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Algorithmic Vulnerabilities and the Datalogical: early motherhood and the tracking-as-care regimes.

This article draws on work from a six-month project with 12 young mothers in which we mapped and tracked ourselves and our infants. The project employed a range of methods including digital ethnographies, walk along methods, hacking and playful experimentations. We explored, broke and tested a range of wearables and phone based tracking apps, meeting regularly to discuss and compare our experiences and interrogate the socio-technical systems of postnatal healthcare alongside the particular politics of certain apps and their connective affordances.

I use the project as a springboard to explore what I call algorithmic vulnerabilities: the ways that the datalogical is exposing and positioning subjects in ways that not only rarely match their own lived senses of identity, but are also increasingly difficult to interrupt or disrupt. Vulnerability in this sense refers to being both exposed to, and positioned by the datalogical in lived, affective and ideological ways. 'Datalogical' refers to the ways that machine learning and large scale databases are reshaping the politics and logics of the socio-technical (Suchman 2007), generating what Clough et al. have called the 'new onto-logic of sociality or the social itself' (2015: 146). While this is not necessarily a new phenomenon (see Hayles 2017, Clough et al. 2015), I argue that the particular algorithmic vulnerabilities experienced by the women of my project are forged in part through the ideological enmeshing of the long-running atomisation of maternal and infant bodies within the healthcare systems (Crowe 1987, Wajcman 1991, Shaw 2012) and the new and emergent tracking apps (O'Riordan 2017, Greenfield 2016, Lupton 2016). These stabilisations have become increasingly and problematically normative, partly because they feed and perpetuate a wider 'taken-for granted' sensibility of gendered neoliberalism (Gill 2017:609) which, as I argue, is also coming to encapsulate and define the contemporary datalogical. Secondly, the socio-technical politics of the apps and the healthcare systems are revealed as co-dependent, raising a number of questions about long-term algorithmic vulnerabilities and normativities which predate the contemporary datalogical 'turn' and impact both practices and methods.

Every other Friday between 10.30am and 12pm twelve new mothers and I met at a breast-feeding clinic in Leeds UK. The clinic took place in a Children's Centre - an NHS and Leeds Council supported initiative – where you can have a cup of tea and breast feed, weigh your newborn and talk to health professionals and midwives about any breastfeeding or mental health concerns or issues. Our group of women met accidentally, arriving at the clinic and sitting down at the same table at the same time together. We started talking about our newborns but relatively quickly moved on to a discussion about the tracking apps for breastfeeding, baby weight and our own health apps which midwives, friends, digital platforms and relatives had told us about. How we met is significant as I will explain, and over the following 6 months we met fortnightly at the café and often more frequently and ad hoc in the park, in town, for walks. The images I am using in this article are from my phone – I was on maternity leave and was group member number 13, but the idea and interest for the project came about collectively. The rules for the project were relatively simple: we each chose a baby tracking app, or apps, and recorded what we wanted to. We met and discussed the recordings, dashboards and apps, answering three questions each fortnight: (1) what we liked or were impressed by (2) what we did not like and were

not impressed by (3) what changes to the app, behaviour, thoughts, feelings we noted. In what follows I firstly offer a context and description of the apps used, partly to demonstrate their complexity in terms of data sharing but also as a basic introduction to what might be unfamiliar apps. The second section discusses the concept of the datalogical in terms of the normative data-driven processes of healthcare as both a system and a felt and embodied experience. The third section demonstrates how these normative practices and systems create algorithmic vulnerabilities firstly because of the silences in and of the data, which generate feelings of isolation and vulnerability for the women who have to create what they feel as less validated spaces to discuss embodied maternal subjectivity. Secondly, the lived consequences of datalogical healthcare and self-tracking apps also create algorithmic vulnerabilities in terms of the lack of agency or autonomy the women have to disrupt or circumvent the datalogical environment in which they find themselves. Finally I discuss the implications of my work within the wider context of feminist scholarship and maternal subjectivity.

