Materializing

Period-tracking with apps and the (re)constitution of menstrual cycles

Victoria Andelsman

Abstract

The present article explores how cycles are brought into being through the practices and affordances involved in period-tracking with apps. Based on thirteen in-depth semi-structured interviews with period-tracking app users living in the Netherlands, it expands on literature discussing the relationship between embodiment, apps, and quantification. The contributions of this article are two-fold. Theoretically, it argues for the use of Karen Barad's notion of apparatus to understand how bodies are (re)configured in relation to self-tracking technologies (1998). Empirically, it exposes how bodies emerge in localized period-tracking practices, within material-semiotic arrangements that both resist and reproduce cultural ideals about menstruating bodies. Period-tracking with apps, this study finds, brings the body's interior processes into being in a "systematic" way, (re)configuring the cycle as either a series of phases or an interval with a certain (normative) duration. In all cases, period-tracking with apps becomes a means for users to access their internal body and to materialize the invisible processes of the cycle in ways that can be acted upon.

Keywords
Period-tracking apps, Body, Self-tracking, Material-semiotics, Apparatus

Introduction

> Before it was more just focused on, just okay having... my period is coming. That's what's going on. Whereas now it's more like the whole cycle because the period is the only part that you see with your eyes, but the rest of it... now I have more of an understanding of like the whole cycle. (Cara)

This article explores how menstrual cycles are materialized in situated practices of app-assisted period-tracking. In a time where everyday life is interwoven with (digital) media, sexual and reproductive functions are progressively experienced and configured through self-tracking technologies (Lupton, 2015). Period-tracking apps, that is, apps that map ovulation and menstrual cycles using various bodily indicators, are particularly popular within the fast-growing "femtech" market (Swain & Ugalmugle, 2019). In contrast to their popularity among users, scholarly attention to period-tracking with apps has been scant. Existing research on period-tracking apps has emphasized the technology's risks – both in terms of privacy and pregnancy – or looked into how their interfacial regimes reproduce normative portrayals of menstruating bodies (Epstein et al., 2017; Levy, 2018; Lupton, 2015). The few studies that do look into users' practices have done so in an exploratory manner, focusing primarily on users' motivations. What is missing in the existing literature is an analysis that captures the relationship between localized period-tracking practices and embodiment, exploring how menstruating bodies emerge in relation to these technologies.

The quotation that introduces this article comes from an interviewee's answer to my question on whether tracking her period has changed how she experiences her cycle and how she feels about it. Cara's answer, singling out her perceptions before and after period-tracking, points to this article's main argument: App assisted period-tracking (re)configures how participant's cycles are materialized. What changes when users start tracking is the "mattering" of cycles, from a focus on the period as the only external element of the cycle, to an understanding of the cycle as a whole process that happens mostly inside the body, inaccessible to the bare eye. Period-tracking with apps emerges here as a means for users to access the internal processes of their bodies, making them capable of being acted upon.

This article expands on literature discussing the relationship between (female) embodiment, apps, and quantification, by following app-assisted period-tracking practices that give rise to specific materializations of the cycle. Paying particular attention to how the "period in-between periods" is brought into being, the present article applies a material-semiotic approach to the study of period-tracking. This framework allows scholars to move from questions regarding the representation of periods and cycles to questions of (re)constitution (Barla, 2019). The analysis is organized around the following research question: How are cycles brought into being through the practices and affordances involved in period-tracking with apps? To answer this question, thirteen in-depth

semi-structured interviews were conducted with period-tracking app users living in the Netherlands.

In the following section, I briefly discuss what period-tracking apps are and the existing literature on them. I then apply Barad's (1998, 2007) concept of "apparatus" to look at how apps widen users' ability to scrutinize their bodies. Next, I put forward the methodological approach to then provide an analysis of the interview material. The analysis starts by discussing the before-and-after narratives of users reflecting on how period-tracking has changed how they experience their cycles. The pleasure and purpose of period-tracking with apps, this study finds, is that it brings the body's interior processes into being in a "systematic" way, (re)configuring the cycle as either a series of phases or an interval with a certain (normative) duration. Measuring and metrics, in this context, are employed in a quest to make the body accessible and transparent. The contributions of this paper are therefore two-fold. Theoretically, the article argues for the use of the notion of apparatus to understand how bodies are (re)configured in relation to self-tracking technologies. Empirically, it exposes how menstruating bodies emerge in localized period-tracking practices, within material-semiotic arrangements that both resist and reproduce cultural ideals about menstruating bodies.

Tracking menstruating bodies

Period-tracking apps are technologies that allow the observation and analysis of menstrual cycles and a wide variety of (seemingly) related factors. Most apps have four main features or screens (Levy, 2020). First, a numerical countdown indicating the number of days left until the start of the next period. Second, a screen with a menstrual calendar showing past, current, and predicted period dates. Third, menus that offer a variety of tracking categories, including physical and mental parameters as well as behavioral aspects assumed to be related to menstruation. Fourth, most apps include graphs, tables, and numerical illustrations charting users' average cycle length, period length, and other statistics for the various parameters measured.

The menstruating body has historically been construed as unruly, and thus in need of strict monitoring (Chrisler et al., 2015). Researchers studying period-tracking apps argue that these technologies participate in and (re)produce long-established discourses that construe female bodies as needing constant scrutinizing (Kressbach, 2019; Lupton, 2015). While scant, this scholarship examines the normative implications of period-tracking apps, concluding that their interfaces and marketing material reinforce binary gender roles, portray female bodies as chaotic, and make women responsible for reproduction (Lupton, 2015). As such, this research argues, period-tracking apps conform to the age-old self-tracking habits of people with periods while promising a more objective and scientific approach whereby "digital data are promoted and valued over people's own embodied knowledges of their bodies" (Lupton, 2015, p. 447).

