Multiples Over Models: Interrogating the Past and Collectively Reimagining the Future of Menstrual Sensemaking

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In this article, we describe our efforts to retrace and reimagine period tracking technology—or, mobile applications designed to support the documentation and quantification of menstrual cycle data. In their current form, these systems often encourage those who menstruate to extract intimate information about the body (e.g., consistency or color of menstrual flow, physical and emotional symptoms), while promising to predict fertility and offer insight into managing one's period. In doing so, these technologies subtly dictate the forms of knowledge and types of relationships menstruators are expected to establish with their bodies (i.e., transactional or instrumentalized). Through historical analysis and a series of participatory experiments, we offer a vision for menstrual sensemaking that expands on these forms of interaction and ways of knowing to emphasize *multiplicity* and *dimensionality* rather than models, predictability, or a user's relation to averages or norms.

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1 INTRODUCTION

In early 2018, the team behind the popular menstrual tracking application (hereafter referred to as *app*) Clue issued a statement. They would be making changes to the icons they used for recording sexual activity [14]. In recent years, the company had gained prominence on the market by

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emphasizing their use of “science” and a wide array of collected data to derive patterns in users’ cycles [97]. Prior to the announcement, the app featured two symbols of a man lounging (*a la* Burt Reynolds’ 1972 *Cosmopolitan* centerfold), one sporting a tie and the other not. According to the developers, these were meant to be humorous representations of protected and unprotected sex, but an appeal from users prompted the app makers to explore non-gendered terminology and a shift in iconography. In the next iteration, images of a flip-flop sandal and rain boot would replace the men—a move described as a reparative to “sexist and heteronormative” imagery [14]. Though the data-driven nature of the platform did not drive the imagery, this brief episode shows just how easily gendered understandings of the body and sexuality can figure into the design of a system shrouded in scientism. It is also a story about how that codification can be reordered or undone through the application of public pressure.

This article is about efforts to retrace and reimagine menstrual tracking technology—or, mobile apps designed to support the documentation and quantification of menstrual cycle data. In their current formation, these technologies encourage those who menstruate to extract intimate information about the body. Users of these applications are commonly asked to record menstrual cycle start and end dates, consistency or color of menstrual flow, physical and emotional symptoms, and details of sexual behavior. In return, apps regularly promise to predict the beginning and duration of one’s next cycle, “fertile days,” and offer insight into managing one’s period (e.g., tips on forms of self-care and material preparedness through the carry of pads). In examining menstrual tracking technology, we take up archival analysis and modes of design inquiry to open up the ways in which apps inscribe particular visions of what the body is capable of and how one is enrolled to make sense of menstruation. We explore how these technologies could exist differently, in ways that might encourage self-knowledge and affirm and support the needs of different kinds of menstruating bodies (i.e., beyond a fertility or contraceptive focus that occupies many apps on the market). Toward the aim of reimagining, we identify expanded forms of monitoring menses, ones that might emphasize *multiplicity* reflective of people’s actions and identities—over the models that come with algorithmic ways of knowing—and *dimensionality*, rather than a user’s relation to averages or norms. In doing so, we offer two key contributions to the HCI community. First, connecting modes of tracking with individual forms of self-knowledge may help researchers develop systems that reflect a range of concerns that reach beyond fertility or contraception. Second, our ongoing participatory activities extended the scope of our study, enabling collaborations that cut across communities and opened up our research to those limited by any one particular method of engagement.

We begin this article by charting recent engagement with issues of reproductive and menstrual health within and alongside the HCI community. Building on these perspectives, we next examine histories of menstrual tracking and explore how this under-interrogated form of record-keeping about the body has evolved to serve people differently through contemporary apps and wearable devices. Next, we describe our own efforts to take up collaborative techniques of design research in order to invite members of the menstruating public to reimagine these tracking technologies to better serve their own goals of sensemaking. We end by outlining expanded qualities of interaction around menstrual tracking and other forms of intimate sensing.

2 RELATED WORK

We first turn to a backdrop of research and design activity within and just outside the space of menstrual tracking that both animates and motivates our discussion. In particular, we draw from two key streams of work on the treatment of gender within the design of digital systems, as well as critical approaches to self-tracking technologies and the surveillance infrastructure they support.

2.1 Moving Beyond the “User Is Everybody”

Over the past couple of decades, design researchers have given increasing attention to the role of gender in studies of technology development and use, offering a lens through which to understand and contend with a masculinist culture that pervades computing domains. Oudshoorn et al. [68], for instance, describe how the goal of designing for “all users” can overwhelm developers and lead to a reliance on the “I-methodology,” or the use of one’s own personal experience to guide design decision making. In the cases Oudshoorn and colleagues outline, development teams setting out to “design for everyone,” instead created systems serving young, technically inclined men (reflective of the members of the team), reinforcing status quo relationships to technology. The authors argue that by identifying potential roots for (intentional or unintentional) exclusionary design we may turn attention to the potential for change.

Looking to upend exclusions, recent scholarship within HCI attends explicitly to concerns of intersectionality—or, the ways structures of dominance such as sexism, racism, ableism, classism, homophobia, transphobia, and xenophobia interact and compound to create unique conditions of oppression and discrimination [74]. Drawing on the work of legal scholar Kimberlé Crenshaw [19] and a generation of black feminist activism and scholarship [15, 16, 44, 58], this work highlights analyses offering nuanced treatments of identity that reveal social inequities and discrepancies in access to resources [9, 17, 48, 76, 78, 98]. For design, this means cultivating an ongoing concern for the ways “marginalization and oppression impact people’s experiences of and practices with technology” [24:658]. Smyth and Dimond [79], for instance, propose an anti-oppressive design framework as a means for designers to engage in discussions of oppression in its complexity and to do the work of recognizing the structural barriers and power discrepancies that might be at play before development begins.

Toward designing beyond a perceived “norm,” we draw on recent approaches within and just beyond the HCI community arguing for a feminist technology design practice. For example, D’Ignazio and colleagues take up the format of the large-scale hackathon to focus engineering attention on the task of redesigning the breast pump, a technology the researchers identify as long overlooked by industry [22]. Balaam et al. describe the design and deployment of FeedFinder, a mobile phone platform for evaluating the suitability of the physical environment in supporting a community-oriented public health initiative locating sites for safely breastfeeding or expressing milk [4]. Similarly, Almeida et al. [1] use familiar smartphone technology to promote pelvic floor fitness and everyday engagement with reproductive health concepts. Together these projects have helped scaffold a growing literature concerned with offering direct ways for researchers and practitioners alike to critically and productively explore alternatives to the here and now of technology design.