Context

The contemporary baby tracking market is relatively buoyant. Not only has tracking culture and the datafied self become increasingly normative in the UK (see Lupton 2016), but there is also a longer term and more historical tracking-as-care discourse of early motherhood (see Wajcman 1991) which has shifted to the digital where it is also part of the mhealth (mobile health) movement in the UK (Speciale & Freytis 2013). Tracking and biosensor apps occur within the intimate and neoliberal frameworks of 'knowing yourself' better (Sanders 2017, Lupton 2016). They are highly personal, often uneven and malleable data sets that rely on automatic, biosensor and inputted information to varying degrees, and as such they are negotiated differently, played with and appropriated. During the course of this project the women used a range of apps – starting with *BabyFeed* and *Baby Buddy* where data is inputted manually, and moving (or returning) at around month 4 and 5 to self-tracking apps – health monitors and pedometers such as *Jawbone* and *Fitbit*, Garmin & Apple watches. Some of the mothers used baby-weaning apps like *Made for Mums* for a few weeks between 4 and 6 months, although there was much less take up of weaning apps within the project. Tracking and biosensor apps offer users and interested parties 'granulated' data of 'pixelated' selves (Topol, 2012:231). As Kitchin (2016) and others (Neff & Nafus 2016, Day & Lury 2016) have noted, such apps atomize us, and in so doing are part of a long history of the atomization of – particularly female - bodies which has occurred mostly through health and medical discourses as well as within wider popular culture (Thornham 2018). For those of us that use them, they enable us to find, as Greenfield argues, 'personal answers to personal questions', seeking a 'different kind of knowledge' by comparison with traditional expertise (Greenfield 2016:131-2). They are intimate, individual and are built on and through a neoliberal discourse of individualism, choice, meritocracy and mobility. Tracking and biosensor apps are part of a wider discourse of biopower, disciplining bodies over time whilst also generating data to be used by others to discipline us, thus reconfiguring traditional notions of structure and agency (O'Riordan 2017:49).

Tracking apps, wearables and biosensors are interested in very particular data, producing dashboards that are necessarily meaningful on a range of levels, for a variety of stakeholders. And although they may be highly personal, they are also, as Deborah Lupton reminds us, inherently tied to, and the product of, 'broader social, cultural and political processes' (2016:1). It is worth noting, for example, that *Baby*

Connect is developed by Seacloud Software: a mobile app developer company in California USA. Any data generated outside the US is transferred and stored in the USA in keeping with their data protection and privacy laws. Seacloud Software collects usage data (click data, duration, time and date), technical data (IP addresses, devices operating system, geolocation, browser language) as well as the inputted data 'itself' regarding length of sleep, feeding patterns, growth, gender etc of the infant. Usage and technical data is shared primarily with subprocessors for the app: Amazon Web Services, Google, Groove, Twilio, Recurly; but Seacloud reserves the right to share anonymized data inputted by individuals for business or research purposes.[i] It operates along the lines of what José van Dijck has called a 'cultivated garden politics' (2013:164) whereby the data provided by the app may be sold in carefully packaged ways to other – usually health - organisations. *Baby Feed* (the app most of us used) is produced by a software development company Fehners Software LLP, in Haywards Health UK and has a sliding scale of data privacy insofar as the paid version only enables subprocessors to collect usage and technical data from users and only via synching processes with other devices (apple watches, garmins, other iphones): the company itself claims to collect no data whatsoever. The free version however, includes the Google AdMob SDK plugin, which means that data is governed by Google data policies which are much more open (collecting GPS, sensor data, other services in the proximity of the device such as Wi-Fi access points and other Bluetooth enabled devices).[ii] *Baby Buddy,* by comparison, is owned by the charity Best Beginnings, and was developed as part of the shift towards mhealth in the UK within the third and public sectors (see for example Becker et al. 2014, Sama et al. 2014) and was funded in the final stages of development by the Big Lottery. It was designed in conjunction with Guys and St Thomas' and Blackpool's NHS Foundation Trusts where it was embedded into their service delivery as part of the pilot testing period.[iii] The rationale for the app was to reach parents who are 'least likely to engage with traditional forms of health information' (Cooper, 2015:7) but was prompted in its design by the 'advent' of mhealth interventions (ibid.:8) and by comparison with *Baby Connect* and *Baby Feed* incorporates an appointment diary and 'what to ask' functions for interactions with health professionals. Although the three apps have very different data policies and origins then, they have comparable functionality, dashboards and data interests as I will go on to explore, and indicate quite clearly (I think) the range of data cross over not only between the private and public sectors, but also between the consumer and healthcare interests.

Datalogical Perinatal Care

Baby Connect, *Baby Feed*, and *Baby Buddy* are part of a number of health apps endorsed - in their advertising first of all, but also discursively, and as part of perinatal professional practice (as with *Baby Buddy*) - by health professionals. As tracking apps, they following in the footsteps not only of the health apps and biosensors discussed most prominently in the literature on datafied and quantified selves (see for example Nafus (ed.) 2016, Neff & Nafus 2016, Lupton 2016, O'Riordan 2017) but they also more overtly follow the ovulation and period tracking apps used for conception and widely discussed on forums like *netmums* and *BabyCentre*. Increasingly (as with *Baby Buddy*) such apps are not just pre- or post natal but perinatal, incorporating conception, pregnancy and postnatal experiences in a single app thus prolonging their use and collating much more nuanced data. For our project, a discussion of postnatal and perinatal apps came up in the very first conversations we had and when I later asked in the first month of our project how the women came to

know about apps like *Baby Connect*, *Baby Feed*, and *Baby Buddy* they detailed a range of discussions with midwifes friends and family as well as online forums and platforms:

