

Removal as a Method: a Fourth Wave HCI Approach to Understanding the Experience of Self-Tracking

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ABSTRACT

This paper offers first-steps guidance towards the development of a methodology that embodies theoretical proposals for a fourth-wave, ‘entanglement’ approach to HCI. We propose the removal of technologies and the documenting of their absence as a method. Removal disrupts habitual relationships with our everyday technologies, revealing otherwise hidden knowledges. Removal as a method exemplifies that “you don’t know what you’ve got till it’s gone”. We apply removal to the case of menstrual cycle tracking in two ways: literally through two autoethnographies, and hypothetically through semi-structured interviews. We show how this method especially facilitates emotional, embodied and cultural knowledge of the lived experience of self-tracking and we unpack some opportunities, implications and limitations in its use. Finally, we present how this method might be adopted by others and propose cases in which removal as a method might be applicable to study of a wider range of technologies beyond self-tracking.

Author Keywords

Self-tracking; fourth wave HCI; menstrual cycle tracking; autoethnography; non-use; feminism;

CSS Concepts

• Human-centered computing~ Interaction design process and methods

INTRODUCTION

As the field of self-tracking matures, it becomes necessary to reflect on how research on the self-tracking phenomenon is being conducted, and what impact our methods have on the knowledge we produce [29]. In recent years, qualitative and ethnographic methods have begun to replace more quantitative measures within the study of the self-tracking [1].

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This shift in methods is driven by a shift in perspectives. From predominantly perceiving the user as a rational actor making informed decisions with the aim of self-improvement, we now see the self-tracker as collecting personal informatics through “a range of lived activities” [51], without necessarily having a specific goal to achieve [17]. Once we move on from viewing self-tracking through the lens of optimization, we can address how self-tracking shapes lived experience [10]. This is challenging, however, because the body within self-tracking is both the focal point (object) as well as the medium of perception (subject) [12, 27, 41, 59]. Indeed, self-tracking produces particular ways of being-in-the-world as we reflexively experience external information about ourselves. The status of the body as subject and object also has an impact on how we understand our own data. According to Lupton, this process is a “highly sensory experience” [38], one which involves negotiating and making sense of external sources of information in conjunction with bodily experience. This shift in perspective within research on self-tracking reflected the third wave of human-computer interaction (HCI) [6]. This wave prioritized phenomenological enquiries into the emotional and social effects of using technologies, rather than enquiries into functionality and usability [14, 15, 45].

With our research, we support Frauenberger’s proposal that HCI is entering into a fourth wave of ‘entanglement HCI’ [22]. We not only support Frauenberger’s proposal, but also develop it by proposing the initial steps in the development of a method suitable for a fourth wave of HCI. According to Frauenberger, ‘entanglement theories’ such as post-humanism, feminism, and post-phenomenology should be adopted and applied to the subject of science and technological innovation [2, 22]. This wave understands relations between humans and objects as producing realities through their intra-actions [2]. Knowledge is shown to be socially constructed, and objects are shown to be political actors. These theories all reject a positivist, Cartesian understanding that there is an external reality that can be conquered by the inquiring, cognitive mind. Frauenberger describes how HCI can be understood as having outgrown its epistemological and ontological commitments as it is “systematically struggling to keep up with what is empirically observed” [22]. Frauenberger proposes that as technologies literally became entangled in and with our bodies and everyday lives, what is empirically observed becomes less possible to understand and explain without the

use of entanglement theories; we have reached what Kuhn refers to as a “model crisis” [31].

The fact that societal and technological developments mean that we are now *never without* our technological devices therefore makes a shift to a perspective on users and their devices as “entangled” relevant, particularly within the domain of self-tracking. The complex relationships between people and their data produce complex lived experiences. Approaches to understanding the lived experience of self-tracking up to this point have included the active and passive collection of data that contextualizes users’ self-tracking practices [23, 62]. More traditional methods of self-reporting have been applied through autoethnographies, surveys and diary studies, for example [16, 50, 66]. While these methods can reveal some aspects of the sensorial and emotional effects of technologies on lived experience, we suggest that they are limited by the fact that once technologies have been enfolded and embedded in our lives, we are not good at understanding and articulating the particular ways they affect us. This is due to the fact that we are situated within these complex entanglements of our own data [37].

In this paper we propose removal as a method – the deliberate removal of technologies and the documenting of their absence, in order to further research that aims to understand the lived experience of self-tracking. Following Frauenberger, we adopt ethico-onto-epistemological commitments. The theory of ‘embodied subjectivity’, derived from feminist philosopher Elizabeth Grosz, is employed to explore the effects of being without menstrual-cycle tracking devices. On the question of how subjectivity is produced, she proposes a theory of ‘embodied subjectivity’, especially as a way of countering dualist understandings of the cognitive mind and the mechanical body [24]. Grosz describes how selfhood is produced both through the specificities of the biological body as an object, e.g. sex, race, dis/ability, and the body as living subject, with social interactions and societal and cultural aspects shaping the subject’s sense of self. Grosz describes this relationship between the body as subject and the body as object as being like a mobius strip. The biological, material body can never be experienced “in the raw” but always through the lens of culture, and the particular biological body and anatomy that the self is experiencing the world through will influence how the world is perceived.