Period-tracking apps, as self-tracking technologies, provide users with feedback through displays of basic statistics and predictions, privileging the visual and the quantifiable in communicating about the body (Lomborg & Frandsen, 2016; Lupton, 2012; Lupton & Maslen, 2018; Ruckenstein, 2014). In providing these visual aids, period-tracking apps advance the ideal of a "transparent body", that is, a body that can be totally known and acted upon – if the right tools are employed (van Dijck, 2011). Ethnographic studies exploring the relationship between self-tracking data and the experiences of users, however, have complicated the assumption that self-monitoring's appeal resides solely in the promise of objectivity and control. Instead, researchers have pointed to how data is interpreted, used, and enjoyed in the context of subjective experiences (Didžiokaitė et al., 2018; Pantzar & Ruckenstein, 2017; Sharon & Zandbergen, 2017). Regarding the motivation to "keep track", scholars find that what "hooks" users can be as simple as the act of registering information, or the ways in which logged data allows them to tell stories about themselves (Lomborg et al., 2018; Sharon & Zandbergen, 2017). By making visible aspects of people's lives and bodies that are not typically a subject of reflection, apps are valuable to users because they help "render aspects of a private, subjective and somewhat inaccessible world of feelings and problems more tangible and comparable" (Sharon & Zandbergen, 2017, p. 1705). Thus, this literature points to how app-assisted tracking becomes entangled in complex affective processes of technological and social relations that go beyond its potential for objectivity and that are experienced as pleasurable (Lomborg et al., 2018; Ruckenstein, 2015).

There is a dearth of qualitative research looking at period-tracking with apps. A notable exception is Amanda Karlsson's research on users' motivations for period-tracking. Karlsson (2019, p. 120) finds that apps serve not just as "management tools to keep track of bleeding days but also as private scopes to engage with the menstruating body". These findings point to how period-tracking may counteract some negative discourses of menstruation, such as the "menstrual concealment imperative", which requires that people with periods maintain menstrual shame, or secrecy (Wood, 2020). This article contributes to this line of research, looking at how the personal and intimate practices of menstrual tracking materialize the "whole cycle" to users themselves, allowing them to scrutinize and act upon the interior processes of their bodies.

Material semiotics, or how things come to matter

The present article explores how period-tracking with apps affects users' experiences of their cycles by employing a material-semiotics approach and focusing on practices, rather than interfaces or motivations alone (Law, 2019). Material-semiotics are a set of approaches to social analysis which understand every-*thing*, human or otherwise, as shaped in relations (Law, 2019). Reality, from this perspective, is constantly being enacted – produced, materialized, (re)configured – through practices (Law, 2010). Since every-

thing is the relational effect of practices, to understand the "mattering" of the material, researchers must look at situated practices to see how various constellations of actants emerge and act in specific situations (Barad, 1998; Law, 2010). It is through these relations that something "becomes material" because it has the ability to affect and mediate other practices.

Materiality, from this perspective, is the product of an ongoing process of becoming, through which different actors are brought together and aligned in particular ways that shape reality (Barad, 2007). Humans' own constitution is understood here as "vital materiality" (Bennett, 2010). Bodies, just like objects and facts, are not reducible to discourse, culture, or social construction; they are materialized and brought into being in material-discursive practices which mark their boundaries with other bodies and things (Barad, 2007). The production of bodies "is intimately connected to the practices, techniques and artefacts which make different bodies possible" (Blackman, 2008, p. 123). Because bodies, from this perspective, are always already technologized and "technologies are always already a part of 'us'" (Barla, 2019, p. 10), the question is not whether technology participates in the production of (human) bodies, but rather how concrete bodies and technologies materialize through their entanglements with one another.

When studying the use of period-tracking apps, measuring emerges as a key practice through which cycles are materialized. To attend to these practices, I adopt Karen Barad's notion of "apparatus" (1998) and explore period-tracking apps as technologies employed in the measurement of a body's properties. The notion of apparatus does not refer here to a bound object or device, but to specific material-semiotic configurations and open-ended practices through which bodies are relationally materialized. The boundaries of the "measured object" and the "measuring instrument" are enacted through the measuring practice itself; they co-constitute each other. The notion of apparatus therefore emphasizes that bodies are not born, but rather produced, or at least (re)configured, "in world-changing techno-scientific practices by particular collective actors in particular times and places" (Haraway, 1992, p. 297).

Thinking about period-tracking apps – and the measuring practices they take part in – along these lines exposes how apps are neither neutral tools nor structures that can determine a particular outcome (Barad, 2007; Mol et al., 2015). Instead, apps are understood here as material-semiotic phenomena constituted within diverse locally situated practices perpetually open to rearrangement (Barad, 1998). Just like any other apparatus, the measuring practices involved in period-tracking with apps do not measure an inherent property of a pre-existing entity (the cycle). Rather, the material arrangement of a specific measuring device in association with the object *produces* the object's boundaries and the parameters of the object measured. Thus, Barad's approach allows us to understand bodies and cycles as complex entanglements whose properties are the effects of their coming together with technologies, rather than pre-existing the measuring practices. Technologies, for their part, are not simply intermediaries that deliver meaning

unchanged; they are transformative nonhuman actants with the ability to guide, format, and/or alter the tracked phenomenon in situated practices that include the technology's materiality as well as other biological, political, and sociocultural forces.