> 'my midwife suggested some names [of apps] I think coz I couldn't remember how long she'd fed for one time, but I knew about like *Made for Mums* coz my sister uses it and I used *Glow*[iv] actually when we were trying to conceive' (Sanja, month 1)
> 'it was actually my sister what suggested *Baby Buddy*. She said it were really good for like, keeping records, seeing what to do and ask' (Naveena, month 1)
> 'They [midwives] gave me this pack with all this info in – this list of apps and resources and that. But I've got a period tracker app and a *FitBit*, so its second nature really' (Aimee, month 1)
> 'I was my midwife. I think she just said it was a useful thing. Like, as in, you know, other mums are using this. I think she told me, is it *Baby Buddy*? That one' (Lee-Ann, month 1)

What I am suggesting here then is that baby tracking apps – like biosensors and wearables - are (increasingly) widely normative. It is not necessarily that they are being promoted by midwives or health professionals but rather that they have become widely used and taken for granted and then latterly (as the report on *Baby Buddy* clearly details see Cooper 2015) taken up within the mhealth movement and have fed into conversations with health professionals because of their normativity ('as in you know, other mums are using this'). At the same time, the endorsement by health professionals is clearly important for advertising purposes and take up, and it should be no surprise that that data captured by apps like *Baby Connect*, *Baby Feed* and *Baby Buddy* closely mimic the data required and demanded by midwives and health visitors not least because these cross overs are precisely what makes the apps useful and meaningful for mothers. Indeed when you look at the NICE (national institute for clinical excellence) briefing papers for postnatal care[v] or examples of breastfeeding assessment forms used by health professionals during postnatal care in the UK; [vi] it is clear that data pertaining to for example, length of feed, latch, and whether a second breast is offered – data that is constituent for professional healthcare – is also the data monitored by the apps.

Baby Connect, *Baby Feed* and *Baby Buddy* also monitor this data – the length of feed, the weight of the baby, the side of the feed, time between feeds: *Baby Buddy* monitors the latch and position of the baby during feed as well. Unlike the apps though, such data within the postnatal healthcare system that is gathered at every appointment between mother, infant and health professional is constitutive, algorithmic, and based on a series of gatekeeping ('yes/no') decisions through questions such as: is the baby 'gaining weight?' does the baby feed 'for 5-30 minutes at each feed?' [vii] Such questions form part of a decision-making process around which medical and health intervention is based. Women are routinely asked questions pertaining to such data at each appointment, which is of course one reason why such apps are meaningful, but *not* knowing the answer, resisting the question, or offering the 'wrong' answer, generates a whole range of subjective anxieties and annoyances as well as interventions as the quotes below detail. The answers mothers give to health visitors and midwives generate processes and procedures within the very regulated and metrified system of care, a system that itself feeds into wider health and social care

systems. The women know this, not least because as I said at the start of the paper, we met at a breast-feeding clinic to which we were all referred precisely because of our breast-feeding metrics:

> '[My midwife] suggested I came – I'm really struggling. She's lost 9% of her body weight. I'm trying to feed her every 2 and half hours, but it's really difficult.' (Karen, month 1)
> 'She's underweight so the midwife referred me. I'm not feeding her right' (Naveena, month 1)
> 'I needed to get out of the house. Simple as. I've not been out in 2 days. I haven't slept so they sent me here.' (Shelly, month 1)
> 'Cracked nipples, mastitis, cysts. Engorged boobs, leaking nipples, bleeding nipples. You name it, I've got it.' (Akira, month 1)

A question from the midwife (for example asking how often a baby has fed) constitutes a particular metric around which intervention is based. At the same time, such a metric enforces the intervention *as* a necessary outcome. This is a self-perpetuating cycle that creates normative behaviour of tracking as care as well as standardised metrics based both on the data provided by the individual mother and wider medical data and against which responses are plotted. Every visit from the midwife or health visitor includes form-filling and formal questions, and prompts a series of 'actions', from hand-over (to community nurses from midwives after twelve days and feeding is 'established' in the UK), to referral, to suggestions, to intervention, to signing 'off'. All of the mothers joked about the questions around their partners' involvement in looking after the baby for example, or the overt questions around domestic abuse or feeling unable to cope – which are questions designed to reveal postnatal depression or mental health issues to the midwife as the policy guidelines tell us.[viii] We can also identify in the quotes below a knowingness and irony about the questions being asked by the health visitors and midwives. But underpinning the jokes was a clear acknowledgement of the instrumental nature of these questions and the fact that a 'wrong' answer would have consequences:

> ''Am I feeling unusually tired?' she [the health visitor] asked me. 'Am I feeling *tired*?!' What the *fuck*?! ' (Mae. Month 2.)
> 'Have you had the conversation about sex yet?! 'Am I interested in or have I resumed sexual intimacy?' They asked me. What's that about? 'None of your business' I said. She said, she *had* to ask me that and I should answer.' (Lucy. Month 3.)