This feminist theory combats societal understandings of the body as inferior to the cognitive mind, and thus the devaluation of those associated more closely with their bodies, such as women, labourers, those with disabilities, and non-white people [24, 33, 48, 61]. In line with fourth-wave HCI, this is a move that rejects culture/material dualisms in how we attempt to understand use of technological devices [22]. Rather than seeing removal as a deletion of a device, as though it were possible to return to a state pre-use, or even reveal a “natural” body, we apply removal to disturb existing entanglements in order to produce knowledge about the

particular ways in which we are entangled. To use Grosz’ theory; we use removal to disturb our mobius strips of selfhood [24].

We use the method of removal in two autoethnographical accounts documenting the absence of menstrual cycle tracking apps. These accounts are supported by the reactions of eight current users of menstrual cycle tracking apps to the request to stop tracking. We find that removal as a method produces knowledge about the embodied, emotional and cultural factors shaping the lived experience of self-tracking. We reflect on the benefits and limitations of removal as a method and its relevance to other cases. We conclude with guidelines for when and where to apply removal as a method, and how to do it in four different ways.

RELATED WORK

Although it has not been articulated as such, removal has been a method employed by researchers within information studies and HCI in a number of ways.

Cases of researchers using their own experience of removal as a research method include Science and Technology Studies researcher Phoebe Sengers’ experience of removing herself from her typical work and home environment whilst conducting fieldwork on the isolated Change Island in Newfoundland, Canada [55]. Sengers’ removed situation allowed her to reflect on her habitual relationships with work and time. This facilitated a critical stance that led to a change in everyday practices and wider societal reflections on how the design of software shapes “being modern”. Sengers uses these reflections to propose the design of technologies that help us create constraints on our choices in order to avoid overworking and the constant strain of decision making.

Interaction-design researcher Andrés Lucero conducted an autoethnography of living without a mobile phone episodically over the span of nine years [35]. Lucero’s experience prompted him to reflect on the social factors that allowed him the freedom of not having a mobile phone over this time period. One example of this was the support of his immediate family; “If I was a single parent, I could not be constantly disconnected”. Another was how being isolated from the changing design of everyday technologies informed his work as a researcher – “allowed me to focus on developing ideas and improvements for mobile devices that were revolutionary in nature, and not constrained by the status quo”.

In his 1990 book “The Age of Missing Information”, environmentalist Bill McKibben explores the effects of our society “moving steadily from natural sources of information toward electronic ones, from the mountain and the field toward the television.” [39]. McKibben juxtaposes his experience of spending 24 hours on a mountain top with watching 24 hours of recordings from each of his ninety-three television channels, which he had his neighbours and friends record on VHS while he was up on the mountain. McKibben first removed himself from the technological

world, then dived back into it, in an extreme way. Insights from this experience include how television places the viewer in the center; disconnected from the natural world and community, and from the detrimental impact this has on our sense of responsibility for the natural environment and climate change.

More broadly within HCI, Satchell and Dourish [53] and Wyatt [67] give categories to different types of non-users. They discuss what can be gained from understanding why people do not use technological systems, whether this is through adopting and then abandoning them, or never using the system at all. Similarly, Baumer et al. [4] shows us how understanding non-use contributes to our awareness of appropriateness of use in specific contexts, and how non-use can be performative; such as an act of defiance akin to striking. Others within the field of psychology have studied the effects of stopping use of social media [63, 65].

Within the field of self-tracking and personal informatics, there has been an increasing awareness of self-tracking practices as episodic. Episodic use includes lapsing of use, switching between devices, and abandonment [8, 18, 20, 32]. Though relevant, these examples differ from our proposed method as they address cases where self-tracking devices have been abandoned by choice of the users due to causes such as a change in lifestyle or dissatisfaction with the technology itself [8]. This fact thereby influences users' reflections and attitudes, predominantly inasmuch as these users will reflect back on the device through a negative lens. Other research on episodic use has reported cases where self-tracking technologies have trained users to a point where they become obsolete [18]. These examples point to the fact that self-tracked data does indeed have an after-life; lessons learnt from data collection do shape the future lives of self-trackers. As Williams described after calorie counting and measuring his meals; "I can't un-know the weight of things" [66]. In this paper, we aim to explore not only *whether* data shapes us after we stop self-tracking, but the qualities of *how* this information expresses itself within lived experience. As Kaziunas et al., describes it; "the dynamics of this livedness" of data [28]. We propose that, due to the entangled nature of interactions with self-tracking technologies, an entanglement, fourth-wave HCI method is required.

REMOVAL AS A METHOD

Interaction design is traditionally focused on the development or evaluation of new technologies, new constellations of existing technologies, or new contexts of use. Removal as a method is a qualitative method that is applied on an individual scale. This produces idiosyncratic accounts that allow situated knowledge to contribute to a wider understanding of how technologies shape lived experience [66]. Within interaction-design research, we often hear the call for more long term studies of users' interactions with technologies [47, 64]. These studies attempt to understand how technologies are embedded in our lives over longer periods of time. We propose an alternative

form of study that addresses long-term relationships with technologies without necessarily being a long-term study itself.

Removal as a method - the deliberate removal of technologies and the documenting of their absences - provides a clear case of "you don't know what you've got until it's gone". Once we have lived with technological artifacts for some time, use of them becomes habitual; interactions become automatic, and relationships and attitudes become embedded and invisible [30]. The fact that interactions and relationships become habitual affects users' ability to reflect on the artifacts themselves and the role they play in their lives. We propose that this impacts user's abilities to communicate these reflections to researchers conducting qualitative studies on these artifacts.