Building on these efforts to contend with forms of dominance and exclusion through design, our work centers menstruators, rather than the more restrictive categories of women or females. Just as there is no “average user” [12], there is no average menstruator—not all women menstruate, and not all menstruators are women. Drawing on recent HCI work on how both technologies and research methodologies can reinforce expectations of “normalized” genders [82] and bodies [11, 81] and, consequently, be trans-exclusionary [38, 47, 83], we also interrogate the entwined relationships of gender, power, embodiment, and care embedded in technologies of menstrual tracking.

2.2 Data-Driven Bodies and Intimate Surveillance

Contemporary modes of accounting around the body through digital systems have gained critical attention in recent design and science and technology studies (STS) scholarship. Neff and Nafus [65] argue that along with a change in the technologies of tracking, a cultural shift toward

biomedicalization—or, the “extension of medical or biological explanations for the way things are” [ibid:14]—marks this turn toward mediated self-knowledge. Kaziunas et al. [46] highlight the often-invisible physical and emotional work of producing health data, as well as the collaborative care arrangements upon which it depends. Complementing this critique, Crawford et al. [18] take up a historical approach to self-tracking by offering a dual analysis of the weight scale and contemporary fitness monitoring devices. The authors argue each technology offers an abstracted, quantified reading often understood as more credible than personal accounts. What might wearable data say about a defendant in a courtroom, for instance? What sorts of power might it hold in the pursuit of truth? How might hardware or software flaws be accounted for within this setting? Reflecting on this example calls on us to attend to the ways technology alters processes of knowing and controlling bodies, where normalcy is more and more defined by technological systems.

Until the last decade, the tech industry has largely ignored practices and issues associated with women’s health, including menstruation. For instance, Apple Health launched in 2014 with the promise of monitoring “all of your metrics that you’re most interested in,” yet did not include the ability to track menstruation until 9 months later and only after online backlash [71]. This attention has shifted as startups have formed to fill in this gap with the number of menstrual applications growing rapidly over the last decade and an estimated 200 million downloads worldwide by 2016 [25]. More recently, standalone mobile applications for menstrual tracking and integrated hardware meant to connect the collection of sensor-based data with predictive models (e.g., a connected thermometer encouraging daily collection of basal body measurements and automatic storage of such data [59]) have been developed by companies such as Clue, Kindara, and Glow. These startups tout precise data analytics to inform knowledge of users’ cycles [56, 59], as they garner millions of dollars in venture capital. With this rise, there remain open questions about the data that is being collected and how it constructs a narrow—and sometimes instrumentalized—view of menstrual experiences.

Nursing scholars Moglia et al. describe shortcomings in the “accuracy, features, and functionality” in their review of free, English-language, menstrual-tracking apps [61]. The authors note commercial health care apps are not regulated by any governmental agency and argue for the importance of these apps to be built upon clinical perspectives by involving a health care professional in the software development process. Within HCI, Epstein et al. offer an analysis of the motivations and methods behind menstrual tracking through the analysis of 2,000 reviews from the 12 most reviewed apps, a survey of 687 respondents, and 12 follow-up interviews with users [30]. In doing so, they put forth several key design considerations such as improving the accuracy of menstrual cycle prediction, avoiding gender stereotypes in app interfaces (i.e., pink and “girly” visuals), supporting various and changing purposes for tracking, integrating menstrual tracking into other health apps, and designing to support sharing of data with medical professionals. Gender studies scholar Levy complements this work by describing the ways in which design choices can affect those who use the apps, particularly as they relate to norms and expectations around sexuality and gender identity [54]. Taking up modes of design fiction, HCI researchers Søndergaard and Hansen [80] explore the politics of self-tracking through Period Share, a connected menstrual cup that automatically shares always-on intimate data on users’ social media feeds. Thinking beyond the form factors of typical wearable technologies or tracking devices, design researcher Homewood [43] describes series of explorations with domestic, ambient displays developed to cultivate the expressive, affective qualities of self-tracking.

Drawing out the stakes of this work, Rizk and Othman of the Tactical Technology Collective investigate the privacy and security practices of 10 popular menstrual tracking apps, which they conclude share users’ data with “invisible third parties” [32]. The researchers raise the question, “what [does] this mass quantification of women’s bodies [mean] for the creation of new normals,

of new standards of reproductive and genealogical indicators based only on women who have access to these apps, and those who bother to use them[?]" [32]. As legal scholar and sociologist Levy notes, both this cultivation of an "algorithmic subjectivity" through tracking and the unevenness of legal protections in areas of domestic and intimate life result in new risks not addressable under current regulation [55]. Recently developed apps designed specifically for partners of menstruators, for example, may provide pathways for communicating health and wellbeing, but they also intensify surveillance and stalking capabilities [89].

As mobile apps and wearable technologies to support self-knowledge become more widely adopted, "users" possess an increasingly diverse range of lived experiences. For example, those approaching menopause might face new uncertainties currently not well accounted for or reflected. There remains a need for a reimagination of technologies to support, in the words of Bardzell and Bardzell, "pleasurable, embodied, affective experiences" [5:265] of and around the body. We build toward this vision by reexamining existing practices of menstrual tracking, through both historical analysis and a series of participatory engagements.

3 OUR PROJECT

To investigate our questions, we draw from feminist modes of situated inquiry [39, 40, 86, 87] and techniques of participatory design [7, 27]. A feminist situated practice acknowledges the ways in which investigators' political and social conditions shape their ways of knowing [39, 87]. We see ourselves as participants in, not simply observers of, our site. Each of us identifies as women who do or, at some point in our lives, have menstruated. One of us is a cancer survivor who previously experienced "chemo-pause," or early menopause brought on by treatment, and another of us secondary amenorrhea as a byproduct of a hormonal imbalance. We also occupy positions within departments of engineering or informatics, which often work to reinforce the hierarchies of knowledge and sensemaking we seek to draw out and attend to. Drawing on traditions of participatory design, we build toward collaborative engagements to form alliances across lines of expertise and experience. Our project uses the above investigative tools to draw out the conditions defining menstrual technologies today, while reflecting on and contending with those circumstances through generative inquiry.

The data we reflect on in this article encompasses our corresponding encounters with historical resources and participants across a set of design engagements. Although histories of menstrual tracking remain largely unexplored, we draw on a range of archival material—from annals published by religious institutions to the marketing materials for recent tech products. Ours is not a study focused on generalizable claims about menstrual tracking as it relates to the general public (see [30]). Instead, we set out to offer a textured understanding of how these systems are created in ways that reinforce particular visions of how the body should operate, and that do not always match with the lived worlds of those who use them. Toward this end, we collected jottings and fieldnotes, captured audio and images during the workshop session, and gathered notes and drawings generated by participants. We later transcribed relevant episodes of the recordings and thematically analyzed our empirical data alongside archival materials using inductive techniques of contextualized grounded theory [13]. Across later rounds of analysis, we developed reflective memos and iteratively revisited and refined our interpretations to build emergent themes such as rigidity and precision, as outlined later.