Why is this important? It highlights the synergy between the data of the apps and the data noted by midwives and health visitors, which as suggested above we should not be surprised by. But I also want to suggest that the data of *both* are 'constitutive' (Kitchin 2014: 21), and 'framing' (Gitelman and Jackson 2013: 5) within a much wider datalogical system of health care and intervention. When the women talked more generally about the apps within the context of health visitors and midwives, we see a much more blurred and enmeshed relationship between the apps and the health care systems:

> '*BabyFeed* shows me really clearly that I'm doing ok. The midwife said I should feed for 8 minutes on each side minimum: I've gone from 2 and a half to 8 and a half [minutes] over the last two weeks. I can show her that and she doesn't just have to take my word for it. It's *there* [pointing to screen].' (Naveena, month 2)
>
> 'I don't have to remember or write anything down: I just record it and then when I need to check the answers it's all there.' (Karen, month 1)
>
> 'The charts make it really clear that I am doing okay in some things and not others. It shows me what I need to change.' (Lee-Ann, month 2)

What is interesting about these comments is the way that the women use the apps to cement their conversations with health professionals and to verify their own practices as being correct and 'okay'. However, by comparison with the claims made about wearables and self-tracking – particularly the idea of 'knowing yourself better' (Sanders 2017, Lupton 2016), or an empowered feeling of agency supposedly generated through the act of 'revealing', 'identifying' and becoming 'attuned' to habits through self-tracking (Neff and Nafus 2016: 91) - our conversations suggested something else. What the women clearly expressed in our early conversations were not feelings of control, but feelings of anxiety and even failure that were exacerbated – I think - because the sense of 'constant visibility' that Sanders discusses in relation to the perpetual self-policing practices of femininity (2017: 53) had *already* been highlighted to the women before our project even began (because they had all been referred to the clinic). This shifted the power relationships somewhat between the health professionals, apps, data and subjectivity, and we can begin to see this more clearly when we think about how the apps actually underpinned their meetings with midwives and health visitors because they were understood by the mothers as more 'accurate' or 'truthful' than the women themselves.

Indeed, as Lee-Ann says in the excerpt above, it is the app that tells her what she is doing 'okay' and what she needs to change as a mothering practice. Naveena tells us that her app underpins her meetings with her midwife, and she uses it to demonstrate her mothering practices. More than this though and as suggested above, it is the data which is trusted as opposed to her own experience: 'she doesn't just have to take my word for it', conceiving of the data as offering 'certainty' which is set against her own 'untrustworthy, inexact' expertise (Lupton 2016:94). Deborah Lupton argues that we increasing trust 'data over embodied knowledge' (2016: 94) in relation to apps and wearables, whilst Kate O'Riordan has talked recently about how data is becoming material through such apps because of what is valued, researched and measured (2017). The fact that mothers also, in their conversations in the breast feeding café, echoed these metrics in their own discussions about their baby's 'progress' is indicative of the power of these metrics. There are a number of issues to note here then, firstly in terms of the way data is valued and conceived as more accurate than the lived experiences of maternal subjectivity – and issue I will return to below and which has resonances with a long history of medicalising childbirth, pregnancy and early motherhood. This suggests at the very least a continuity in terms of the ideological underpinnings of both maternal subjectivity and indeed data rather than a shift prompted by wearables and biosensors. The second issue to note relates to the way the metrics discussed during medical appointments with midwives and health

professionals bleed across into other spaces to become markers of successful mothering *per se*. The fact that the women constantly talked about how many feeds their infant had in every 24 hour period; the length and quality of feed; and whether the baby fed from both breasts or one, doubly emphasises not only the power of these metrics, but also the way they become enmeshed in subjective and normative markers of successful mothering. What is valued about motherhood, indeed what motherhood *is* – how it is experienced, discussed, measured, is 'leaking' across (to borrow Cheney-Lippold's term 2017:143) from the data and algorithmic to the subjective and vice versa. This is precisely what Fotopoulou (2016:96-9) argues when she suggests, drawing on Foucault's concept of biopower (1990:130), that wearables and biosensors 'discipline' the body through a lived negotiation with regulatory power systems and processes (see also Sanders 2017: 40, Lupton 2016:1). This means that, at the very least, the data recorded by the apps, along with the processes of inputting data by the women, are far from benign and should be regarded as part of a process of soft biopolitics – of conditioning into particular structures of surveillance and care as well as wider ideologies of maternal subjectivity.