Removal as a method represents a type of defamiliarization [3, 5]. Through removal, we are given a critical distance from the habitual that allows us to reflect on our interactions with technologies with fresh eyes. Removal disrupts the habitual. Anybody who has ever lost their mobile phone can relate to the fact that the loss of our everyday technologies makes our dependencies upon them evident. The outcomes of disruption can reveal otherwise hidden aspects of how the technologies we adopt in our daily lives shape us and our lived experience; both in the short term and in the long term.

We applied removal as a method in three different ways:

1. The imagined loss of the technological device before removal takes place.
2. The immediate reaction to losing the technological device after removal.
3. The adaptation to living without the technological device after removal in the long term.

These three applications produce different types of results and findings to generate wider reflections on removal as a method and the nature of our entanglements with technologies.

CASE STUDY: THE REMOVAL OF MENSTRUAL CYCLE TRACKING TECHNOLOGIES

We have applied removal as a method both literally through two autoethnographic studies (one short-term and one long-term), and hypothetically in semi-structured interviews with eight users of menstrual-cycle tracking technologies.

Literal Removal as a Method

During the autoethnographies the two first authors of this paper removed their menstrual cycle tracking apps from their lives. Autoethnographical methods used in the field of personal health technologies have been seen to allow researchers to carry out research in ways that could be not requested of research participants due to the heavy work load required; to value the subjective experience of the researcher as equal to that of other participants; and to use the collection of "idiosyncratic accounts" to evaluate the impact of personal devices on our lives [11, 46, 49, 66].

Autoethnographic removal as a method is the opposite of autobiographical design, where researchers adopt the technologies that they are designing in order to gain long-term and personal insights for use in the design process [44]. Due to the fact that the first two authors menstruate and use menstrual cycle tracking technologies, and that our professions as fulltime academic researchers allow us the time and attention required for a full and rich autoethnographic study, we therefore qualified as suitable participants for the study. The fact that we are researchers also means that our knowledge of the field is deeper than the average user of menstrual-cycle tracking technologies, and that our accounts probably do not resemble those of the wider population. This reflexivity does not undermine the validity of these accounts, but rather positions them as expert accounts that include a greater depth of reflection and critical thinking.

We entered our autoethnographic study with no expectations of how long it was to continue. Gaver warns that this type and level of engagement from researchers should only be conducted from a place of genuine interest or need, rather than for “research points” [44]. After one month, the second author (A2) left the study and returned to using Clue as she found the costs to her quality of life were too high. The first author (A1) continued the autoethnographic study in living without Clue for a further year and a half. To avoid autoethnographic note-taking acting as a form of menstrual cycle tracking, we refrained from recording fieldnotes until the end of each phase of removal; we both recorded fieldnotes after one month when A2 left the study, and A1 recorded additional fieldnotes at the end of the year and a half. To prevent influencing one another’s experiences, we had no contact during the initial study. Reflections back on our individual experiences were recorded in separate documents and then compared and analyzed thematically by the first and second authors.

Imagined Removal as a Method

Users of menstrual cycle tracking apps were interviewed with the aim of recruiting them to participate in a study after seeing the value of removal as a method within our autoethnographies. This would have entailed them stopping their menstrual cycle tracking practices for a negotiable amount of time. Participants were aged between 22 and 37 and located in Aarhus and Copenhagen, Denmark. During the semi-structured interviews, it became apparent that too few would be willing to give up their practice of tracking their menstrual cycle for the sake of our study for a diverse range of reasons. We will discuss the limitations of removal as a method in this respect below. This led to autoethnography being our sole literal application of removal as a method. However, reactions from our interview participants still signal the roles that menstrual-cycle tracking apps play in shaping lived experience.

Asking the participants to remove their menstrual cycle tracking apps prompted them to put themselves into a

fictitious scenario and predict the impact of this scenario practically and emotionally on their lives. We found that many predictions of the implications of stopping self-tracking that were troubling and of concern to participants presented themselves within our autoethnographies.

Menstrual Cycle Tracking Technologies

In order to understand the implications of the removal of menstrual tracking technologies, it is important to understand more about the menstrual cycle tracking technology that was removed. Not all self-tracking technologies are designed with the same goals and there are different types of self-tracking practice [42]. The goal for menstrual-cycle tracking is the act of tracking and documenting itself. Rooksby et al. describe this type of tracking as a form of “documentary tracking”, where there is no set goal in mind and tracking is seen to be done by people in order to “tell stories about themselves” [48: 1168]. Menstrual-cycle trackers are seeking self-knowledge and self-awareness rather than self-improvement and optimization [19, 25].



Figure 1. Screenshots from the Clue app showing the main page and the emotion logging page of the app.

Menstrual cycle tracking apps use algorithms based on collected and self-reported data to predict and visualize the emotional and physiological state of the user at each stage of their menstrual cycle through written notifications or symbols (Figure 1.). Although certain menstrual cycle tracking apps have recently been approved as methods of contraception by the FDA [43], these technologies will not be discussed in this study.

Both authors of this paper previously used a menstrual cycle tracking app called Clue. Clue is currently one of the most popular menstrual-cycle tracking apps in Western Europe with more than five million users worldwide [9]. Clue is not to be used as a form of contraception. Clue collects user-reported data on factors such as length of menstruation, mood, sexual activity, exercise and alcohol intake (Figure 1.). Users can decide what kind of information they want to track and Clue’s algorithm collects this data and uses it to

predict future cycles; as stated on Clue's website "The more you use Clue, the smarter it gets" [9].