In the next section, we look to historical examples of menstrual tracking in order to gain an understanding of the ways in which these technologies have developed through time and against particular social and political backdrops. Later, we detail our efforts to reimagine the state of menstrual tracking through a set of participatory activities—in the form of three in-person workshops

and an activity booklet, which could be completed asynchronously—centering the concerns of a multiplicity of menstruators.

4 RETRACING HISTORIES OF MENSTRUAL TRACKING

That which is preserved about everyday menstrual experiences prior to the 20th century comes in the form of extent archival fragments. Historian Laura Klosterman Kidd [49] explains that the ways in which people managed and made sense of menstruation was not deemed remarkable by doctors or health professionals and thus was rarely written down. Even in personal accounts such as diaries or correspondence, mention of menses was often obscured through coded notations or euphemisms. In the 1890s, for example, rural Iowan homemaker Emily Hawley Gillespie wrote of her daughter's first period and is believed to have used camouflaged punctuation "!!!" to signify her own menstrual cycle [ibid:19]. Also, in the late 19th century, Mabel Loomis Todd, now famous for her role in the posthumous publication of Emily Dickenson's work, reportedly documented the days of her cycle, alongside coded notes on when she engaged in intercourse [57]. While these examples offer glimpses of intimate accounting from the past, they represent some of the only archived material on personal menstrual record-keeping at the time—expressions that exclusively stem from those who were literate and often of higher rank. Though pre-commercial or home-made technologies for menstrual management are featured within collections on broader topics such as the Valentine Museum in Virginia focusing on "urban life," curatorial procedures and the exhibition of these artefacts "afford no clue to the origin of the design" [49:22]. Taken together, the limited access to information about how people interpreted and managed their periods before the turn of the last century means that much of what is known comes from later corporate, medical, or religious materials (rather than menstruators themselves).

4.1 Instrumenting the Body

Within the last century, pen and paper mechanisms for tracking menstruation have been met with new tools like branded calendars, and specialized charts have been fashioned to aid with fertility processes in particular. For instance, in 1944, Harvard Medical School professor and gynecologist John C. Rock (who later led some of the first trials for hormone-based birth control and whose lab performed the first successful *in vitro* fertilization) crafted the Rhythmeter, a "prediction dial" to help users avoid pregnancy [41]. At the time, the only legal method of birth control in the state of Massachusetts was the rhythm method that the device helped users follow. Delivered in the form of a kit with detailed instructions for use, the dial was meant to offer support for heterosexual couples meaning to have only the number of children they believed they could financially support. In the 1980s, CycleBeads were developed as a tool for practicing the Standard Days Method by researchers at the Institute for Reproductive Health at Georgetown University. Fashioned in the style of a rosary with a color-coded string of beads, this device is meant to help one identify "fertile windows," or days when the chances of conception are higher or lower [95]. Remediated from the analog device into the form of web and smartphone apps, CycleBeads (Figure 1) now has added functions of data storage and long-term profiles of use [37].

Undergirding these paper-based and digital platforms are fertility awareness-based methods (FAMs) of menstrual sensemaking, or tracking techniques designed to promote "natural family planning" [50].¹ Drawing on traditions of menstruation calendaring and fertility awareness

¹Fertility awareness method (FAM) is an umbrella term for practices such as counting days between menstrual cycles (e.g., Knaus–Ogino Method or Rhythm Method, Standard Days Method), measuring one's waking temperature (Basal Body Temperature Method), tracking changes in cervical mucus and in the color, size, shape, and position of the cervix (Billings Ovulation Method) or some combination of these activities (Symptothermal Method). The intent with these methods has

Fig. 1. CycleBeads have gone through a remediation from their physical form developed in the mid-20th century to their current incarnation as a mobile interface.

charting, these methods offer a means of tracking ovulation in order to prevent or promote pregnancy, forming modes of contraception that are relatively inexpensive (in terms of monetary investment) and free of hormonal side effects [67]. Though there is evidence that people have long been aware of notions of ovulation [85] and engaged in periodic abstinence, histories of FAMs are rooted in a series of findings from the early 1920s—on the regularity of ovulation and its relationship to changes in cervical mucus and resting body temperatures [94]—and the Catholic church. Promoted by Catholic physicians, endorsed by the Pope [73], and taken up by parishioners over most of the last century, these methods aimed at allowing Catholic couples to have more control over the size of their families. Here, then, these applications not only inherit modes of counting, but also moral orientations. Up until the 1980s, literature published on FAMs was largely distributed through religious circles. However, the popular book *Taking Charge of Your Fertility* by Toni Weschler introduced these methods more broadly to secular audiences [23, 96].

Though FAM methods underpin most apps on the market, there are drawbacks in terms of their reliability as tools for fertility or contraception. The rhythm method, for instance, involves counting the number of days in one’s menstrual cycle to predict ovulation and is reliant on the notion of a “normal” 26-to-32-day cycle. If a user finds themselves outside of this range, the method is ineffective and not recommended [33]. This and other types of calendar methods have the highest failure rate of any of the “natural family planning” approaches. Relatedly, methods based on resting temperature are precarious because these measures can be influenced by factors such as stress, sleeping patterns, alcohol consumption, and travel and time zone differences [2]. Post-ovulation methods have the lowest failure rate, but they also call for roughly 13 days of abstinence (or protected vaginal-penile intercourse) depending on the regularity of one’s cycle, which again is influenced by factors like breastfeeding or proximity to perimenopause [91]. The importance of considering these issues of reliability is made more evident by recent reporting from *The Guardian* that found the popular fertility tracking app Femm was largely backed by conservative anti-choice founda-

been—in the past and is in their current incarnation within period app technology—to help one figure the days of one’s cycle when unprotected vaginal-penile intercourse would most likely lead to pregnancy (i.e., plotting out “safe” and “unsafe” days). There are three primary phases of one’s cycle including the pre-ovulatory infertile phase, the fertile phase, and the post-ovulatory infertile phase. When looking to avoid pregnancy, the user would engage in “periodic abstinence” or withholding from this form of sexual activity when approaching “unsafe days.” The opposite approach would be taken up if the user is attempting to conceive. In addition to these primary indicators, some methods also take into account “secondary” types of information like breast tenderness and ovulation pain.

tion chiaroscuro and was said to have shared misleading and inaccurate information with users regarding the side effects of hormonal birth control [35].

4.2 The Personal (Informatics) Is Political

“Health is a big information problem waiting for data analytics and wearable sensors. I wanted to start somewhere to make a difference [...] I found it in procreation.”

— Max Levchin; Cofounder of Glow and former Chief Technology Officer at PayPal.