The materialities of technologies themselves become important here. This can be better understood by referring to the concept of affordances, conceived in relational terms (Gibson, 2014). Borrowed from ecological psychology, the notion of affordances designates what material artefacts may allow (or constrain) people to do. They are not simply the technologies' physical features. Rather, the term affordances refers to an ongoing socio-material accomplishment: they are the properties of an object *relative* to an actor. While artefacts do not "impose themselves upon humans' actions" (Hutchby, 2001, p. 453), their materiality sets the limits of what is possible to do with them in ways that are never neutral. This is because technologies have built-in assumptions and values about the world on which they are acting upon (Bucher & Helmond, 2017). Recognizing the constraining and enabling materiality of artefacts, the notion of affordances allows us to ask: How do technologies, by taking part in particular practices, participate in reconfiguring bodies? What normativities does technology enact, and how does it affect bodily materializations?

Methodology

I carried out individual in-depth interviews in March and April 2020 with people who self-identified as period-tracking app users. While other ethnographic approaches, such as participatory observation, might be better suited for the study of day-to-day practices, the intimate nature of the doings and data recorded in period-tracking made it impossible to employ such methods. To minimize interviews' limitations when looking at practices, I combined an open-ended approach to interviewing with an adaptation of the walkthrough method and a media go-along with users (Jørgensen, 2016; Light et al., 2016). This strategy, by jointly navigating the app's features and discussing their use, provided me with insight into how individuals engage with a particular app in their daily life, exploring various use scenarios as well as the ways that participants respond to the media.

Following institutional ethics approval, I recruited participants through several Facebook groups to ensure variation in the resulting sample in terms of the apps used and users' ages and backgrounds. The post inviting people to participate in the study requested anyone interested to fill out a short survey and contact the primary researcher if they were interested in being interviewed. While this self-initiated sampling strategy was preferred due to ethical concerns, it is not without limitations. In particular, the recruitment strategy potentially excluded younger period-tracking app users who may not be on Facebook, as well as people who are less comfortable talking about their menstrual cycles and who would therefore not easily volunteer to participate. But, insofar as the goal of qualitative research is not to universalize the research findings, user accounts allow me

to widen our understanding of digital period-tracking practices and of how menstruating bodies emerge in relation to technologies.

I recruited 13 participants, all of whom gave written informed consent. Participants' ages ranged between 24 and 38. While attentive to issues of diversity in the analysis, users' age, sexuality, and cultural background were not significant in the current analysis. Regarding the apps used, Clue was the most popular one, with 6 participants using it. Of the other seven participants, two used My Calendar, and the rest used either Monthly Cycles, Period Tracker, Flo, Natural Cycles, or FitrWoman. Before each interview, I conducted an exploratory walkthrough of the interviewee's app to be acquainted with the interface.

Due to the Covid-19 crisis, only three of the interviews were conducted face-to-face, and the rest were conducted online via videoconferencing software. The interviews took between 35 and 80 minutes, lasting an average of 55 minutes. I recorded and transcribed the interviews; the transcripts and any other data were anonymized, and all the names used in this article are pseudonyms. My interview guide had two main stages. The first stage consisted of open-ended questions about the participant's use of period-tracking apps. In the second stage, participants were invited to access their app and go through it with the researcher. This portion of the interview – based on an adaptation of a media go-along and the walkthrough method – addressed users' everyday engagement and practices with the apps, focusing on the apps' materiality and affordances (Jørgensen, 2016; Light et al., 2016).

Following Lupton and Maslen (2018), transcripts were analyzed using an interpretive thematic analysis informed by a material-semiotic perspective on self-tracking. To do so, I read through the transcripts repeatedly, drawing on the theoretical literature to pinpoint the relational connections, practices, and affordances that emerged. The research design was, from the outset, informed by Karen Barad's agential realism. The concept of apparatus, however, became significant during the analysis stage, when conceptualizing the relation between digital technologies and the materialization of the menstruating body. Throughout the interpretative process, events, actions, practices, and feelings were grouped and turned into categories to discover how the relations between human and technology shaped the materialization of cycles. What stood out were the different temporalities of cycles that emerged through app-assisted period-tracking, and the themes of systematicity, phases, and intervals, which are discussed in the next sections.

Not just a period

The simplest way to track a cycle using a period-tracking app is to log in the dates when the period occurs. Florencia, for instance, a Clue user, describes her use of the app in the following way: "I realize I am having my period, and I say, 'ah, since I have the phone with me…' I open Clue and I fill it in. It takes two seconds, I just do tic, tic, tic". While users

receive more complex data the more indicators they track, users who only input the date when they are bleeding still get information about their average cycle length and predictions about when their future period might take place. In other words, data is processed and aggregated, coupling different datapoints into analysis and predictions that are fed back to users. Hence, even with minimal engagement, the apps act not as record-keeping intermediaries, but as nonhuman mediators that take a simple piece of information – users' period date – and transform its meaning by producing visualizations, averages, and associations.

Users' reflections demonstrate that period-tracking materializes the cycle as more than "just a period", as Joyce would put it. Just like Cara, in the quotation that introduces this article, most interviewees felt that using a period-tracking app had changed the way they experienced their cycles, making visible "the periods that are in between" periods, as Elena calls them. Talking about the app in the interview, Hannah explained, made her realize "the impact that it had without even me noticing that it was happening". She does not know when "the switch happened" but "before all the different information that I've gotten from the app, I looked at my period like something that just happened". That is, in the context of the interview, Hannah realized how her understanding of the cycle had shifted since using the app. Instead of the period being something that happens or is "coming out of nowhere", app-assisted period-tracking makes users aware of their cycle and helps them be more "in touch with kind of what's happening" (Agne).