A1, aged 27 at the beginning of the study, had been using Clue for three years before this study began. Before Clue, she had not tracked her menstrual cycle digitally nor in an analogue calendar. A1 used Clue to track aspects such as heaviness and length of menstruation and for registering when she experienced PMS and increased libido during ovulation.

A2, aged 40 at the beginning of the study, had also used Clue for three years before the study began and had tracked menstruation by marking the first day of menstruation in a calendar since her menstruation began. A2 used Clue to track heaviness and length of menstruation, pain (i.e. breast, cramps and headaches), the consistency of cervical mucus, and emotions and energy levels.

FINDINGS

We will now present some findings that resulted from our short and long-term autoethnographic applications of removal as a method, and reactions from our eight interview participants to the request to stop tracking.

Gone but Not Forgotten

Our autoethnographic study showed that once we had internalized menstrual cycle information, we did not need to access it again in order to interpret our physiological sensations. This information, (such as ovulation increasing libido, or PMS being experienced as depression or anxiety) remained in our memory and influenced our experience of our bodies. We continued to interpret our visceral sensations in relation to our memory of our previous menstrual cycles and the textual and graphical information and predictions of patterns Clue had provided us.

During our interviews with our potential participants, many also predicted that they would not forget what they had learnt from their menstrual cycle tracking apps. P6 predicted that she had been tracking so long that she had learnt and internalized her menstrual cycle data, thereby possibly making the app obsolete. P2 also believed that she had internalized the information provided by the menstrual cycle tracking app. This led her to wonder whether it would be difficult to refrain from reading her felt experience of her menstrual cycle through the lens of the information she had previously been exposed to; *"I think I would try to find this, like, knowledge of like 'this is probably because, my, this hormone is going down' even if (the information about her menstrual cycle) is really difficult to remember"*. P4 initially stated; *"I've trained myself to analyze down how (inner sensations) fits with my hormones and my cycle"*. However, after some moments pause, she wondered out loud whether removing her app would allow her to *"just feel... things... how I actually feel it"*. This shows that for P4, there is still a natural, unchanged, body beneath the act of tracking; she does not believe that her use of technologies changes her at a fundamental and ontological level.

Returning to Bodily Sensations

In our autoethnographies, we both found how, although we could remember enough to interpret our bodily sensations, losing the ability to track changed our experience of our bodies. During the first month after removal, A1 documented *"I am hyper aware of every twinge of pain in my stomach as it gave me hope that my period would come soon"* and A2 stated *"Hyper aware of my body. I believe I can describe every kind of cervical mucus my body delivers while I sleep"*. When we discussed stopping menstrual cycle tracking with our participants, several predicted that their bodies and physical sensations would become more present to them after stopping their menstrual cycle tracking practices. P6 considered that not using her app could prompt her to *"think more about what's happening in my body"*. Removal as a method provides a collection of examples of how technologies shape our felt experience of our bodies, even after they are removed. This shift in focus was uncomfortable and strange. As A2 stated *"It has been a rare experience like being forced to use a muscle in your body that you normally don't use (...) like putting away your glasses and forcing the eye to see by itself"*.

A1's longer term experience revealed a shift from using information remembered from Clue to interpret sensations to having *"embodied"* the information. For A1, after a year and a half of interpreting sensations, a stage of reflection was no longer required in positioning felt sensations within the menstrual cycle; *"I don't feel something, then try to analyze it like I did at the start. The sensation and what that sensation means occurs to me at the same time"*. With this development, the uncomfortable emotions around the stage of analysis where she felt *"out of control"* had faded into a *"neutral awareness"*. She still used the internalized information to read her bodily sensations, but she was more confident in her ability to do so.

Losing Certainty

Returning to felt sensations during the initial month after removal provoked negative emotions for us both. A1 described experiencing *"withdrawal symptoms"* from her app. A1 later reported *"When my period came, I felt a rush of relief. I was once again able to know for certain where I was in my menstrual cycle and regained control of my body"*. One motivation behind the bodily *"control"* so desired and valued by us and our participants was the fear of not knowing when menstruation would begin. Not knowing left us in a state of being unprepared and without our usual paraphernalia to conceal our menstruation. A2 began carrying tampons everywhere from the first week of her cycle in order to avoid this happening.

P3 self-reported as having mild obsessive-compulsive disorder and linked menstrual cycle tracking to preferring *"to be more organized"*. She thought that stopping tracking *"would make me a bit more, uhh, maybe uncertain"*. This theme of uncertainty was echoed by P4; *"I would think it was a little bit bad (to stop tracking) (...) now I've been used to*

have some certainty or security even in some way”. P5 was overall relatively ambivalent about her dependency on the app, but still stated “it’s very nice just to be able to look at”. P1 reacted to the proposal of stopping tracking by saying “that would be kind of horrible for me”. P1 then qualified this by stating that her app had an invaluable function for her; “oh I’m feeling this so I can input it here and if I go to the doctor I can remember exactly when and like what I was feeling”. However, as we continued the interview it became clear to P1 that her relationship with her app was not purely functional; “I mean, yes, I think I am a little too addicted to my phone so, like, it would be good if I wasn’t- because also this question you made right now made me think “wow, I’m really dependent on these apps, I should chill with that (...) I want to put more and more info, in a way I think to control my life. To have more control of what is going on with my body”.