Within the realm of technology design, the past couple of decades has seen a turn toward big data. Though not a wholly new phenomenon, innovation in terms of cloud storage and machine learning has introduced an era where “value comes from the patterns that can be derived by making connections between pieces of data, about an individual, about individuals in relation to others, about groups of people, or simply about the structure of information itself” [10]. Practitioners and “tech evangelists” alike preach the almost limitless potential of data to tell us things about the world—with enough of it, we can we cast away uncertainty and focus the fuzziness associated with forms of risk. There is hardly a more apt embodiment of this technological utopian view than the statement that opens this section from Max Levchin, co-founder of the menstrual tracking app Glow [36]. Prior to Glow, Levchin’s interests largely focused on building finance companies; a startup that enables people to send money to others (PayPal) and another to predict risk associated with lending (Affirm) are among those in his portfolio. In his view, as explained during Glow’s debut at the technology conference *D: All Things Digital*, concerns about menstrual tracking and financial transactions are not distinct—predictive models guide both modern forms of fertility awareness and market decision making [36]. Operating in a country where infertility is largely left uncovered by health insurance, Levchin insists menstrual tracking fills a gap, offering a form of technologically aided assurance in place of medical attention. If one carefully collects data such as cervical mucus texture and menstrual cycle dates and follows the guidance of the predictive model, the need for traditional forms of medical or health advice (through, say, a doctor or doula) are no longer necessary to achieve pregnancy—all one needs is a smartphone, an internet connection, \$47.99 (for a premium account), and a willingness to track. Yet, this analysis may not be meant solely for one’s own view. The *Washington Post* reports that the fertility tracking firm Ovia markets its users’ health data to employers with little oversight or regulation on how information such as how many workers faced high-risk pregnancies or how soon new parents planned to return to work might be put to use (e.g., discrimination based on pregnancy or health status) [42].

This message of big data assurance, alongside a contemporary political climate particularly unfriendly to particular forms of reproductive health care and education, has placed new weight and sense of importance on data-rich menstrual tracking technologies. A leaked memo from the United States White House, for instance, described a U.S. Department of Health and Human Services proposal to remove all forms of family planning programming for teens aside from the promotion of FAMs [8]. In Europe, Natural Cycles was the first menstrual tracking application to be certified by the European Union as a method of contraception, a designation later also conferred by the United States Food and Drug Administration [64, 93]. This move has since garnered renewed attention and scrutiny, as a Swedish clinic raised flags following 37 of their patients reporting unwanted pregnancies despite using the app [29, 70]. These cases begin to expose the limits to a singular vision on the role of technology in menstrual tracking—as a standalone contraceptive or fertility device—and the ways in which these apps are of both political and personal consequence ripe for critical investigation.

5 REIMAGINING MENSTRUAL SENSEMAKING

Many of the most popular contemporary apps carry over a presumption that users are both cis-gender women (or, those whose gender identity matches the sex they were assigned at birth) and heterosexual. On setup of Glow, for instance, users are asked to provide information about their reasons for using the app, but the only pre-defined responses include “avoiding pregnancy,” “trying to conceive,” or “fertility treatments.” As Electrical Engineer and Computer Science scholar Maggie Delano notes, these answers assume the type of sex one is having can result in pregnancy [20]. In the first item of the questionnaire, Delano recalls being prompted to indicate the type of birth control method she uses. When she entered none, she received a notification warning of high rates of unintended pregnancies among women who use birth control inconsistently. What Glow and many other apps on the market ignore are the many other types of people who might be interested in making use of period tracking technology. Queer, unpartnered, infertile women, users uninterested in procreation, and transgender people, for example, are left from consideration in the design of these apps.

The terms “fertility tracking” and “menstrual tracking” are often used interchangeably, yet there are stark differences in tracking to conceive and seeking to gain a sense of one’s menstrual health generally. Understanding this diversity of motivations, in contrast to some of the more popular apps on the market, Planned Parenthood recently released Spot On, an app specifically designed for those who do not seek to become pregnant. Features of the app include predicting periods, promoting knowledge of menstruation, and helping to manage birth control options [69]. Other apps have been developed to aid in understanding and managing common medical conditions related to menstruation. For instance, biomedical informatics scholar Noémie Elhadad and colleagues in Columbia University’s Citizen Endo group led the design and implementation of Phendo [28], an app focused on recording endometritis pain so that one’s experience might be more easily shared with a doctor or medical professional and a citizen science community dedicated to supporting research of the condition.

While the above examples have introduced promising extra-fertility tracking options, there are still open questions to be addressed on the privacy and security of these systems and toward imagining different ways of tracking that might be further focused on self-knowledge (beyond knowledge of fertility), menstruation through life phases (menarche through to menopause), and designing for more affirming experiences for queer and transgender users. We recognize the pronounced importance of focusing on designing for queer and women’s health—particularly as recent policy initiatives threaten access to health care for these groups. Here, we assume the position of activist-scholars seeking to inform the design of better systems for underexamined areas of health that disproportionately affect communities frequently marginalized.

5.1 Participatory Engagements

Toward collectively reimagining menstrual tracking apps, we facilitated a series of participatory design engagements from early 2017 to mid-2018. These took the form of an in-person workshop, an activity booklet or “Period Packet” completed asynchronously, and two in-person “Craft Nights,” described in detail below. Across each of these participatory engagements, we sought to bring together perspectives of those whose needs and interests were not currently reflected in the platforms available. See Figure 2 for a summary of the three participatory engagements that comprised this work.

5.1.1 Workshop. We held the first workshop in spring of 2017 at a public library in the Pacific Northwest region of the United States. Our recruitment efforts for this event centered on three core activities. We posted flyers advertising the event at community gathering points in the local area,

Fig. 2. A brief summary of the three participatory engagements we facilitated during the reimagining phase of our project.

including coffee shops, public health offices, queer and feminist community centers, and libraries. We also sent an email announcement to various professional and community listservs of which we were either a part ourselves or knew members who were willing to share the message. Finally, a professor at the University of Washington circulated a digital version of our flyer to students in her course on physiological and psychological aspects of women’s lives and to others she thought might be interested in participating in the workshop.

During the event, three participants gathered around a table with craft materials (e.g., markers, magazines, pipe cleaners, pom poms, glitter, play dough, tape, scissors, and beads). Over the course of 2 hours, the group discussed the ways in which they used menstrual tracking techniques and worked toward developing alternative designs using the available materials. As they collaborated with one another, they reflected on a set of questions that guided this activity, including “What types of information would you like to know from your cycle?” and “Which ways would you like to or could you imagine receiving that information?” Together the group proposed a single design that incorporated their collective concerns on the reliability of health information featured within apps and privacy of personal data.