Period-tracking with apps was portrayed by users as making cycles more "systematic" or "organized" (Florencia), and the practices involved in doing it were described by Jori as giving "a bit of consistency to my life". Monitoring makes the hidden processes of the cycle, if not comprehensible, at least perceptible to users. If you do not track your period, Florencia explains, "it is easier to see it as something more random". Similar to a calendar, she explains, apps give users a "material record". Their visualizations and affordances, however, make the systematicity of cycles even more evident than a calendar: "in the app you even see it more clearly because you see the whole little circle, and that little circle repeats itself every month" (Florencia). Even when looking at the calendar function of apps, participants perceive a difference, because while in a traditional calendar, users have to "go back and count", the apps' calendar both marks past periods and predicts the next cycle (Surya). It is through these visual patterns, which make the inner rhythms and temporal structures of the body accessible to users, that cycles as a whole materialize as a process that has – at least – a beginning and an ending and that is repeated every month or so.

Indeed, the apps' interfaces were praised by users for giving them an "overview" (Elena) and allowing them to "see at one glance" (Blake) where in the cycle they were. Jori, speaking of Clue, explained: "I just like the... face... facing... the interface of that and how it shows you like where you *are* in your cycle and if you are at the beginning or midway or almost done". These visual representations are not limited to pre-determined stages of

the cycle. What some users call "symptoms" may also be visualized and color-coded in the apps' illustration of the cycle, as Blake explains:

> When you track a symptom on a specific day you get a little square in that colour that shows up on the circle. That helps you see that particular symptoms are more frequent in a particular phase and then, if you've been using the app for a while, you can analyze a specific symptom and you get an overview of all of your cycles and where on your cycle you had… you tracked that symptom the most.

What constitutes a sign of an upcoming period is therefore informed by the patterns found by previous app use, corresponding to past bodily experiences. For long-time users, Blake explains, "it is really easy to see like, 'oh I get headaches before my period starts'". Since their cycle is not regular, Blake uses this information "to always kind of know where I am in my menstrual cycle". The relation between body sensations and the app is here one of co-constitution, where users' inputs shape the app's information and the connections it draws, as found in previous research on other forms of self-tracking (Kristensen & Ruckenstein, 2018). In this process, the app's affordances suggest what sensations may be seen as "symptoms", but what is relevant can only be found by users' attentive and persistent tracking and the patterns that emerge from them, which are then materialized in the app's visualizations.

Thus, apps do not just represent cycles to users, but participate in re-configuring the experience of them. Users described how using an app to monitor their cycle has changed how they feel about their bodies: "the app has helped me understand, more medically why certain things are happening, during certain times, and like how can I address them in ways that are more positive" (Hannah). Inner workings hidden to the untrained eye can therefore be unearthed through tracking and acted upon. Period-tracking apps, therefore, widen human sight's capabilities – what Cara calls "seeing with your eyes" – just like (medical) technologies have done in the past. In doing so, instead of encouraging menstrual concealment, period-tracking with apps advances an ideal of a transparent body where the human body is conceived as completely knowable, if the right tools are employed (van Dijck, 2011; Wood, 2020).

The pleasure and purpose of using a period-tracking app, then, has to do with the fact that it brings the cycle into being in some "systematic" way. It materializes the invisible and seemingly immaterial processes of the body, "what escapes everyday perceptions", as Pols and colleagues (2019) put it, to oneself through practices that require users to measure, making sense of, and making sense with, digital data. Blake, for example, describes how using a period tracker "helps me make sense of things that are happening, and it also shows me… It has shown me that a lot of things that are happening to my body have a reason for happening". Measuring has materialized aspects of Blake's embodiment which used to be inaccessible, such as "hormone levels", and allows Blake to see patterns in the inner workings of their body, even when their period is irregular. Some participants also

claimed that using a period tracker has allowed them to identify their ovulation. Lisa, for example, explained that she started tracking because she wanted to know the "exact rhythm of it [the cycle]". By tracking, she was able to experience the cycle as a whole, including noticing "when I'm fertile". "Now I actually do feel something when like an egg is actually coming out. I feel like a little bit of pain", she clarified. Sam, for her part, explains that using her app has enabled her to perceive changes in sexual drive, which she correlates with a particular phase of her cycle – ovulation – by checking the app's predictions. These findings on the learning and sensing processes involved in period-tracking with apps are in line with previous research on self-tracking (Fotopoulou & O'Riordan, 2017; Lupton & Maslen, 2018; Ruckenstein, 2014). However, when thinking of materialization, these examples emphasize how the apps' affordances intra-act and align with users and their bodies in ways that shape the reality of cycles for users themselves. The allure of tracking – as previous research has discussed – does not stem from technology's perceived objectivity (Sharon & Zandbergen, 2017). Indeed, users, such as Eva and Blake, claim to trust the data only because they have entered it themselves. Rather, it is the ability to convert users' inner processes and behaviors into traceable and actionable evidence that is valued by users (Ruckenstein, 2015).

Through period-tracking with apps, user accounts demonstrate, cycles are systematized in two main ways, which relate to two different temporal sequencings: as either a series of phases or as an interval. The ways in which cycles are materialized are informed by the relational connections between users and the apps' affordances. As we shall see, when cycles are materialized as a sequence of phases, the body emerges as "working" with multiple actants to reach the following stage, and each phase is correlated with specific sociability and performance levels. When cycles are instead (re)configured as intervals, apps serve to visualize the duration of the gap between periods. In both cases, however, what users gain from period-tracking is the materialization of their cycle in a more "systematic" way that allows them to take action.

Sequence of phases

When going through her app with me, Cara excitedly says: "Oh, I forgot to show you… This is one of the best bits!" The phone displays a graph which, Cara tells me, charts a full month of temperatures she has input on her app, Natural Cycles. It shows how every cycle "follows the same pattern every time", going up or down depending on which phase of the cycle you are in. Using this chart, Cara says, "I know exactly when I had my period and what my body is *trying to do* on its way to the next part". Here, cycles are materialized as following a knowable pattern, comprised of a continuous sequence of phases. These phases include not only menstruation and ovulation, but also the follicular phase – where, according to Natural Cycles, "your temperature is low and your body experiences an increase in both estrogen and the follicle-stimulating hormone" – and the luteal phase – where "oestrogen and progesterone start to rise and remain high", according to another

app, FitrWoman. In these descriptions, and throughout my conversation with users such as Cara, Blake, and Hannah, different actors and elements are brought together to be in play. Follicles, temperatures, ovulation, and hormones are all invisible actors that affect each other, "working", as Cara puts it, towards the next cycle phase.