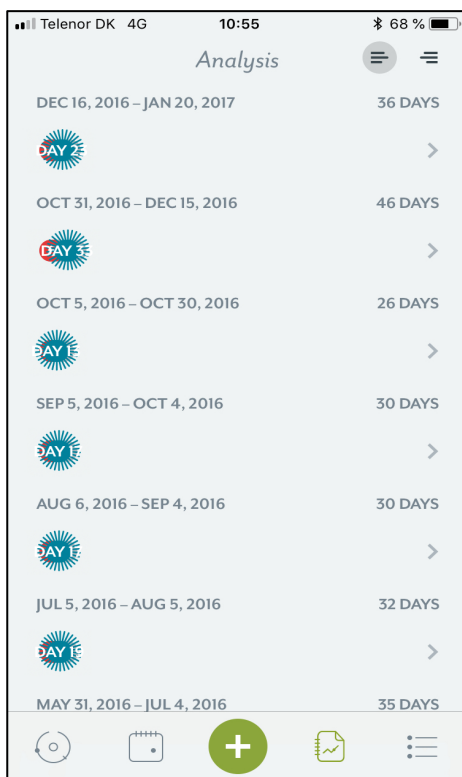


Figure 2. Screenshot from the A1’s app showing the lengths of previous menstrual cycles.

At the end of the autoethnography A1 returned to her Clue app. She was surprised to find out just how irregular her cycles had been while she had been tracking her menstrual cycle (Figure 2). A1 had never consulted this information while using Clue. What she had taken to be accurate information and used as a guide to predict when her menstruation would begin was revealed as being built upon much more erratic data than she had expected.

Troubling Subjectivity

Once we had removed our menstrual cycle tracking app, we lost the ability to track and predict our hormones changing

over chronological time. This prevented us from validating how we experienced the world through our menstrual cycle data. For example, we could remember that PMS happened on day 20 of the cycle, but we no longer knew when day 20 occurred. This provoked negative emotions; “Losing track of time felt like losing track of me, losing control over my body” A2. P2 predicted that unlabeled and unexplained sensations would be deemed as “illogical”; “I think I would be trying to uhh, to give myself, or to find a logical explanation as to why I was a bit sore or why I was a bit emotional or why I was feeling very pumped and on”.

Losing the ability to explain her subjective experience through her app was particularly distressing for A1 during the first month after removal. “I started doubting decisions I had made; am I feeling like this because I just moved in with my partner?... I asked my partner to check where I was in my cycle but not to tell me. I wanted him to know that this (PMS) wasn’t the real me, but just my hormones... but I felt as if he had some power over me. It felt unfair that he could understand my behavior when I couldn’t”. Over the following year and a half, however, A1 described taking a “less diagnostic, and more holistic approach”, to the question of whether or not her emotional experience was influenced by her hormones. Her “holistic” view allowed her to understand that her subjective experience of the world was influenced by her changing hormones, but that she would never really know what their influence was, and so was less keen to find a diagnosis.

ANALYZING AND ARTICULATING OUR ENTANGLED FINDINGS WITH AN ENTANGLED THEORY

In order to provide an example of what removal as a method can contribute, we will now analyze our findings through the lens of one example of what Frauenberger refers to as an entanglement theory [22]. As discussed, we support Frauenberger’s statement that, in order to avoid a model crisis, entanglement theories are required to understand findings about users’ entangled relations with technological devices [22, 31]. These theories argue that humans and their things are ontologically inseparable from the start. We will now show this in practice in order to analyze and further articulate our findings from removal as a method.

A range of theories could be used to discuss the findings of removal as a method in different use cases and domains. In this particular case, feminist philosopher Elizabeth Grosz’s theory of embodied subjectivity is useful in unpacking how removal as a method provided access to the entangled nature of interactions between users and their technological device in the domain of menstrual-cycle tracking [24]. Although this is not an example of the theories given by Frauenberger, we deem it a relevant theory as it includes ontological, epistemological and ethical considerations. We have argued that removal as a method is a good method to understand entanglements and we will now use Grosz’s theory of subjectivity to articulate and analyze these entanglements.

In her book *'Volatile Bodies: Towards a Corporeal Feminism'* Grosz firstly shows how, throughout history, philosophers' conception of the "natural" and "universal" body has actually been the male body [24]. She states that this has led to the erasure of the female body and ignorance around how sexual specificity shapes subjectivity. For example, although phenomenologist Merleau-Ponty stated that the body is our mode of being in the world, he did not address how the differences between our bodies will produce different ways of being in the world, nor how the social standing of that body influenced its embodiment [40, 41]. To rectify this, Grosz contributes the theory of embodied subjectivity. Embodied subjectivity is a model of selfhood as a mobius-strip like relationship between the body as subject and the body as object. Grosz proposes that our experience of the world is shaped by the anatomical and physiological specificities of our bodies, and how we understand our anatomical and physiological body is shaped in turn by cultural and societal factors in turn. Grosz states that a *neutral, natural, a-historical or pre-cultural body does not exist*. Grosz's mobius strip model describes the reality of our body as an entanglement of our flesh, bone, muscle and blood with the cultures and societies we are situated within. Grosz's theory is particularly relevant to self-tracking, where the body as object is presented to the self-tracker through technological mediation. Since Grosz states that we can never experience our bodies "in the raw" [24], even our experience of our inner body is shaped by external factors. Grosz's theory troubles the assumption that the self-tracker can neutrally discover their body through the use of self-tracking devices.