5.1.2 Period Packet. Inviting further reimagination of the menstrual tracking app protocol, we released a set of participatory design objects in the form of design packets [26, 72]—here called Period Packets—calling on participants to make their own sense of menstruation through responding to questions and prompts, such as “How do you know your period is coming? What does it mean to know your period? How does your period fit into your life? Record a week of your period, focusing on what’s interesting to you.” With the physical packets, (Figure 3) we included markers, paint, and other craft materials, as well as a link to an online folder that could house digital text, image, video, and audio files, offering opportunity for respondents to use a means of expression they saw most fit—from sketches to sound files. We distributed the packets online, through the project’s own website, Instagram account, and via e-mail, sending the call for participation to our own personal and professional networks and extending out from there. We also circulated

Fig. 3. Period Packet with markers, paints, decorative tape, pipe cleaners, and sticky notes.

the packets through the physical mail—initially, sending sets of packets to queer and feminist bookstores across the country (from New Orleans, Louisiana to Madison, Wisconsin to Tucson, Arizona) and later fulfilling requests for physical packets received through the project’s website. Ten people completed and returned the packet, either through an online form or physical mail, offering longform responses to the open-ended questions and describing their own mechanisms for menstrual sensemaking both visually and textually. Others asked to keep the packets they had completed, finding themselves having become attached to what they had written or reluctant to share. We obliged each of these requests.

5.1.3 Craft Nights. To complement the reflective and individual engagements of the packets, we hosted two Craft Nights in two large West Coast cities in the United States. With these gatherings, we drew on the packet questions to outline a set of activities that were less focused on narrowing in on particular design outputs (e.g., use cases or sketches of screens) and more oriented toward attendees’ understandings of menstrual health and their methods for cultivating forms of self-knowledge and sensemaking. In this way, we integrated the two prior approaches of collective participation (from the workshop) and individual reflection (of the packet).

In terms of participation, we focused on drawing in attendees with either existing relationships to one another or to the topic of menstrual health. This was meant to address issues of discomfort

or unease that might come with discussing a stigmatized topic in a group setting (highlighted by a set of prospective participants). The group that gathered in the first craft night was made up of four acquaintances known to the second author. With the second workshop, we collaborated with a community group working in the space of menstrual advocacy—efforts to promote increased understanding of issues related to menstrual health and resources—to organize the event. The group circulated notice of the event through their listserv, social media accounts, posted flyers at area community centers and public bulletin boards, and announced the event during their weekly membership meetings. The 12 people who attended the second craft night represented areas of public health and policy, as well as members of the public with personal interest in menstrual sensemaking and gaining access to information about menstrual health. During the workshop and craft night events, we provided refreshments and offered childcare to those who attended. In addition to the events we facilitated, we circulated instructions and materials on facilitating a Period Packet craft night online. At the time of writing, we have been contacted by people in Michigan and Peru who have or plan to lead their own local versions of the event.

Across each of these encounters (workshop, Period Packets, Craft Nights), we sought to engage as many menstruators as possible, though we were unable to recruit menstruators who have or are currently experiencing menopause. This may be due, in part, to our own situatedness; we range in age from 32 to 43. However, Backonja’s previous work involved facilitating participatory design sessions with individuals experiencing menopause to understand their practices and how technology could support them through the menopausal transition [3]. While we were leading the research reported here, we also conducted complementary heuristic analysis of existing menstrual tracking apps. One of our findings was that current menstrual technologies fail to account for the needs of menstruators at menarche and during perimenopause and menopause (see [31] for more detail).

Over the following sections, we draw findings from each of the participatory engagements of our current study to form an account that considers how people use (or do not use) tracking technologies to manage or learn about their menstrual cycles. We focus particular attention on points of frustration or contestation, as well as the alternative ways of knowing menstruation participants highlighted.

5.2 Reflections from across Engagements

Across each of the engagements, we heard from a range of menstruators—from activists in the space of menstrual equity to those who have clinical or medical training in fertility to those who experience trauma linked to their periods. Many described not having encountered an opportunity to learn about their periods while growing up and needing to teach themselves about menstruation. For instance, during the first craft night, the group began by discussing how they came to know about menstruation. Some of the earliest experiences they shared were closely tied to families of origin. Evelyn² recalled her mother as “firehose” of information who drew on training as a nurse to explain Evelyn’s transition to menarche. Marie and Anna’s parents, on the other hand, were each religious and conservative so conversation between them on puberty was less free flowing, though “generally sympathetic.” Despite the relative support, the group recalled feeling embarrassment about their periods when they were younger, noting anxieties around playing sports while menstruating, buying products, or learning how to use tampons. Members of the group had an uneasy relationship to their periods for many of the first years of experiencing it and “knowing [their] bodies” took longer than expected, several members of the group explained. Only now that a number of them were learning about fertility and conception (as adults seeking to become

²Names of all respondents and workshops attendees have been changed in order to preserve anonymity, as have details on location.

pregnant or as new parents) did they feel they were beginning to learn about menstruation. This moment of collective reflection allowed for attendees to recognize the ways in which social stigma surrounded this bodily experience and defined early feelings about oneself, even in settings where there were varying degrees of familial support or help to draw on.

Others described existing methods they used to collect information about their menstrual experience, but that might not match the data types and forms of capture that are featured in tracking apps. For instance, one packet respondent noted comparing relative volume across their cycle, by “[recording] the amount of fluid captured in [their] diva cup or pad or underwear throughout the day, [as well as] color, viscosity, [and] presence of any clots or cervical fluid.” Period Packet respondent Jenna reported charting and journaling about her menstrual cycle experience every day and described, “organizing my life around my cycle.” This recognition of the body in daily practice fostered existential exploration and reflection for Jenna: “I think knowing my period involves understanding why I get it and situating it in the context of other female-bodied people/creatures and the elements. I used to think that ovulation happened during a period and that the whole deal was just a pain in the butt. Now I understand the process a lot better and feel glad when I shed my uterine lining because it means my body is working as it should. Like the cycles of birth, death, and rebirth that we see in nature (phases of the moon, tide, seasons) with each cycle I am letting go of old stuff my body doesn’t need and beginning anew.” Here, Jenna gestures toward forms of sensemaking practice that currently fall outside of what designers and technologists developing apps recognize. Rather than tracking to find optimal days for conception, for instance, she and others who participated in the gatherings or responded via the packets hoped to foster a relational perspective through recordkeeping—a practice as much about making sense of one’s place in the world as it was about predicting a next period.

These initial reflections begin to suggest that existing, personal practices of sensemaking evade current apps, but could complement and extend the protocols that guide them by allowing for more flexibility and variability across individual experiences. In the sections that follow, we describe three distinct vignettes that draw out the stakes of such a project. The first is Robert, a Period Packet respondent who described a changing relationship to his period that coincided with gender-affirming hormone therapy. The second focuses on Anna and Jamie who joined the first workshop and concentrated on the prediction algorithms that undergird many available apps and notions of data privacy. The final case describes craft night attendee Allison and her creative modes of coping with endometrial pain.