Motherhood. Metrics. Agency

The apps work by atomising and disaggregating lived experiences of motherhood into metrics that can then be re-aggregated divest from the messiness of lived experiences and in ways that can be plotted against standardised data visualisations. This atomization and re-aggregation is a familiar process of medical and health care well documented by scholars (such as Mol 2002, Mol and Law 2004, Latimer 2013) in terms of the simultaneous objectification and pixilation of bodies – a process according to these scholars that ultimately renders subjects powerless (and vulnerable) on many levels. In drawing these correlations there is also a familiar feeling of déjà vu here and I am thinking of long-running feminist concerns with the medicalization of childbirth and early motherhood as well as the atomization not only of the female body *per se* in wider cultures (see for example Pollock 1987, Gill 2007), but also within wider medical discourse. Lucy Wajcman tells us that technologies 'coexist with a powerful ideology of motherhood' (1991:57) and have long sought to atomise complex lived relations and ontologies into discrete and separate data and technological processes. Her historical work on the relationship between technology and motherhood highlights not only the longevity of this process of the atomisation of the female body through technological processes (1991: 70 see also Michael and Rosengarten 2012, Shaw 2012); it also demonstrates a long-term failure to conceive of motherhood in and of itself as a constitutive category within systems. Instead, motherhood is defined as the outcome of aggregated data, like in these apps: how motherhood is subjectively understood and valued by these women is in part constituted through these metrics and legitimated by them. As many feminist scholars have noted (see for example Minden 1987, Crowe 1987, Lawler 2000, Shaw 2012, Franklin 2010) this is long running and amongst other things, works to cement the notion of technology as validator and legitimator of motherhood *and* maintains a conceptual separation between technology and maternal subjectivity. As Wajcman reminds us, 'machines inexorably direct the attention of both the doctor and the patient…towards the measurable aspects of illness' (1991: 70). This means that technologies (e.g. scales, syringes, blood pressure monitors, apps) and metrics have long been conceived of as more 'honest' as N. Katherine Hayles discusses (2017:126-7), truthful and accurate (Gitelman & Jackson 2013:2) than lived embodied experience and that this is part of a wider datalogical environment that constitutes

maternal subjectivity. What I am arguing then, is that valuing data over lived experience is not a new phenomenon, nor is the atomization of female and maternal bodies and so on many levels the wider discursive and every day normativity of these apps should be no surprise. But this also means as Fotopoulou & O'Riordan have argued in relation to biosensor apps, there is much more 'at stake' here, (2016: 2) than we might realise.

Algorithmic Vulnerabilities

In the second half of this paper I want to consider what is absent in the apps and wider health metrics in terms of data silences. Most notably I will discuss the lived embodied experiences of early motherhood which are entirely absent and which generates a range of subjective anxieties and vulnerabilities for the women of this project as they navigate their own experiences within the frameworks of the wider datalogical healthcare provision in which their apps are complicit. More than this though, I argue that the fundamental premise of tracking and biosensor apps is at odds with maternal subjectivity as discussed by feminist scholars. What this means in thinking about the datalogical and indeed digital culture more generally, is that there is huge silence if not negation of lived experience and maternal subjectivity that is increasingly infrastructural, cultural and problematically normative, partly because they feed and perpetuate a wider 'taken-for granted' sensibility of gendered neoliberalism (Gill 2017:609) which I will go on to explore.

As Frankie tells us, 'what all these nice graphs and charts don't tell you, is how much it fucking hurts!' (Frankie, month 1). Indeed, the apps do not count or measure pain, frustration or anxiety. There is no way to chart unsuccessful or aborted attempts at bottle or breast-feeding for example. Similarly, the apps count intentional breast or bottle-feeding only - not unintentional leakages; they count the duration and frequency of sleep, not the quality. Although nuances and complexities can be added as a note to inputted data, this functions in a non-constitutive way - as bounded or 'stranded' data (Singh 2012) – information that is also devalued here because such notes are a complication and messiness to a clean and simple, 'scientific' and atomized metric. Such silences are not just evident in the data (or lack of it); they are in the design and aesthetics of the apps too. The 'clean and proper' (to borrow Kristeva's term 1982: 102) design of the apps, their pastel colours, simple 2-D geometric shapes and overall uncluttered aesthetic renders invisible – indeed, erases – the 'fleshy' maternal body discussed in much feminist scholarship (Battersby 1998:11, Shaw 2012: 121) and related subjectivities. These are dashboards that explicitly make breastfeeding and the lived experiences of it entirely *invisible.* Maternal subjectivity is not a concern for the apps: *data* is. In recognising this, we also need to note that this is entirely in keeping with wider discourses around motherhood and maternity, as well as the discussions above in terms of the various interactions with health care professionals and their interest in certain *data*. For scholars such as Sarah Franklin (2010) what is important about such long running discourses is the generation of an ultimately patriarchal epistemology – which arguably is exactly what is represented in these apps. For other scholars such as Bassett (2010), and Firestone (1969), what is important is the obscuring, if not 'obliteration', of the *mother* within medical discourses (Bassett 2010: 97). My suggestion in thinking about these apps is that we can find resonances of these concerns here too – in the silences of the data and in the design of the apps. Maternal identity is firmly located at the site of embodied experience: bound up in the lived

practices that may be partly constituted by the apps, but are not located or visible within them. Thus the silences and politics of the app are entirely normative in terms of wider discourses of maternal subjectivity in which we can trace a strong and consistent thread of the negation or eradication of the *mother*. As Akira tells us:

> 'What I really want is something on here that also counts how many times I have been vomited on, shat on, peed on. I swear, at least 3 times a day. Then I could be like, 'well he hasn't fed 8 times in the last 24 hours, but he HAS puked all over me 10 times – is *that* ok?" (Akira. Month 1. 2016)

There are a number of issues to note here then in terms of what is valued and captured through the apps and healthcare professionals by comparison to the lived and embodied experiences recounted and agonised over by the women of the project. They generate algorithmic vulnerabilities I think, in the sense that the apps and metrics powerfully and affectively constitute and generate processes to which the women are subject. At the same time the women have to find other spaces to discuss or find representation of, or support for, the lived experiences of maternal subjectivity not least because it is *not there* in the professionalised, sanitised and data-rich discourses of data-focused maternal subjectivity. This means not only that these lived experiences of maternal subjectivity are conceived of as less 'valid' by the women, it also means that some of them – the cracked and leaking nipples, mastitis, pain and being vomited, shat and peed on – become primarily discussed within specific spaces which are – at least in the experiences of the women of my project – feminised, domestic and private.

One contributing factor to the disappearance or silencing of shared and common lived experiences might be found in the way the data for wearables and biosensors work. Indeed and by comparison with traditional medical data, which works by statistically verifying an individuals data by correlating it with bigger (big data) real-time data that is correlated at a range of points (for example age, gender, ethnicity, medical history as well as similar stage of illness); wearables and biosensors work with what Greenfield has called the 'n of 1' principle (2016:125):

> The *n of 1* rejects the requirements of large numbers of subjects for statistical validity and expert credentials, forging a new epistemology of health and being where the single case or person collecting the data over a lifetime displaces the population as locus for knowledge and intervention. (2016:125)

The *n of 1* principle assumes that singular data gathered over time and from a single source is sufficient for meaning-making and even when scaled through data sharing, the principle remains the same: instead of the *n of 1*, we have the *n of a billion 1s* (see also Nafus 2016: 228). This has a number of implications for the purposes of this article, but in the first instance it means that new lived experiences are always going to be initially problematic not least because the data being captured is measured against your own data over time. As Day and Lury have argued in relation to biosensors, meaningful data is gathered through recursive looping whereby new data is correlated with existing data if it is to be significant:

> ‘The recursive looping turns observations or traces made through data collection into tracks: it makes data meaningful insofar as the traces are related, linked or connected to each other’ (2016: 43)

This means at a very basic level that radical changes to routine are problematic to log whereas incremental changes are more easily logged over time. But this also relies on dynamic systems that can be flexible enough to log incremental change. The silences within the baby monitoring apps do not fit this logic for two reasons. The first is that there is a much shorter temporality to the apps so that normative data is difficult to establish, and the second is that the lived experiences recounted by the women – of pain, frustration and anxiety are not (as I have said) valued as important data and are entirely absent in the apps themselves.

Perhaps more importantly, the *n of 1* principle only works if we believe in a whole, unified and *consistent* self over time and space. The data of wearables and biosensors is only ever meaningful if we assume that the constant factor that can be metrically assumed is a whole, unified and complete subject. But maternal subjectivity, as many theorists have noted (Battersby 1998; Baraitser 2009; Tyler 2009), encompasses a range of embodied subjectivities and relations (pregnant body, birthing body, mothering body), each also bound up in wider ideologies of embodied female form with its inescapable and inevitable promise of ambiguity, contradiction or mutation through its reproductive capabilities (see also Thornham 2015). It is in fact at the opposite end of the spectrum to a whole, unified consistent self over time. The apps emphasis on certain metrics – such as latch of baby, position of baby while feeding, whether both breasts are offered – is logical not least because validity through consistency over time is problematic. But the inflexibility this produces in terms of logging the experiences of maternal subjectivity create real data silences which contribute to an overall feeling amongst the women that such experiences are devalued, unimportant and undermined. We can see this sentiment in the comments from Frankie and Akira quoted above but also in the following discussions which detail conversations about cracked or bleeding nipples and mastitis with medical professionals:

> ‘she asked me how often the baby was feeding and when I said how sore it was, she told me to just ‘feed through the pain’ and my nipples needed to ‘toughen up’. I cried when she left. Honestly. I just cried and cried.’ (Aimee, month 1)
> ‘I went to the out of hours surgery coz of this lump which was so bloody sore. Couldn’t touch it, I like thought it were mastitis, but weren’t sure – like you don’t know do you? So the doctor asked me how old [baby] was and then just wrote me out three-week prescription for antibiotics. Never really looked at me boob, never really asked me much, just said the pills were okay if I were breast-feeding. I wanted to like talk about it, and I was in and out before I could take a breath!’ (Mae, month 3)