Removal as a method showed how using menstrual cycle tracking technologies fundamentally change how the body is understood, even after they these technologies are removed. From Grosz's perspective, adopting menstrual cycle tracking technologies creates a different kind of embodied subjectivity than if menstrual-cycle tracking devices had never been employed, or if an analogue calendar had been used instead. We do not say that removing the Clue app from our lives allowed us to go back to the embodied subjectivity that we had before we adopted a menstrual-cycle tracking app, but rather we use the method to understand *the particular ways* in which Clue had shaped us.

Internalized Epistemological Hierarchies

Grosz's theory highlights how epistemologies are always culturally contextual. Methods of enquiry are always shaped by cultural and societal values and biases. This means that the body can never be neutrally discovered through those methods of enquiry such as self-tracking technologies. This was exemplified by the fact that removal as a method showed how our menstrual cycle tracking apps had given us a sense of control and certainty about our bodies. To contextualize this mode of within cultural factors; gaining control and certainty over the unruly body through objectification is a key aim of Cartesian dualism. Descartes' theory of the "self" being split into the cognitive mind and the irrational body is

still evident today in how the body is understood and treated, especially within medicine and the way we design for and with the body [26, 33, 34]. Within this epistemology, subjective, felt knowledge about the body is devalued in favour of objective, rationalist scientific knowledge about biology and anatomy [60].

The ways in which stopping tracking, and even the idea of stopping tracking, brought the body into "hyper awareness" and prompted uncomfortable and negative emotions, shed light on how self-tracking reflects epistemological hierarchies. Our study showed the extent to which we accepted and relied upon a scientific depiction of our bodies rather than our felt sensations. Once we had lost access to external sources of information about our bodies, we were forced to turn inwards and return to signs and signals coming from the insides of our bodies in order to know where we were within our menstrual cycles. Removal as a method revealed that our use of self-tracking technologies had made our felt, embodied experience strange. Removal revealed that we had outsourced the task of tracking our menstrual cycle to our technological devices. When we removed our devices, the task did not disappear. Rather, the task was delegated back to us, only this time with fewer resources and inferior tools, i.e. physiological sensations and bodily fluids rather than quantified data and predictive algorithms.

This was exemplified when A1 returned to her Clue app and looked up her past data to find it was much more erratic than expected. The fact that she had not interrogated this collection of data when using the app reflects her unquestioning trust. She never felt she had cause to question that her menstrual cycles were perhaps not regular enough to produce meaningful predictions. This was despite the fact that she often found the predictions to be inaccurate, e.g. menstruation often took place up to a week after the predicted data. When her period was late it caused her to question her own menstrual health, or even worry that she was pregnant, rather than question the validity of the prediction. Irregularity was seen as being caused by the body rather than questioning whether her menstrual cycle was regular enough to make using apps such as Clue meaningful.

Internalized Cultural and Societal Ethics and Values

Our research shows how technologies reflect and perpetuate cultural ideals and taboos that then manifest in the lived experience and subjectivities of users. One aspect that was of concern to us and our participants was that we could no longer predict when our menstruation would begin. The female body is understood to be particularly "leaky". Menstruation, childbirth and its changeable hormonal states mean that the female body lacks the control of the male body [57]. Grosz states that the body and lived experience of the body is socially constructed and shaped according to norms and taboos [24]. Grosz uses the contrasting examples of saliva and tears to show how bodily fluids are perceived through cultural norms [24]. For example, through our social conditioning we understand that it is not acceptable to

publicly show menstrual blood [54, 58]. Amongst other things, menstrual cycle tracking apps are used to avoid public displays of menstrual blood, and therefore relate to cultural expectations of bodies as being controlled [25]. The prospect of socially disgracing ourselves through breaking social norms and taboos shaped our lived experience of our menstrual cycle as something uncontrolled and unruly. Although anxiety around the onset of menstruation can also relate to the possibility of pregnancy, were there no more taboo around publicly leaking menstrual blood than there is around sneezing, then knowing when menstruation would begin would not be such a large concern to those tracking their menstrual cycle.

Our study showed how body politics around controlling unruly and leaky bodies had become internalized by users of menstrual cycle tracking technologies. This is Foucault's ultimate definition of biopower; when disciplinary forces are adopted and enforced by the individual themselves [21]. This is a common critique of self-tracking technologies in terms of the individual maintaining fitness and health through adopting self-tracking technologies for the sake of the state [7, 36, 52]. Our study points to how the cultural and societal expectation of self-control is also enacted in the self-tracking of physiological processes such as menstrual cycles. This is in spite of the fact that these processes cannot be optimized or controlled by the user through tracking.

Augmented Ontologies

Removal as a method highlighted the different ontologies at play, both between us and our participants, as well as how our ontological understanding of ourselves changed after removal. For example, P4's reflection that removing her menstrual cycle tracking app would allow her to "really feel" her body represents that she understands there to be an ontologically un-affected body beneath her use of her menstrual cycle tracking app. If she could remove the knowledge of her body that she has built from using her app, then she would be able to access her "natural" body.

One way in which we and our participants had used menstrual cycle tracking apps was to allow us to reflect on how hormones influence how we experience the world [19]. Our own sense of self was augmented by our use of our apps. A1 felt that she was not "*the real me*" when she had PMS, and her app could be used to validate who she really was in relation to her hormones. As P2 predicted, she wanted a "*logical*" reason for her emotional experience. This provides a literal example of Grosz's mobius strip in action; we used the external information from our menstrual cycle tracking apps in conjunction with our lived experience to form our understanding of ourselves. Our ontological understanding of ourselves was revealed to be a static self that morphed into something that was not "us" when we were influenced by our hormones. The menstrual cycle tracking app could be used to keep a hold of who we really were once we could account for our hormonal influences.