5.1.4 The Accidental Period: Robert. Robert carefully detailed a history of traumatic experiences with menstruation through the text and imagery of his packet (see Figure 4). Menstruation, he described, caused “the most dysphoria” for him as a transgender man, leading to symptoms of anxiety and depression. Here, dysphoria refers to—in the words of HCI scholars Scheuerman, Spiel, Haimson, Hamidi, and Branham—the condition of “gendered dissonance between one’s physical form and how one expects it to be” [77]. Within popular, normative depictions in the media, marketplace, and at times the medical field, the bodily process of menstruation is exclusively tied to cisgender women. Yet, Robert like many trans, intersex, and non-binary people experienced menses and period-like symptoms such as muscle soreness and headaches [66]. Without recognition or affirming conditions for managing his period, menstruation was a perpetual site of distress and discomfort.

Tracking was a means for Robert to prepare—both materially and emotionally—for what was to come with his period: “[My period] used to be a thing I had to emotionally prepare for (either by closing off entirely and pointedly not thinking about it much more than “okay time to change tampons, don’t look at it, etc.”). So knowing when it was coming via when I realized the aching

Fig. 4. Through illustration, Robert recalls how tracking was a matter of materially and emotionally preparing for what was to come with menstruation—exacerbated feelings of dysmorphia.

correlation, using a tracker app, etc. made it a lot easier on me since I could reliably know when and not have to look at a calendar in dread.” Robert described finding use for existing menstrual tools, alongside recognizing bodily markers such as aches, as a kind of barometer to gauge when his period was coming. Rather than regularly checking a calendar with unease, he could narrow in on a loose timeframe using this combination of digital and physical readings.

The feelings of dread and disquiet Robert sought to avoid through modes of tracking did not totally subside. Months into gender-affirming hormone therapy treatment, Robert described experiencing occasional periods, which could be more frequent if he was not able to take testosterone (referred to below as “T”). “If I forget/can’t get [the prescription] refilled on time it becomes more and more of an anxiety trigger until I can. If I do just completely forget and then get a period I’ll immediately (if I can) do my shots to end it ASAP,” he wrote. Here, Robert recounts the process he went through when without medication and faced with the reemergence of bleeding. All of his energy became focused on gaining access to testosterone and coping the anxiety-inducing experience of having a period, but this was better than the alternative. Robert continued, “Oddly, starting T has made the occasional accidental period easier to deal with emotionally compared to before. Not sure why but I’m not complaining! Now, it’s just a matter of ‘oh opps,’ go do a tampon, change underwear if necessary, then go back to what I was doing. I know that occasionally my depression would be worse the week/a few days before when I’d look back in retrospect, so sometimes would explain it.” This might seem contradictory at first; an “accidental period” easier to manage? But the important part was that it was occasional and not the constant trauma that it had once been. Over time, for Robert, menses became a reminder to take care of himself and to take the testosterone he needed if he somehow had forgotten (though Robert had consistent health care and prescription coverage, barriers to such care among transgender patients more broadly are widely documented [84]).

Through the pages of his packet, Robert recorded his changing relationship to menstruation, one that had triggered intense experiences throughout his adolescent and adult life, but which was becoming easier to manage as it became more sporadic. Yet, this relationship was not reflected in the design of the apps he used, which relied on a 30-day cycle marked by the first appearance of menstrual blood (following FAM-based methods, described in Section 4). According to obstetrics and gynecology researcher Unger [63, 92], menstruation typically ends after a few months of hormone treatment, but this is not a universal experience, as Robert's account illustrates. In cases where bleeding does stop, other menstrual symptoms such as cramping and shifts in mood may continue [66]. Thinking through this vignette, we might consider how a model that relies on certain markers to determine predictability might instead allow for one to adjust the parameters according to one's own observations and experience. For Robert, this might mean recording testosterone levels, in perhaps a similar way to how that existing apps take into account birth control medications. For others, it might involve charting cramping, with no expectation that blood would follow or coincide. Rather than applying the same rigid standards or norms across bodies and time, opening up the models of prediction might create space for redefining menstruation for oneself.

5.1.5 Opting-in and -out: Anna and Jamie. Seated next to each other around a table in the basement community space of a public library, couple Anna and Jamie explained their proposed app design during the workshop. They were drawing on years of collective experience with period tracking applications. Platforms like MyPeriodCalender and Period Tracker were among the ones they had tried. Anna and Jamie had used these apps even though they found them to be frustrating. Jamie, for instance, described the “quirkiness” of Eve, a platform she had recently adopted. Periodically, she would receive notifications like the one reading, “Aunt Flow is coming,” which were meant to alert her of the start of her period. Other messages, such as “you go girl!” were intended to be notes of encouragement. She found this communication to be infantilizing and said she would, “rather get a notification saying, ‘your period is going to start today,’” in simple and direct language. On top of the euphemistic tone (rooted in a long history, described in Section 4), Anna added, “all apps assume you’re a woman.” Here, Anna highlighted the tendency for popular tracking platforms to use gendered language in referring to users both in the app and associated communication like community fora and marketing emails. “It’s important to have apps available to people who menstruate, but aren’t women,” she urged. Even with these concerns, both Anna and Jamie saw potential in menstrual tracking and set out on the day of the workshop to recuperate the technology from the pitfalls of the platforms they had encountered.

Jamie, much like Robert from the previous section, described tracking as a “method to ease anxiety” around when her period might start. She did not trust any given app to predict her cycle with precision using “a ‘smart’ algorithm that isn’t very smart” (none she had tried seemed capable of doing that), but she did expect for it to be within a range of a couple of days. This exactness was something she tested by “[counting] backwards from the week before [the start of her period] to see if it’s accurate.” Having a predicted start date, she further explained, allowed her time to begin packing supplies such as pads, tampons, and over-the-counter pain medication. She had initially begun tracking because she thought her menstrual cycle was highly irregular, and had trouble finding patterns on her own using pen and paper. After several months of app use, she noticed that rather than erratic, she had what she described as “super long” cycles—or those that extend far beyond the “normal” range. In this way, she used the apps cycle plotting function to find her own average length, and whether it was increasing, decreasing, or staying the same over time.