The previously inaccessible hormonal changes happening inside users' bodies are charted by the apps' interfaces and correlated with certain energy, productivity, and sociability levels. Tracking, users contend, gives them a "better appreciation for their body", because they understand why certain things happen "and what your body is like going through and the capabilities that it's enabling you" (Hannah). While before tracking they thought of their cycle only in terms of their period, some users now experience their cycle as subdivided into different phases with a particular "physiology" that can be chan-neled in productive ways. Indeed, apps like Natural Cycles and FitrWoman, and to a lesser extent Clue, recommend particular behaviors at different times of the cycle, which some participants tried to implement. Cara, for example, explains that at the NGO where she works, she and her co-workers are using these apps to see how the different phases of the cycle may affect their ability to "work most productively". Similarly, Hannah now tries to attune her diet and exercise routine to the app's recommendations for each phase.

Here, cycles are materialized as a sequence of phases not only through the app's dis-course and interfacial regimes, but also through the material practices and relations that they encourage and demand. Hannah's understanding and use of the information her app gives her illustrates this point. The app provides her with information about "where your hormone levels are", which must then be put to work by engaging in practices that "best keep that balance". Not all users, however, choose to engage in these self-optimizing practices. Eva, for instance, said that her friends had recommended to her a book about "using your cycle for the better and when to plan this and when to plan that… and I was like, fuck, I don't want to be dictated by this". Even when presented with the possibil-ity of self-optimizing, then, users may be skeptical of engaging in such practices. Apps appear here as one of many "entangled material agencies" (Barad, 2007, p. 56), including users' friends, books, and their understandings of what it means to "use your cycle for the better", which, in Eva's case, is equated to being "dictated" to by her hormonal (im) balances. Interestingly, what deters Eva from engaging in self-optimization is not that she does not believe that hormonal changes may affect her sociability or her performance, it is that she does not want to be a "victim of my cycle", as she puts it. Hence, while it is not possible to further explore this tension here, it is important to note that self-optimization is experienced by Eva as a possibility, but that she prefers not to engage in it.

Intervals

Not all human–app assemblages support the materialization of cycles as divided into phases. Instead, many of the participants' accounts configure that time as an "interval" defined by how many days there are between one period and the next. The material

practices and relations that enact cycles in such a way are different from those involved in the materialization of cycles as sequences of phases. Here, the most important task is to annotate period dates. As argued above, while input here is minimal, the app still transforms users' "taps" into complex data, particularly averages and visualizations. As Surya puts it, her app's interface is simple, but has "a big calendar" she consults to know how long it has been since her last period: "you are like, okay it makes sense, *it is far apart enough*". This comment points to how numbers are seen as normative (Pols et al., 2019). The measuring of periods, to be of any significance, has to be accompanied by standards or target levels that give meaning to the data collected by the user. This target, in most cases, was defined as having intervals of roughly the same length as either a personal average or the average value suggested by the app. As Joyce puts it: "I just want to see the intervals and if it is not on my average interval, I get to check myself". This interpretation is echoed by several participants who use different apps. Elena, Lisa, Eva, Surya, and Vanessa all suggested that, in one way or another, the information provided by the app about the duration of their cycles allowed them to know "if I'm fine or not", as Elena puts it. That is, cycle duration (and its constancy) was understood by participants as a sign of the inner workings of the body: One is fine if the interval in between periods is around one month, every month; otherwise, something "inside" is wrong.

Importantly, the human–app apparatus not only performs cycles in a certain way, but also *produces* the standards against which participants measure themselves. In other words, the practices involved in period-tracking with apps both produce the cycles as intervals and establish a threshold of what good and bad interval values are. This does not mean that apps in and of themselves push users to measure themselves against an average they provide. The technical affordances of period-tracking apps participate in configuring target levels, but so do users' biographies, previous experiences, and socio-cultural backgrounds. In some cases, for instance, target values are defined by information acquired outside the app, like in the case of Elena, who had previously read that the length of a regular cycle was "between 28 and 35" days. Joyce, in contrast, is happy to have a regular cycle, which for her means "27 or 25 days only" because that is the average duration of her cycle as calculated by the app. Thus, attention to the apparatus illuminates how the different target levels do not precede the apparatus but are instead materialized via the practices involved in period-tracking.

When cycles are materialized as intervals, app-assisted period-tracking construes irregular cycles – that is, intervals which continually fall outside average ranges – as deviant. Falling into the "right" values, however defined, is therefore seen by users as an achievement and source of joy, while being unable to achieve the target values produces worry. Using an app to track her cycle, for instance, makes Joyce feel more positive about her period, "since I am still on track, I still meet the average, it means that 'Oh, you're doing great'". The flip side of this is that because tracking periods makes irregularities detectable and readable as a sign that something is wrong with the inner workings of the body, using

the app can elicit negative emotions. Elena was particularly upset not to be "regular", constantly referring to her cycle as abnormal, even after consulting with a doctor who had assured her she was healthy.