Our menstrual cycle tracking apps had defined a logic for how and when PMS was to be experienced. Once our external data had been removed, the "PMS" phenomenon became blurred and illogical. It seeped into other aspects of life by making us unsure of the source of our emotions and undermined our own sense of rationality and self. This was exemplified by A1's questioning of her decision to move in with her boyfriend. She looked to other parts of her life to validate her negative emotions.

Over the year and a half that she lived without a menstrual-cycle tracking app, A1's negative reaction to losing Clue faded into a more holistic approach to her menstrual cycle. She still used the internalized information to read her bodily sensations to know where she was in her menstrual cycle, but she was more confident in her abilities, and so did not experience negative emotions of feelings of loss. She became more accepting of not having a certain reading of her body. One reason that this was acceptable for A1, but not acceptable for A2, was possibly that A1 had only begun tracking menstruation when she started using Clue for three years before the study began. A2 had been using a paper calendar to predict her menstruation since she had begun menstruating. A1's embodied subjectivity had been changed by using Clue, but since it was a relatively recent change, perhaps she was more open to her reality of her menstrual cycle being an uncertain phenomenon. A1 could more easily accept an ontological understanding of herself as being in a state of change. Since she could no longer validate who she really was in relation to her PMS, then she took a more "*holistic*" view on herself as a changeable being.

REFLECTING ON REMOVAL AS A METHOD

As a method that supports Frauenberger's call for the need for a conceptualization of a fourth wave, entanglement HCI, removal as a method facilitated insights into the particular ways in which users are entangled with their everyday technological devices. The research we have presented in this paper present the first tentative steps in the formation of this method. However, we see promise in it as an example of a fourth-wave approach to HCI that emphasizes the epistemological, ontological and ethical aspects of interactions with technologies. Using one such entanglement theory, Grosz's theory of embodied subjectivity helped articulate and understand these entanglements in the case of self-tracking through the mobius strip model; the body as subject and object were in a constant state of becoming through and with one another.

Removal as a method is appropriate for an entanglement HCI as it "serves to decentre the human as the sole source of activity and to elevate the role of the non-human world from a passive backdrop to human activity, to active contributors to relational action as it unfolds" [21]. To remove one physical artefact as a method seems at odds with the entanglement HCI perspective. Removal as a method might appear to be a solely subject-oriented method that focuses on the person, rather than a method that understands that

realities, subjectivities, and agency is created through interactions between people and objects [2, 22]. What removal showed, however, was the qualities with which relationships with objects become part of webbed entanglements, through which we experience and make meaning of the world. Not only do the findings from our use of removal as a method support Frauenberger's call for the necessity of different conceptual perspectives in HCI in order to avoid a model crisis, but we also offer a humble proposal for how we might *do* entanglement HCI research in practice. Our research is driven by the question: shouldn't our research methods adapt to new paradigms in HCI? Once we adopt the conceptual perspective that users are entangled in their interactions with devices, then we must question whether our research methods are adequate for understanding these entanglements.

Removal as a method produced specific types of knowledge about the gaps that are left in webs of relations with our devices once they are removed. A1 and A2's autoethnographic experiences of removal showed how their use of menstrual cycle tracking apps had irrevocably changed their ontological understanding of their bodies. Removal as a method revealed the dominance of scientific knowledge on the body, resulting in a sense of a "loss of control" when this scientific information was removed. Removal as a method highlighted these different ontological and epistemological perspectives, and the ethics behind these different ways of understanding the world. These findings particularly revealed how societal and cultural values and biases had been internalized and played out in our interactions with technologies. Not only are technologies designed with particular political and ethical worldviews, but how users employ and *become with* their technologies also reflects the society and culture they are situated within.

The aim of employing removal as a method was not to dissuade participants from using menstrual cycle tracking apps, but P1's reaction showed how even the question of removal allowed space for critical reflection. Removal as a method produced unexpected insights for P1; *"this question you made right now made me think "wow, I'm really dependent on these apps, I should chill with that" "*. This was also evident in A1's experience after returning to the app and discovering how irregular her data had been in the two years of using Clue. This undermined the validity of the app that had caused her unnecessary anxiety about her menstruation not starting on the predicted date. This shows how removal gives space for critical reflection on what we gain and what we want from our relationships from our technological devices.

EXPANDING AND APPLYING REMOVAL AS A METHOD

This paper presents the first steps in developing this method. Clearly, this method would have to be applied to many different cases before we could make generalized statements about its value, limitations and implications as a fourth-wave method. We believe that removal as a method could be

applied to other cases to understand entanglements between users and other types of technological devices. We will now tentatively present where, when, and how removal as a method could be employed.

Where to use the method

In the case presented above we have applied removal as a method to self-tracking. Self-tracking devices are specific type of technologies, which, the method revealed, had strong influences on our emotions, our embodied experience, and social and cultural readings of the body. The method proved effective in uncovering some of these otherwise difficult aspects to get access to in studies of technologies. We see no reason to believe the method could not as easily be applied to other self-tracking technologies, or in fact any type of technological device. The type of device, the context of its use and the intention of the study would then dictate the types of knowledges produced. This was visible in how the existing examples of removal as a method we build upon produced different types of knowledge, e.g. Lucero's study of his lack of a mobile phone [35], McKibben's removal of information [39] and Sengers' removal of her typical working environment [56].