This experience was reflected back through the design elements Jamie put forth during the workshop discussion. “There would be ways to see different projections. You can input your own

cycle length or use an algorithm,” she explained. By this, she meant that her app design would include an option to toggle between multiple “views” of the menstrual data and its analysis. For instance, she imagined a flat visualization charting a user’s input of period start and end dates and another that would plot that data alongside the projections that the app’s algorithm gave. This was intended to allow for the user to look across time to see not only potential patterns or aberrations in one’s cycle, but also how the app’s prediction algorithm bore out. With this design, Jamie highlighted an opaqueness around the models developers use to cultivate their predictions, as well as a desire to uncover the relationship between them and her data. Here, she recovers her own record (rather than having it fall into the background of the model) and lifts it up to the level of the prediction within the information hierarchy.

Like Jamie, Anna questioned the infallibility of the information provided in the app. In one of the platforms she was currently using, other users offered suggestions and advice in of place medical information, which was largely absent in the interaction. Rather than providing detailed information in-app, developers offered links to external sources or, sometimes, nothing at all. This was concerning to Jamie as it could lead to instances where one might have questions about their health, but not know the proper search terms to find answers or perhaps not have consistent internet access to pose those questions in the first place. In her design proposal, there would be a “back-and-forth with real doctors,” which would provide users with more contextualized health information at the time when they might need it the most (realizing a vision of women’s telehealth initiatives and responding broader concerns around health misinformation).

Both Anna and Jamie saw a need for more granularity with regard to the app features they used and how their data was shared. Jamie noted liking the ability to make connections among data she referred to as “related” (i.e., ovulation and her libido), but when prompted by an app to share access to her menstrual data with third party health platforms such as Apple Health, she denied it. She described this gathering of disparate data together in one place as “another barrier to go through” if she were to decide later to uninstall the app or migrate her information. Instead, Jamie and Anna often only shared information with each other outside of menstrual apps. As Anna explained, they took up other methods such as tracing through old text messages to “find when she is complaining about cramps.” Jamie also noted that the same data might not remain “always relevant or interesting,” and preferred to have control over how it travels or is put to use. Furthering this point, Anna said she saw little value in tracking ovulation or PMS symptoms and suggested further customization in the form of turning off or hiding certain functions in a way that matched the needs of those using the platforms (e.g., much like the “pregnancy mode” of certain apps, which pauses period charting).

Across Jamie and Anna’s discussions and design ideas, we can hear echoes of some of the concerns raised at the beginning of the article by users of Clue on questions of identity and sexuality baked into platforms. Anna was skeptical about the gendered visual and textual language the apps took on, while Jamie questioned the need for tracking and displaying ovulation information when she herself was not planning to conceive. Through discussion of her “super long” cycles, Jamie also began to complicate the notion of the “normal” 30-day cycle and sketched her own baseline for understanding wellness. Anna and Jamie also connected these conversations with wider debates we witnessed across our engagements on data extraction and ownership, displaying inventive methods for avoidance and protection against harms they saw as imminent.

5.1.6 On Sharing: Allison. Allison saw a post about one of our Craft Nights on social media and decided she would join, even though she was only passing through town for a few days. Leading up to the event, she had become increasingly involved in queer and women’s health communities and regularly volunteered at local clinics nearby where she lived in Philadelphia. As she entered, she

described being drawn to the craft night for the creative space that it offered and the opportunity to talk with others who were similarly interested in issues of health equity and “period positivity.”

Across the discussions at the gathering and within the pages of her booklet, she noted a fraught relationship with menstruation. A few years prior, she started having “weird periods” that lasted well over a month, caused her pain, and left her struggling to understand what was happening with her body. In a moment of confusion and frustration, she posted a message to her Facebook followers: “I can’t stop bleeding. This is weird. Come and bring me snacks.” The lack of publicly available information and research regarding her condition created a situation in which she felt discouraged and isolated. “We can invest in trying to colonize Mars, but we have such shame around this,” she said, regarding research on menstrual health. After receiving messages of support and concern from her friends and loved ones online, she began posting more regularly about her health status to various social media platforms such as Instagram, Facebook, and Twitter. “I started taking pictures of blood on my underwear, at the gynecologist [...] getting a pap smear,” she explained. For Allison, these acts of tracking and sharing were a means to release tension that had built up for her on not having certainty around her condition. It was a way for her to start a conversation with those around her about something that “takes over and that [she] thinks about every day” (emphasis hers). She noted that this same sharing “made [her] a target” for trolls and those you “look for feminist women” online, but that the ridicule she received had not yet outweighed the feelings of solidarity and comfort.

A year on from the craft night, Allison has begun to help build a community of performance artists, comedians, creative writers, health professionals, and others in Philadelphia who gather for recurring meetings, bringing levity to what might ordinarily be isolating menstrual experiences. Her social media activity has also continued, and she has created a private Facebook group for those struggling with polycystic ovary syndrome, infertility, endometriosis, and other related conditions. Despite slow progress on available medical research, she has sought out change now by creating space for “talking about it relentlessly” so at least others around her would not feel alone, as she once did.

Allison’s experience highlights the ways in which self-knowledge about one’s menstruation can be a relational endeavor. Sharing evidence of her lengthened cycle or updating her followers on the status of her pain offered Allison validation and additional ways to cope with her symptoms when visits to her doctor left her without answers. It also eventually allowed her to galvanize and organize a community of others who were experiencing similar symptoms, to share stories and advocate for research on menstrual health and endometriosis, more specifically. Here, a move to seek out comfort in a time of confusion turned to political activity aimed at changing the state of care broadly.

6 DISCUSSION

So far, we have explored how modes of tracking that have existed for the last century crucially inform the design of contemporary menstrual apps. Rather than using a shift in format or media as an opportunity to assess the techniques used to record, analyze, and act upon menstrual record-keeping, technologists port in models that are rooted in religious programs of family planning and tied to particular political regimes that seek to undermine established educational initiatives or limit access to reproductive health resources. These tools often reproduce a common stigma around menstruation through their use of coded language and jokes. In retracing these histories to their influence on the contemporary moment, we find an opportunity to open up menstrual sensemaking to reimagination and redefinition in ways that depart from the extractive and exploitative qualities that pervade tracking past and present.

Across our design engagements, workshop participants, craft night attendees, and packet respondents explored how menstrual technologies could exist differently, in ways that might encourage self-knowledge and affirm and support the needs of all kinds of menstruating bodies (i.e., beyond a fertility or contraceptive focus that occupies many apps on the market). Participants troubled notions of the body that configure it as wholly knowable, controllable, or that presuppose women's bodies, in particular, as primarily for reproduction. Instead, those present offered new types of data and forms of interaction, such as the need to record endometrial pain or the potential in charting testosterone levels to avoid the dysmorphic experience of an unexpected period. They also shared feelings of frustration associated with making things work with the apps currently available, and opened space for talking about less comfortable aspects of sitting at the margins of the model. In doing so, participants introduced new layers of depth and understanding to the period app protocol. This was a recuperative exercise that took up a generative mode of inquiry to draw out the extractive and surveillant qualities of existing techniques and move toward supporting self-knowledge. Drawing from this case, we contribute to the HCI community a vision for expanded forms of bodily sensemaking, ones that might emphasize the *multiplicity* of practices conducted to align with people's goals and identities—over the models that come with algorithmic ways of knowing—and *dimensionality*, rather than a user's relation to averages or norms.

