in themselves—measuring things that many of us already have a sense of in/on our bodies—they are too the catalysts for discovering new relations between bodies all the way down (and up). And, this, it must be said, is Big Data's promise. There may still be little evidence of it, but the innovation in Big Data is precisely its potential for re-imagining relations. To return to boyd and Crawford, the "value comes from the patterns that can be derived by making connections" (boyd and Crawford, 2011, p. 2). Big Data's challenge is to take this, well, challenge seriously.

Yet, there is more to it than this. The flux of data, bodies, places and times—such as mine—provide us with a sense of a spatio-temporal phylum not just of what things *have* happened and the ways things are changing, but of how we might want them to be. The ever-thickening entanglements become possibilities for new cuts or planes. They are not merely where one *has* gone, but also a set of possibilities for how and where things can (or can't) materialise.

Alone, my own biosensed data does, of course, do very little. My momentary slice, a caesura, through a space-time—triggered by some questions about biosensors, cycle flows, geographical coordinates, and so on—only hints at a vastness of traces through nodes and networks of past and present, and a multiplicity of options for moving on. But if we were to follow an open thread of "what ifs", might we just want to imagine what the (bio)sensed data produced from a much larger set of sources could do for us. Here we might take some speculative, tentative steps towards the possibilities of new worlds, of multiple worlds coming into being through relations just forming, new mixtures of Haraway's *naturecultures* that still need claiming, and that we can't yet know the knowings and beings they will enact.

My own inclination would be to see if and how the relations enacted might resist the strong forces at work in London, forces that prioritise regeneration over sustaining cultural life and tradition (Glucksberg, 2014); that bypass or worse still erase the vibrancy of streets like Green Street in the un-invested areas of East London[8]; that literally build over the flows of effluence that have shaped a place and its people; that

[8] For a rich account of a similar street in London (in the South) see: Hall, Suzanne M. "Super-diverse street: a 'trans-ethnography' across migrant localities." *Ethnic and Racial Studies* 38.1 (2015): 22-37.

operate in and reinforce a city's pulse that orientates to the flows and rhythms of wealth and capital (Kaika, 2014, Graham, 2005). To my mind (and many others), these "agencies of homogenization" (Scott, 1998) are figuring a cityscape that feels uniform, that masks and overwrites the unevenness and plurality that has made and makes London vibrant.

My question, then, would be to ask how (big) data might draw out the uneven and plural in the city, how, through (re-)figuring relations, we might begin to foreground the threads that weave through the multiple worlds that make up London rather than overlay them with a totalizing narrative that tidies and neatly compartmentalises people and things. This is a data sensing project that thrives on multiple worlds becoming. As I see it, it aims to locate (bio)sensed data within the ideas of 'civility' and 'conviviality' that Hinchliffe and Whatmore write of, ideas that concentrate our minds on "the practical intercorporeality of civic association in which particular kinds or individual entities thrive in combination with others whose capacities and powers enhance their own." (p. 135). One might imagine that the data is used to tease out these productive combinations, algorithms that aren't just used to find intimate 'soul-mates' but also city-scale relations with those 'capacities and powers' that exceed our own. Might our Boris bikes move and brake in ways that resist some flows and aid others, might they afford new computational-constituted terrains in which our (bio)sensed rhythms ebb and flow unexpectedly, and, in the uncertain and unknown, we might discover combinations of difference that work.

And so my instrumented meanderings on a Boris Bike must stand as experimental intervention aimed at opening questions. The bikes + data provide us with ways of imagining not merely a means to traverse the city, but a means to etch out new surfaces, marking flows, momentary densities, gaps through time, etc. Entangled in webs of (bio)sensors and worldly human/machine/political bodies, the data invite the space for something else. I find it hard to put it better than Nigel Thrift:

"We need spaces that graft… We need spaces that don't line up. We need spaces that breathe different atmospheres. We need new slopes, strips, roads, tracks, ridges, plains, seas... We need room. This is meant as an effort to make room." (2014 p. 18)

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