The production of irregular cycles as deviant is partly the effect of the apps' material arrangements. Having an irregular period not only affects users emotionally; it also interferes with the apps' predictions. Vanessa, for instance, says she has very irregular cycles due to polycystic ovary syndrome. She "wishes" that she could use the app's predictions, but she cannot, because "the data I put, again, is erratic". Despite the apps' claims of personalization, then, their material arrangements both facilitate and are conditioned by sociocultural discourses reinforcing the notion that to be healthy, one's body should function as the average. While she cannot use the predictions, Vanessa still tracks to visualize the variability of the gaps between periods, which serve as proof that she needs medical help. Hence, the information provided by tracking irregular periods is understood here as meaningful and useful, to the lay user as an indicator that something is wrong "inside", and to the doctor as part of the diagnosis.

Discussion

App-assisted period-tracking materializes seemingly invisible, untraceable aspects of one's cycle to the user. Measuring practices, in this context, bring the cycle into being in a more systematic way, as something temporally structured in either a sequence of phases or an interval. Apps act here as mediators that widen users' ability to scrutinize their bodies in the hope that they can do something with the information. This is because, in Baradian terms, the identification of these temporal sequences shapes the material-semiotic field of possibilities, enabling certain relations and practices and not others (Barad, 2007). Data about the body thus carries the promise of actionable knowledge; the ability to seek medical attention or to "cycle-sync" a workout relies on the materialization of cycles as something recurrent, and of the body as having invisible but knowable inner workings that can be modified or exploited in positive ways.

This article offers both empirical and theoretical contributions to the study of self-tracking in general and menstrual tracking specifically. As a theoretical contribution, it puts forward the notion of apparatus to think about the complex and dynamic entanglements of bodies and technologies and how we may methodologically grasp bodily materializations (Barla, 2019). Applied to self-tracking, the notion of apparatus exposes how technologies participate in material-semiotic practices whereby bodies are "performatively enacted" (Barla, 2019, p. 152). Rather than thinking that measuring and other practices involved in digital period-tracking *"present people with facts* [emphasis added]" about their bodies, the argument here is that menstrual tracking *materializes* the bodies of people with periods in particular ways (Pols et al., 2019, p. 109). That is, it is not only the knowledge about the body that changes through situated period-tracking practices: It is

the body itself, and how it is experienced, that is re-constituted. Furthermore, because it is only through particular material-semiotic practices that certain bodily boundaries and properties manifest, this approach requires that we study self-tracking situatedly, noticing the intimate entanglement of people and things. This enables us to emphasize technologies' materiality while retaining attention to other forces – social, cultural, political, and biological, like in the case of people with irregular periods – that participate in the process of bodily (re)constitution. This connects to the empirical contribution of this article, which, by employing a qualitative approach, exposes *how* period-tracking with apps shapes the reality of cycles for users themselves, making the inner rhythms and temporal structures of the body accessible.

Different apparatuses enact cycles in different ways. The use of charts and practices that correlate different times of the period with different sociability and performance levels produce cycles as sequential phases. Calendar functions and a focus on the time between periods, for their part, produce cycles as intervals and inconsistent intervals as deviant. In our conversations, participants commended the apps' interfaces for allowing them to "see at one glance" their whole cycle (Blake). Even for users who barely engaged with their period tracker once a month to input their period dates, the apps behaved as mediators that took this unassuming piece of information and transformed its meaning by producing visualizations, averages, and predictions. These outputs, and the practices they support, helped (re)configure the cycle as something that has an expected length, and which repeats itself over time. But to say that the specific material-semiotic configurations involved in period-tracking with apps materialize bodies in different ways requires looking beyond the technology's interface. The realities that are brought into being are the effects of the coming together of bodies, technologies, cultural expectations of menstruating bodies, users' biographies, and everyday lives (Lupton, 2019). Apps' affordances themselves are contingent and situated, made present under specific circumstances and through users' particular modes of engagement, as the example of Blake's color-coded symptoms reflects (Bloomfield et al., 2010). Only under certain conditions of use – long-time and intense use – does the ability to correlate certain symptoms with stages of the menstrual cycle emerge for people with irregular periods. Here, the users' avid tracking shapes the information they can obtain from the app, and these affordances are not available to all trackers. Thus, cycles are brought into being in human–app relations where period-tracking apps are one of many material-semiotic phenomena (Barad, 1998; Lupton, 2019).

The pleasure and purpose of period-tracking with apps, this study finds, is that it brings the body's interior processes into being in a "systematic" way, (re)configuring the cycle as either a series of phases or an interval with a certain (normative) duration. While existing research on period-tracking apps has highlighted that the rhetoric promoting digital period-tracking and the content of the apps themselves emphasize the technology's accuracy over users' bodily sensations, objectivity did not emerge as an important

factor in my interviews. Users claimed to trust the apps' data because they input it themselves, and, when apps failed to make predictions, they were excused by users who explained that the apps could only be as accurate (or erratic) as the information entered. This finding is in line with, and expands on, existing qualitative research looking at other types of tracking, which argues that monitoring's value is only marginally connected to the promise of objectivity and optimization (Didžiokaitė et al., 2018; Lomborg et al., 2018; Sharon & Zandbergen, 2017). The pleasure of period-tracking did not stem from the apps' perceived neutrality or accuracy, but rather, from its visualizing capacities and their ability to provide users with an "overview" (Elena, Blake) or a "material record", as Florencia put it. Contrary to the social expectation to render menses and the cycle invisible, this article finds that period-tracking with apps directs users' attention to the interior of their (menstruating) bodies and gives an external existence or form to the cycle. What "hooked" users was the ability to render tangible and comparable previously inaccessible aspects of the menstruating body, which is in line with Karlsson's (2019) finding that users experienced period-tracking as a way of reclaiming stigmatized bodies.