6.1 Enacting Sensemaking

In *The Body Multiple*, anthropologist Annemarie Mol outlines a practical ontology where objects do not exist in and of themselves but are “enacted” through a multitude of localized, situated practices [62]. As she describes it, “objects come into being—and disappear—with the practices in which they are manipulated” [ibid:5]. This is an approach driven by partially coordinated, partially coherent action. For example, rather than ascribing to pre-given definitions of lower-limb atherosclerosis, she observes the ways in which the disease is “done” across a Dutch hospital (as a sample read through a microscope, as a series of questions and tests conducted during an inpatient visit, etc.). In doing so, she does not simply offer different perspectives on a given thing, but rather illustrates how an object acted on in many different ways becomes “multiple” [ibid:82]. This multiple object highlights the ways in which problems are framed, bodies are shaped, and lives are manipulated through health care practices. Taking the notion of the multiple object to the sites of tracking, through the accounts described above, we can see how menstruation can be understood as an assemblage—of one's own bodily experiences, the tools one takes up to make sense of them, the actions one might be prompted to partake in as a result of tool use, wider social norms and expectations, and the standards the developers project and reinforce through the protocol of the app. Like the object Mol describes, menstrual sensemaking does not simply transcend practice, instead it is continually constituted and reconstituted by disparate but related actions.

This sense of the fluidity of boundaries and their reconfigurability is resonant with Lucy Suchman's foundational study of photocopier use and the frustration that can emerge from interactions that are too rigidly prescribed [88]. Marking a contrast to the prevailing models of computer intelligence of the time that focused on transforming contingencies into universal principles, she emphasized the dynamic nature of plans, arguing for a user's course of action to remain open to circumstances they may not know ahead of time, whereas protocols and analog technologies of the past (e.g., CycleBeads) offered little room for making adjustments in action, we ask how contemporary digital tools might offer, in the words of Suchman, a “starting place elaborated in use” [88:278]? In an initial step, for example, this might mean pulling back from a tight focus on concrete steps (often expressed through FAM methods), to instead allow more space to know the relationships between various phases of one's cycle and how those associations change over time. Yet we seek to probe further by asking how we might foreground the contingent nature

of sensemaking practices, as well as the relationships and conditions within which they unfold. In many ways, the enactments of menstrual tracking illustrated through the account of Allison reflect the multifarious nature of sensemaking. For Allison, adjusting to new patterns of cycle length and new means of managing endometrial pain meant turning to social media, comprised of a constellation of friends and supporters, as well as trolls. The former validated her pain and offered forms of emotional support, while the latter enacted sensemaking as a site of question and ridicule. To understand menstruation here is to know that it is continually subject to reform.

6.2 Reflecting Uncertainty

This study has set out to expose the logics that underly the body as it is constituted through popular menstrual tracking applications, or what Crawford et al. might call “the measured self” [18]. These systems are distinct cultural artifacts that mobilize standards and profit-seeking priorities to draw out value from our desire to understand ourselves. Measures presented in apps can read as authoritative, but they draw on sometimes loose associations and exclude complicating factors (e.g., stress, lack of sleep) to form their determinations of what constitutes a healthy period. Thinking back to the example of the fertility tracking app Ovia, we can see the importance of surfacing this vagueness as the analysis becomes integrated into programs of workplace surveillance. Like sensemaking generally, the predictive algorithms that often form the centerpiece of these apps are themselves multiple, or material “agglomerations of people, machines, policies, data, and so on whose dimensions and components change over time” [21]. Rather than offer freestanding forecasts or predictions that set out particular declarations (e.g., period start and end dates), those who build tools for bodily sensemaking might more readily expose fuzziness or uncertainty around the measure [34] and offer dimensionality through the representation of users’ own interpretations and beliefs. This aim of making sense-making sensible is not necessarily a move toward algorithmic transparency (in instances where they even could be transparent, considering their frequent complexity or proprietary nature), but rather serves as acknowledgement that one cannot look at the output of an app and call it ‘sense made’.

Seeing menstrual technologies as multiple opens up new entry points for creative and critical practice [21]. The design activities in this study, for instance, provided situations in which to talk-back to tracking in ways that interaction through existing technologies often do not. Several participants described enacting apps’ algorithms differently, expressing menstrual sensemaking is a collective endeavor with the system. Jamie, for example, sought to test the prediction model against her own lived menstruation, and formed new bodily certainty through this ongoing attention. Rather than an uncritical reliance on existing models or concretized standards, designers might offer further opportunities for practicing uncertainty—for some this might mean (re)gaining knowledge of the body in the process and for others it might simply mean making room to see the *multiplicity* inherent in such activity. This might be understood as a process of piecing together, embracing difference, recognizing sensemaking as ongoing collective co-enactments, and shifting the focus from tracking and “knowing” to questioning and producing knowledge.

6.3 Foregrounding and Unsettling Norms

The accounts featured here have illustrated how norms often guide the design of menstrual tracking technologies. Gendered pronouns, heterosexist iconography, and functions purporting to infer emotional state feature prominently in many apps and perpetuate harmful, exclusionary stereotypes (e.g., young cis women as sole menstruators and/or as overly emotional). Ageist oversights also leave support for tracking during the menopausal transition relatively absent (see bioinformatics and HCI scholarship that addresses this very concern [6, 45, 51–53, 60, 75, 90]). We also see how funding and development can be a channel through which groups attempt to extend

religious norms regarding sexuality or reinforce hierarchies of industrial control (with the Femm and Ovia apps, respectively). Such (overtly or inadvertently) harmful designs can be oppressive, presumptive, and based on outdated ideas and ideologies about the body.

Considering all of these issues, there may be an impulse step back from this technology and walk away, but over the course of our participatory engagements many spoke of drawing value from forms of menstrual tracking—using them as means to ease potential anxiety or cultivate their own notions of well-being. In this dual circumstance, we see, in the words of Sasha Costanza-Chock, the ways in which “design reproduces, is reproduced by, and/or challenges the matrix of domination” [17]. In moving forward toward building systems that support rather than undermine those who depend on them, designers might draw from the rich body of work already happening on the ground. Allison and Robert’s experiences, for example, foreground the ways in which assumptions interact with lived menstruation, and how new arrangements of tracking and the body are formed. Allison’s turn to social engagement and activism and Robert’s emotional preparation provide examples of counter-practice resisting against the normativities of designing for the averaged body. This not simply a question of representation, but one of recognition and revision through ongoing processes of design.

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