Whilst these are clearly subjective, individual and emotive accounts of dealing with mastitis and cracked nipples with health professionals, what they articulate is a sense of frustration and powerlessness. What I am suggesting then, is that the data silences of the apps, particularly about the wider lived experiences of postnatal care (and here I have focused on only a few of the experiences discussed in our group) feed into a

wider subjective sense that these experiences are undervalued or acknowledged, which ultimately exacerbate feelings of inadequacy, vulnerability and frustration. Later in the conversation, Aimee for example, talked about how she felt that the midwife was more interested in the frequency of feeds, not how painful they were. I am not suggesting the apps straightforwardly or transparently generate these feelings, but rather that they contribute to a long history of the medicalization of perinatal care in which certain data and metrics have always constituted and legitimated motherhood.

Conclusions

Wilson and Yochin in their book *Mothering Through Precarity* (2017) talk about how the practices of motherhood are increasingly becoming understood in atomatised ways and also becoming overly valued as a marker of successful or competent mothering. They don't talk about data and apps specifically in their book, but are instead concerned with what they call the 'digital mundane': the lived and everyday practices of motherhood and how these mundane practices give sense and meaning to peoples lives (2017:3). What they do discuss, however, is how everyday discrete decisions for example about length of sleep for the baby, amount and type of food, breastfeeding, clothes, playtime activities are all being atomised and simultaneously elevated to the consequential. They argue that motherhood is increasingly being conceptually formed through the aggregation of discrete and atomised measurable elements, and the critical point they make is that maternal subjectivity is being 'liberalised' (2016: 50) in a self-perpetuating cycle that is affectively powerful. Elevating the atomised, pixilated, discrete decisions of motherhood to the consequential – allowing them to become constitutive data in the wider discursive meaning of motherhood - constructs mothers as always responsible, accountable and productive. Mothers are 'important gender citizens' with 'weighty social responsibilities' (2016: 50), but this means the happiness of the family rests on not just the 'minutiae of mothers' actions but also and importantly 'their broader lifestyle choices' (ibid.) And as Oulette and Wilson have argued, these choices are part of a refashioning of motherhood to make 'the feminised labor of caring for others more compatible with the self-enterprising ethos demanded by today's neoliberal policies and reforms' (2011:555). The combined argument of these scholars is that that the digital feeds and perpetuates what we might call the gendered neoliberalism of contemporary motherhood (to borrow Gills phrase 2017:609). For these scholars, the digital does this through an endorsement of resonant politics of neoliberalism, choice, meritocracy and enterprise, which all contribute to emotional anxieties and feelings of inadequacy in a perpetual cycle in which the women are emotionally vulnerable to, and affected by gendered neoliberalism that is always-already algorithmic and digital. There are no cracked and bleeding nipples, no shit or vomit-covered mothers within ideologies of self-enterprising individualism or mother-as-citizen. To reiterate Day and Lury's phrase: this is a recursive fractal, not (only) of data, but of gendered neoliberalism framed within the resonant discourses of motherhood.

Bassett has argued that what has changed in the era of the quantified self is that bodies and computational devices 'intertwine to measure the human day and co-constitute the world in which we live' (2015:136) and if we think about maternal subjectivity in relation to how it is being co-constituted we find an overriding gendered neoliberal discourse which is atomising not only maternal bodies, but practices, subjectivities and relations. This atomisation may well be longstanding but

– as Bassett and Cheney-Lippold also remind us, it is the technological and the datalogical that is gaining traction not only in terms of decision making power, policy, normative practices and discourses – as you can see from the quotes here - but also in terms of our own conceptions of our own identities. Quite often, as Grosz has argued, this is happing at the expense of lived experience (2001), and for the women of this project, the consequence of an increasing irreconcilability between lived experience and the datalogical construction of it, is manifest in real anxiety about doing motherhood 'wrong'. It is manifest the double silencing across the datalogical *and* the everyday of certain experiences and data – like cracked and bleeding nipples, like oscillating emotional states, like changing bodies, opinions, preferences and priorities.