Yet, the enabling and constraining forces that emerge in app-assisted period-tracking have built-in normativities, supporting particular enactments of what constitutes a "normal" menstruating body. In line with previous research, this paper demonstrates how the themes of visibility and "normality" play out in relation to period-tracking analytics (Lupton, 2015). Period-tracking apps widen human sight's capabilities just like (medical) technologies have done in the past, advancing an ideal of a transparent body, where the human body is conceived as totally knowable if the right instruments are employed (van Dijck, 2011). The measuring practices of users and the way participants engaged with visualized data shows how period-tracking with apps participates in a "history of conquering previously unexplored areas" of the body by making physiological processes and behavior available for mapping (Ruckenstein, 2014, p. 69). This focus on visibility is sometimes associated with ideas of self-optimization, especially for those users who hoped to use the information about their cycle phases in "positive" ways.

Moreover, when faced with "bad numbers", users became upset not simply because the body does not behave in predictable ways, but also because consistency was understood as normative. Being healthy was equated with having a regular period that fell into "the average" interval, defined as either a population average or a personal average accessible through tracking. While based on an inference of what is happening inside the body, this (normative) materialization of the cycle nevertheless brings the interior of the body into the world of actionable practices, by, if anything, encouraging users to seek medical attention if the period is not average. These findings, therefore, add to previous research that argues that these technologies extend a medicalizing gaze and point to how technologies may further the pathologization of menstruating bodies (Lupton, 2012, 2015).

While previous research has understood the themes of normativity and transparency in terms of representation, a material-semiotic approach showcases how user cycles

are (re)constituted and experienced differently after tracking. This is because, from this perspective, the cycle is not a pre-existing object with inherent properties – it is a phenomenon produced by historically and culturally situated apparatuses, which may include technologies such as period-tracking apps. Digital period-tracking is here understood as a set of material-semiotic practices that constrain what is seen and materialized in accordance with its development and technology's situated usage (Barad, 1998). Consequently, this approach allows researchers to theorize bodies as open and in flux, while acknowledging how "bodies are made intelligible and therefore potentially lived and enacted across cultural sites and practices" (Blackman, 2008, p. 94). Period-tracking apps, for their part, are not "passive observing instruments" (Barad, 1998, p. 98). They are part of a productive apparatus that makes cycles intelligible in particular ways, which both perpetuate and are partly conditioned by cultural ideals of the (menstruating) body.

Conclusion

Cara's quotation at the start of this article illustrates how period-tracking reshapes users' experiences of menstruating bodies, materializing "the whole cycle" beyond what one, as a person with periods, can "see with your eyes". It is through their coming together with technologies, as well as other material-semiotic factors, that cycles "become material" in particular ways that enable them to affect and mediate other practices. Digital period-tracking gives an external existence to the "invisible" inner processes of the body, allowing users to engage with their menstruating bodies and their rhythms. This may serve to counteract the "menstrual concealment imperative", which requires that people with periods detach themselves from their bodies. However, other cultural expectations of menstruating bodies are reinforced through tracking, as users' accounts of tracking as a way to "check myself" and the construction of irregular cycles as deviant reveal.

As the "FemTech" market continues to grow, scholars studying self-tracking need to develop material approaches to (female) embodiment that reject "both the picture of the body as a mere object upon [which] powerful technologies act as well as the idea of technologies as mere artifacts or systems that would only interact with our bodies" (Barla, 2019, p. 184). In this context, the notion of apparatus helps us understand the body as the material-semiotic effect of multiple forces, encouraging us to look at situated practices to tease out the entanglement of technologies, bodies, and other material-semiotic arrangements. This article is a step in that direction, attending to the material affordances of period-tracking technologies while being careful not to dismiss how people's biographies (and biologies) may affect what they can and cannot do, and how their bodies are materialized.

References

Barad, K. (1998). Getting real: Technoscientific practices and the materialization of reality. *Differences: A Journal of Feminist Cultural Studies*, *10*(2), 88–128.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Duke University Press.

Barla, J. (2019). *The techno-apparatus of bodily production: A new materialist theory of technology and the body*. transcript Verlag.

Bennett, J. (2010). *Vibrant matter: A political ecology of things*. Duke University Press.

Blackman, L. (2008). *The body: The key concepts*. Routledge.

Bloomfield, B. P., Latham, Y., & Vurdubakis, T. (2010). Bodies, technologies and action possibilities: When is an affordance? *Sociology*, *44*(3), 415–433. https://doi.org/10.1177/0038038510362469

Bucher, T., & Helmond, A. (2017). The affordances of social media platforms. In J. Burgess, A. Marwick, & T. Poell (Eds.), *The SAGE handbook of social media* (pp. 233–253). http://dx.doi.org/10.4135/9781473984066.n14

Chrisler, J. C., Marván, M. L., Gorman, J. A., & Rossini, M. (2015). Body appreciation and attitudes toward menstruation. *Body Image*, *12*, 78–81. https://doi.org/10.1016/j.bodyim.2014.10.003

Didžiokaitė, G., Saukko, P., & Greiffenhagen, C. (2018). The mundane experience of everyday calorie trackers: Beyond the metaphor of quantified self. *New Media & Society*, *20*(4), 1470–1487. https://doi.org/10.1177/1461444817698478

Epstein, D. A., Lee, N. B., Kang, J. H., Agapie, E., Schroeder, J., Pina, L. R., Fogarty, J., Kientz, J. A., & Munson, S. (2017). Examining menstrual tracking to inform the design of personal informatics tools. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 6876–6888. https://doi.org/10.1145/3025453.3025635

Fotopoulou, A., & O'Riordan, K. (2017). Training to self-care: Fitness tracking, biopedagogy and the healthy consumer. *Health Sociology Review*, *26*(1), 54–68. https://doi.org/10.1080/14461242.2016.1184582

Gibson, J. J. (2014). *The ecological approach to visual perception: Classic edition*. Psychology Press.