When to use the method

Since removal as a method works by disrupting our habitual relationships with technological devices, the method requires users to have lived with the technology for long enough to have formed such habits in their everyday practice. What is classified as a habitual relationship is unclear, though it could be defined by frequency of use or how integral the device is to the life and activities of the user.

When not to use the method

It is clear that removal is not a method to be applied to novel technologies. This is because habitual relationships will not yet have been formed. Another obvious limitation applicable to the literal form of removal as a method is that this method is only relevant to non-vital cases of technology use. For example, asking somebody with diabetes to stop glucose monitoring could clearly lead to dire consequences.

How to use the method

Based on our preliminary work with the method this far and our reflections on the outcome, we see four ways of applying removal as a method.

1. The first way would be to ask participants to imagine living without their device. Asking participants to stop using a technological artefact that they are happy using apparently crosses borders for some – five out of eight of the participants we interviewed declined to stop tracking for the sake of our case study. We found, however, that in cases where people decline to remove the technology from their lives for the sake of a study, their reactions to such requests still revealed important relationships and practices and are thus relevant in and of themselves. Indeed, throughout this paper, we have presented predictions from our participants about how they would react to removing their menstrual cycle tracking apps that very often accurately reflected A1 and A2's experiences

during the long-term and short-term autoethnographies. Interviews with those who decline could therefore form the initial stages of a larger study if not be a study in and by itself.

2. A second form of removal as a method would be to conduct studies with those willing to literally remove the technology in hand. This could be set up as a diary study with in-depth interviews in the beginning and end and possibly during depending on the length of the study. This form was what we set out to do at first but have not tried in practice. The risk here, of course, is that the participants who would be willing to stop using the technology would be those with a less dependent or invested relationship with the technology compared to those who declined.

3. A third option – a middle ground – could be designing the disruptions of the habitual as forms of restrictions. For example, rather than asking participants to stop using their mobile phones for a week, we could instead limit the amount of internet access they would have over that week. This would require them to limit their use to prioritize what they considered the most vital tasks in order to prolong their internet access. This would thereby produce knowledge on their unrestricted and habitual use of their mobile phones by revealing what tasks and applications they prioritized when their use was limited. As McKibben writes at the end of his account of living with, and without, television; “we can’t go live in the woods by a lake – but we can go there long enough to listen, to hear.” [39].

4. A fourth option is the autoethnographic version of removal. Within this category, we applied the method in two ways, a short term, one-month long autoethnography, and a longer-term autoethnography spanning one-and-a-half years. These two versions address two distinct stages of removal. The short term reveals the immediate reaction to removal; where lack and absence is highlighted. A longer-term removal shows how we negate and work around absence, and what the aspects that we do and do not miss tell us about our habitual use of technologies. As discussed above, particularly in the case of self-tracking, use of technological devices produces particular ways of being-in-the-world. A degree of reflexive attentiveness is required to mark the various *ways* in which technologies shape this being-in-the-world. Researchers can afford this reflexive attentiveness in ways that could not be asked of research participants [35, 66]. However, it must be considered that since researchers will typically be experts in the field of the technology being removed, their account will not resemble that of the wider population. The accounts produced through these autoethnographies are to be treated as particular rather than as generalizable experience.

Finally, an important aspect of how to use the method is how to set up data collection. Overall, we recommend typical autoethnographic tools such as keeping reflective field notes [13]. The design of these methods would depend on the individual study. One curious implication with our particular application of removal as a method was the fact that when it

comes to the removal of self-tracking tools, including mood tracking and journaling technologies, there are some considerations to be made around how to document the absence of the technology. In these cases, the act of keeping autoethnographic notes risks replacing the technology that is being removed. For example, had we recorded every day of our lives without our menstrual cycle tracking technologies, we would have ended up documenting our menstrual cycles. Rather than documenting removal, this would have merely replaced the technology being removed. This was our motivation behind our only recording fieldnotes at the end of the autoethnographic studies. Although this can be seen as a limitation in the context of typical autoethnographic practices, we also see benefits in allowing the loss of technological devices to become a background event. Just as long-term deployments of designed artefacts are used with the intention that the devices will fade into the background of user’s lives over time [64], so should the absence of devices also move beyond novelty and conscious awareness during long-term applications of removal as a method. Therefore, we recommend that this be considered in the collection of data derived from removal as a method with all types of technological devices..

CONCLUSION

This paper marks only the beginning of exploring the qualities of removal as a method. With this paper, we both support and develop proposals for a fourth-wave, entanglement, HCI. Frauenberger proposes that we have reached a model crisis, where current conceptual understandings and practices are no longer able to account for our relationships with technologies as they become increasingly intertwined with our bodies and lives in general. To this shift in paradigm, we contribute a method as an answer to the question; how might we *do* entanglement HCI in practice? Shouldn’t our research methods be updated in line with new paradigms in HCI? We propose the deliberate removal of technologies and the documentation of their absence with the belief that this disrupts habitual relationships with our everyday devices. We applied removal as a method to the case of menstrual-cycle tracking in two ways: literally through two autoethnographies, and hypothetically through eight semi-structured interviews. The disruption of habitual relationships with technologies revealed aspects of how we are epistemologically, ontologically and ethically entangled with our everyday devices. This knowledge helped us understand the lived experience of menstrual cycle tracking. We have proposed that removal as a method is applicable to enquiry into other cases of technology use and have presented here some of its opportunities and limitations.

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