It is important to say that I am not suggesting the women quoted in this article do not resist or question such positionings. Their perceptions and experiences of the apps changed over the six months of the project, as did their willingness to use or engage with them:

> 'I don't mind pacing in the night – I think 'that's another 500 steps' [laughs]. And in the middle of the night, you can like look and go, 'over 10,000 steps at least. Good.' I mean I know this is the point of it, right? But I still take it like a little reward' (Naveena, month 4)
>
> 'I realised I was reaching to turn on the app *before* I started feeding. There I was, she was screaming, and I was scrabbling for my phone! I thought 'what am I doing here?! This is ridiculous!'' (Lee-Ann, month 5)
>
> 'It showed me that I was feeding longer on the left than the right, like 3 minutes more every feed, so then I changed how I fed and then it was the same. And then, looking back I think, 'why did I do that? Did it really matter?' I dunno' (Karen, month 6)

Anecdotes of changed behaviour were frequent, particularly in the latter months of the project and as women moved from the breast-feeding tracking apps to fitness tracking. This shift was also discussed in terms of embodied experiences, of breasts reducing size ('I couldn't fit into any of my sports bras until I stopped breastfeeding' Frankie, month 3) of regaining bladder control ('up until last week I was just weeing whenever I ran' Aimee, month 5), or being 'signed off' to do exercise ('I've still got a 3cm gap between my stomach muscles', Lucy, month 4). This is a further reminder I think, of the problematic assumption of a whole and complete subjectivity. But what is also notable from the comments above is a clear awareness that their practices were in keeping with the politics of the app ('this is the point of it right?') sometimes at the expense of their own practices of mothering ('I was reaching to turn on the app before I started breastfeeding').

What I am suggesting here is two things. The first is that the disciplining process of the apps occurs through mundane and routine behaviour – which in itself assumes some sort of reciprocity between the app and the wider maternal experiences. Tracking-as-care, food diaries, calorie intake, pedometers (for example) are long-term and familiar beyond the specificities of the quantified self or mhealth 'movements': *Being data* is a familiar lived experience. For the mothers of this project, for example there was a deep correlation between ideologies of motherhood that were interwoven with the ideas of tracking-as-care, the intensified surveillance of women (Winch 2015), the long standing (and exacerbated through discourses postfeminism as Gill

argues 2017, 607) `need to monitor and discipline one's self' (Ouellette 2016), the metrics demanded by the wider datalogical health care system as markers of health, and their own uptake of baby monitoring and fitness apps.

My second suggestion is that these practices do not exclude a conscious consideration and even critique of what is occurring: these are not, then, the 'unreflected, taken-for-granted' actions that Shaun Moores talks about in relation to embodied and tactile digital relations (2014:202). We can read this in two ways. We can see it as opening up a potential space of resistance – in keeping with long arguments within the Quantified Self community (see Lupton 2016, Ness and Nafus 2016) – whereby possibilities of resistance and the hacking of these processes are enabled precisely because the politics of the apps become/already are visible. The visibility of the politics combined with a critique of them is what potentially generates a space for resistance, reappropriation, or disruption – enabling such apps to be 'turned inside out' like Greenfield's medical data (2016:126) and perhaps go 'well beyond the individual's quest for self-knowledge and self-improvement' (Lupton 2016:143). This perhaps would prompt the suggestion that the women are less algorithmically 'vulnerable' than I am proposing, not least because, seen here, they would have more negotiating agency.

The second way of reading these actions is less straightforward. Nafus has talked about how tracking apps encourage a process of reflection, making us 'think twice about the social relations [we] believe [our] bodies to be in' as well as the 'materials that constitute both those bodies and their ecosystems' (2016:228). And the comments above – and indeed throughout this chapter – can be read as part and parcel of such reflections. Many of the women during the project articulated concerns about self-tracking and baby-monitoring, but everyone continued to self-track on some level, and this means we have to question the power of reflection within a wider disciplinary process. In thinking about processes of disciplining (Foucault: 1977:221) or 'automata' (ibid. 136), there is something really interesting here not only about the incremental reach of productive labour or work, but also about the conscious awareness that sits alongside – sometimes unproblematically - the politics of the apps that makes them demanding. Indeed, Cheney-Lippold argues that even though algorithmic identities can never 'truly square' with our lived experiences (2017:145), they are nevertheless gaining traction in terms of decision making power, policy, normative practices and discourses. Agency or autonomy is not with the body in this scenario, but with the technological economy that reconfigures the body in its own terms.

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[i] See https://www.baby-connect.com/privacy
[ii] see http://www.fehnerssoftware.com/privacy_general.html and https://policies.google.com/privacy
[iii] see https://www.bestbeginnings.org.uk/baby-buddy
[iv] Glow is a period and ovulation tracker app. See: https://itunes.apple.com/gb/app/glow-ovulation-period-tracker/id638021335?mt=8
[v] see for example https://www.nice.org.uk/guidance/qs37/documents/postnatal-care-briefing-paper2

[vi] https://www.ouh.nhs.uk/women/maternity/postnatal/infant-feeding/documents/assessment-form.pdf
[vii] https://www.ouh.nhs.uk/women/maternity/postnatal/infant-feeding/documents/assessment-form.pdf
[viii] see for example https://www.nice.org.uk/guidance/qs37/documents/postnatal-care-briefing-paper2