Haraway, D. J. (1991). The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others. In L. Grossberg, C. Nelson, & P. A. Treichler (Eds.), *Cultural Studies* (1st ed., pp. 295–336). London: Routledge. https://doi.org/10.4324/9780203699140

Hutchby, I. (2001). Technologies, texts and affordances. *Sociology*, *35*(2), 441-456. https://doi.org/10.1177/S0038038501000219

Jørgensen, K. M. (2016). The media go-along: Researching mobilities with media at hand. *MedieKultur: Journal of Media and Communication Research*, *32*(60), 32–49. https://doi.org/10.7146/mediekultur.v32i60.22429

Karlsson, A. (2019). A room of one's own? Using period trackers to escape menstrual stigma. *Nordicom Review*, *40*(S1), 111–123. https://doi.org/10.2478/nor-2019-0017

Kressbach, M. (2019). Period hacks: Menstruating in the big data paradigm. *Television & New Media*, *22*(3), 241–261. https://doi.org/10.1177/1527476419886389

Kristensen, D. B., & Ruckenstein, M. (2018). Co-evolving with self-tracking technologies. *New Media & Society*, *20*(10), 3624–3640. https://doi.org/10.1177/1461444818755650

Law, J. (2010). The materials of STS. In D. Hicks, & M. C. Beaudry (Eds.), *The Oxford handbook of material culture studies* (pp. 173–188). Oxford Handbooks Online. https://doi.org/10.1093/oxfordhb/9780199218714.001.0001

Law, J. (2019). *Material semiotics*. Sámi University of Applied Sciences. http://www.heterogeneities.net/publications/Law2019MaterialSemiotics.pdf

Levy, J. (2018). "It's your period and therefore it has to be pink and you are a girl": Users' experiences of (de-) gendered menstrual app design. *Proceedings of the 4th Conference on Gender & IT*, 63–65. https://doi.org/10.1145/3196839.3196850

Levy, J. (2020). *In_equalities, digitized: Practices, experiences and consequences of app-supported menstrual tracking*. Universidad de Granada. https://digibug.ugr.es/handle/10481/59386

Light, B., Burgess, J., & Duguay, S. (2016). The walkthrough method: An approach to the study of apps. *New Media & Society*, *20*(3), 881–900. https://doi.org/10.1177/1461444816675438

Lomborg, S., & Frandsen, K. (2016). Self-tracking as communication. *Information, Communication & Society*, *19*(7), 1015–1027. https://doi.org/10.1080/1369118X.2015.1067710

Lomborg, S., Thylstrup, N. B., & Schwartz, J. (2018). The temporal flows of self-tracking: Checking in, moving on, staying hooked. *New Media & Society*, *20*(12), 4590–4607. https://doi.org/10.1177/1461444818778542

Lupton, D. (2012). *Medicine as culture: Illness, Disease and the body*. Sage. http://dx.doi.org/10.4135/9781446254530

Lupton, D. (2015). Quantified sex: A critical analysis of sexual and reproductive self-tracking using apps. *Culture, Health & Sexuality*, *17*(4), 440–453. https://doi.org/10.1080/13691058.2014.920528

Lupton, D. (2019). The thing-power of the human-app health assemblage: Thinking with vital materialism. *Social Theory & Health*, *17*(2), 125–139. https://doi.org/10.1057/s41285-019-00096-y

Lupton, D., & Maslen, S. (2018). The more-than-human sensorium: Sensory engagements with digital self-tracking technologies. *The Senses and Society*, *13*(2), 190–202. https://doi.org/10.1080/17458927.2018.1480177

Mol, A., Moser, I., & Pols, J. (2015). *Care in practice: On tinkering in clinics, homes and farms*. transcript Verlag.

Pantzar, M., & Ruckenstein, M. (2017). Living the metrics: Self-tracking and situated objectivity. *DIGITAL HEALTH*, 3, 1–10. https://doi.org/10.1177/2055207617712590

Pols, J., Willems, D., & Aanestad, M. (2019). Making sense with numbers: Unravelling ethico-psychological subjects in practices of self-quantification. *Sociology of Health & Illness*, *41*(S1), 98–115. https://doi.org/10.1111/1467-9566.12894

Ruckenstein, M. (2014). Visualized and interacted life: Personal analytics and engagements with data doubles. *Societies*, *4*(1), 68–84. https://doi.org/10.3390/soc4010068

Ruckenstein, M. (2015). Uncovering everyday rhythms and patterns: Food tracking and new forms of visibility and temporality in health care. In L. Botin, P. Bertelsen, & C. Nøhr (Eds.), *Studies in health technology and informatics* (pp. 28–40). IOS Press. https://doi.org/10.3233/978-1-61499-560-9-28

Sharon, T., & Zandbergen, D. (2017). From data fetishism to quantifying selves: Self-tracking practices and the other values of data. *New Media & Society*, *19*(11), 1695–1709. https://doi.org/10.1177/1461444816636090

Swain, R., & Ugalmugle, S. (2019, December 3). *Femtech market value to cross $48.5 billion by 2025: Global Market Insights, Inc.* GlobeNewswire News Room. http://www.globenewswire.com/news-release/2019/12/03/1955226/0/en/Femtech-Market-value-to-cross-48-5-billion-by-2025-Global-Market-Insights-Inc.html

van Dijck, J. (2011). *The transparent body: A cultural analysis of medical imaging*. University of Washington Press.

Wood, J. M. (2020). (In)visible bleeding: The menstrual concealment imperative. In C. Bobel, I. T. Winkler, B. Fahs, K. A. Hasson, E. A. Kissling, & T.-A. Roberts (Eds.), *The Palgrave handbook of critical menstruation studies* (pp. 319–336). Palgrave Macmillan. https://doi.org/10.1007/978-981-15-0614-7_25

Victoria Andelsman
Ph.D. fellow
Department of Communication
University of Copenhagen
vaa@hum.ku.dk